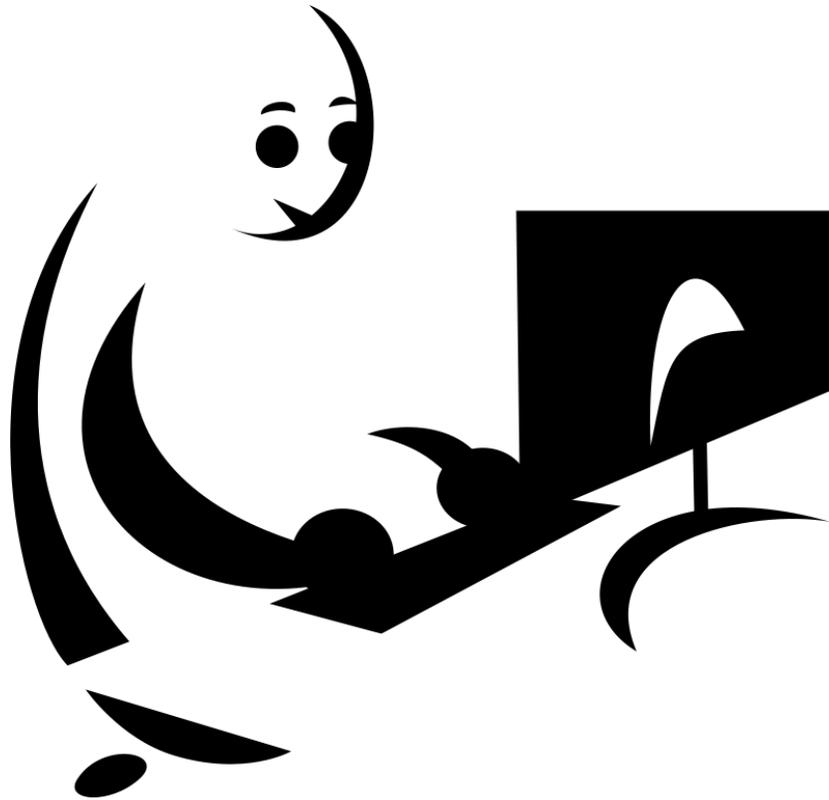


# **An Occupation Overview of the Digital Economy**

## **The Information, Communications Technology (ICT) Workforce**



**February 2018**

**Workforce Planning for Sudbury & Manitoulin**



## Occupational Descriptions by NOC code

Source: The National Occupational Classification 2016, Statistics Canada.  
 Accessed December 8, 2016, updated July 25, 2017

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## Introduction

The Information Communications and Technology (ICT) sector, which is crucial to Canada's ability to compete and innovate, is continually growing and evolving. While some degree of computer literacy is essential for most non-ICT workers, the ICT field requires a specialized level of technical knowledge and hands-on skills.

The World Economic Forum (2016) estimates that 65% of children that are now entering elementary school will end up working in jobs which do not currently exist and for us to attempt to describe what these jobs might entail would be to engage in mere speculation. Experts believe that to truly prepare students for the workplace of tomorrow, educators should focus on teaching students a range of multi-disciplinary skills, ranging from soft-skills such as team work and communication to more hands-on technical skills and business analysis and acumen (ICTC, 2016).

While many fear that disruptive technologies such as the internet of things (IoT), robotics and automation will greatly reduce the number of jobs available in the future, we will still need workers capable of designing, developing and maintaining these technologies. In addition, these and future innovations will lead to the creation of jobs which, at present, we lack titles and descriptions of.

To help prepare our community for this digital shift, Workforce Planning for Sudbury & Manitoulin (WPSM) has created this report as a means of informing educators, students, parents and others about the current state of the ICT job market, as well as emerging fields/trends to help prepare the future workforce gain the essential knowledge and ability to succeed.

WPSM is aware that we will face labour shortages in many fields and ICT is no exception; according to The ICTC (2015) that gap is growing and Ontario (and across Canada) may not have enough of a local talent supply to fill these needs. Based on their estimates, Ontario could face a shortage of about 76,000 workers with ICT expertise by 2019 (ICTC, 2015). With occupations such as Information systems analysts and consultants (NOC 2171) and Software engineers and designers (NOC 2173) being especially high in demand.

### **Overview of this report:**

This report uses NOC (National Occupational Classification) codes as a means of organizing IT occupations. NOC acts as taxonomic structure and groups like occupations together using the same number(s). Each NOC code provides a description of the occupation, example titles (we have provided some which are commonly used although more can be found online, see references for NOC), job duties, and educational/employment requirements. We have used 4-digit NOC codes to gain more specific information on each occupation (as opposed to using a 1-3-digit NOC code, which are more general).

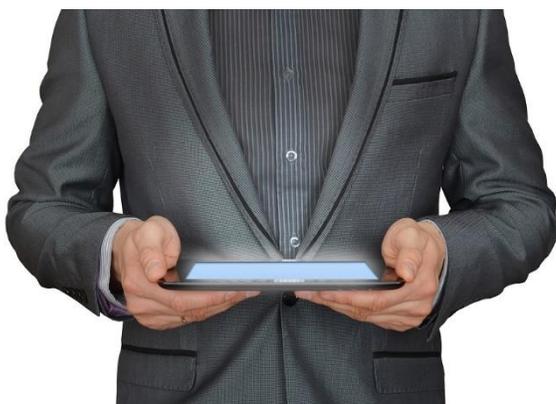
However, as useful as this system may be, we often find that the lines dividing occupations may not be so clear cut, as we see job titles and duties varying across organizations. Another limitation of this report is that the industry itself is changing so rapidly, it can often be difficult to keep up, and many newly emerging jobs make it difficult to find accurate information. In order to avoid speculation and remain accurate, we have examined the current state of the industry, and, at the end of our report, we will touch upon some areas which are emerging in the field. As noted, most of this information comes from ICTC.

## 0213 Computer and information systems managers

Computer and information systems managers plan, organize, direct, control and evaluate the activities of organizations that analyze, design, develop, implement, operate and administer computer and telecommunications software, networks and information systems. They are employed throughout the public and private sectors.

### Main duties

- Develop and implement policies and procedures for electronic data processing and computer systems development and operations
- Meet with clients to discuss system requirements, specifications, costs and timelines
- Control the budget and expenditures of the department, company or project
- Recruit and supervise computer analysts, engineers, programmers, technicians and other personnel and oversee their professional development and training



### Education/Employment requirements



A bachelor's or master's degree in computer science, business administration, commerce or engineering is usually required. Several years of experience in systems analysis, data administration, software engineering, network design or computer programming, including supervisory experience, are required.

### EXAMPLE TITLES

**computer systems manager**

**data centre manager**

**data processing and systems analysis manager**

**data processing director**

**electronic data processing (EDP) manager**

**information systems manager**

**management information system (MIS) manager**

**software development manager**

**software engineering manager**

**systems development manager**

## 2147 Computer engineers (except software engineers and designers)

Computer engineers (except software engineers and designers) research, plan, design, develop, modify, evaluate and integrate computer and telecommunications hardware and related equipment, and information and communication system networks including mainframe systems, local and wide area networks, fibre-optic networks, wireless communication networks, intranets, the Internet and other data communications systems. They are employed by computer and telecommunication hardware manufacturers, by engineering, manufacturing and telecommunications firms, in information technology consulting firms, by governmental, educational and research institutions and in information technology units throughout the private and public sectors.

### Main duties

#### Computer and telecommunications hardware engineers:

- Analyze user's requirements, and design and develop system architecture and specifications
- Develop and conduct design verification simulations and prototype bench tests of components
- Supervise, inspect and provide design support during the manufacturing, installation and implementation of computer and telecommunications hardware

#### Network system and data communication engineers:

- Research, design and develop information and communication system network architecture
- Assess, document and optimize the capacity and performance of information and communication system networks



### Education/Employment requirements

Computer engineers require a bachelor's degree in computer engineering, electrical or electronics engineering, engineering physics or computer science.

Licensing by a provincial or territorial association of professional engineers is required to approve engineering drawings and reports and to practise as a Professional Engineer (P.Eng.). Engineers are eligible for registration following graduation from an accredited educational program, three or four years of supervised work experience in engineering and passing a professional practice examination.

### EXAMPLE TITLES

computer hardware engineer

hardware development engineer

telecommunications hardware engineer

fibre-optic network designer

hardware technical architect

wireless communications network engineer

hardware circuit board designer

systems designer - hardware

## 2281 Computer network technicians

Computer network technicians establish, operate, maintain and co-ordinate the use of local and wide area networks (LANs and WANs), mainframe networks, hardware, software and related computer equipment. They set up and maintain Internet and intranet Web sites and Web-server hardware and software, and monitor and optimize network connectivity and performance. They are employed in information technology units throughout the private and public sectors. Supervisors of computer network technicians are included in this unit group.



### Main duties

- Evaluate and install computer hardware, networking software, operating system software and software applications
- Operate master consoles to monitor the performance of computer systems and networks and to co-ordinate access and use of computer networks
- Install, maintain, troubleshoot and upgrade Web-server hardware and software
- Perform data backups and disaster recovery operations
- Conduct tests and perform security and quality controls
- Control and monitor e-mail use, Web navigation, and installed software

### Education/Employment requirements



Completion of a college or other program in computer science, network administration, Web technology or a related field is usually required. Certification or training provided by software vendors may be required by some employers.

### EXAMPLE TITLES

**computer network technician**

**computer network technicians' supervisor**

**data centre operator**

**Internet Web site technician**

**LAN (local area network) administrator**

**LAN (local area network) technician**

**network administrator**

**network support technician**

**system administrator**

**Web technician**

## 2174 Computer programmers and interactive media developers



Computer programmers write, modify, integrate and test computer code for software applications, data processing applications, operating systems-level software and communications software. Interactive media developers write, modify, integrate and test computer code for Internet and mobile applications,

computer-based training software, computer games, film, video and other interactive media. Both groups assist in the collection and documentation of user requirements and the development of logical and physical specifications. They are employed in computer software development firms, information technology consulting firms, and in information technology units throughout the private and public sectors.



### Main duties

#### Computer programmers:

- Identify and communicate technical problems, processes and solutions
- Prepare reports, manuals and other documentation on the status, operation and maintenance of software
- May research and evaluate a variety of software products

#### Interactive media developers:

- Program animation software to predefined specifications for interactive video games, Internet and mobile applications
- Program special effects software for film and video applications
- May research and evaluate a variety of interactive media software products

### Education/Employment requirements



A bachelor's degree in computer science or in another discipline with a significant programming component **OR** completion of a college program in computer science is usually required. Specialization in programming for engineering and scientific applications requires specific post-secondary study or experience.

### EXAMPLE TITLES

**business application programmer**

**computer game developer**

**scientific programmer**

**electronic business (e-business) software developer**

**interactive media developer**

**multimedia developer**

**operating systems programmer**

**software developer**

**systems programmer**

## 2172 Database analysts and data administrators

Database analysts design, develop and administer data management solutions using database management software. Data administrators develop and implement data administration policy, standards and models. They are employed in information technology consulting firms and in information technology units throughout the private and public sectors.

### Main duties

#### Database analysts:

- Collect and document user requirements
- Design, construct, modify, integrate, implement and test data models and database management systems
- Conduct research and provide advice to other informatics professionals regarding the selection, application and implementation of database management tools
- Operate database management systems to analyze data and perform data mining analysis
- May lead, co-ordinate or supervise other workers in this group

#### Data administrators:

- Research and document data requirements, data collection and administration policy, data access rules and security
- Develop policies and procedures for network and/or Internet database access and usage and for the backup and recovery of data
- Write scripts related to stored procedures and triggers
- Conduct research and provide advice to other information systems professionals regarding the collection, availability, security and suitability of data



### Education/Employment requirements

A bachelor's degree, usually in computer science or in mathematics **OR** completion of a college program in computer science is usually required. Computer programming experience is usually required.



### EXAMPLE TITLES

**data administrator**

**database administrator (DBA)**

**database analyst**

**database architect**

**data warehouse analyst**

**technical architect – database**

**data custodian**

**data dictionary administrator**

**data warehouse analyst**

## 2242 Electronic service technicians (household and business equipment)

Electronic service technicians service and repair household and business electronic equipment such as audio and video systems, computers and peripherals, office equipment, and other consumer electronic equipment and assemblies. They are employed by electronic service and retail establishments, by wholesale distributors and within service departments of electronic manufacturing companies.

### EXAMPLE TITLES

alarm system technician

audio-video service technician

computer service technician

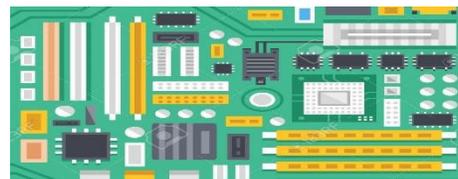
computer equipment installer

computer equipment repairer

electronic products field service technician

electronic service technician apprentice

office equipment service technician



### Main duties

- Inspect and test electronic equipment, components and assemblies using multimeters, circuit testers, oscilloscopes, logic probes and other electronic test instruments, tools and equipment
- Diagnose and locate circuit, component and equipment faults
- Adjust, align, replace or repair electronic equipment, assemblies and components following equipment manuals and schematics, and using soldering tools and other hand and power tools
- Complete work orders, test and maintenance reports



### Education/Employment requirements

Completion of a 2-3 year college program in electronics **OR** completion of a four-year apprenticeship program in electronic servicing and repair **OR** completion of high school or college courses in electronics and on-the-job training is required.

Trade certification for electronics technicians (consumer products) is available, but voluntary, in Ontario, British Columbia and the Yukon.

## 2171 Information systems analysts and consultants

Information systems analysts and consultants analyze systems requirements, develop and implement information systems development plans, policies and procedures, and provide advice on a wide range of information systems issues. They are employed in information technology consulting firms and in information technology units throughout the private and public sectors, or they may be self-employed.

### Main duties

#### Information systems business analysts and consultants:

- Confer with clients to identify and document requirements
- Conduct business and technical studies
- Design, develop, integrate and implement information systems business solutions
- Provide advice on information systems strategy, policy, management, security and service delivery

#### Systems security analysts:

- Confer with clients to identify and document requirements, assess physical and technical security risks to data, software and hardware
- Develop policies, procedures and contingency plans to minimize the effects of security breaches

#### Information systems quality assurance analysts:

- Develop and implement policies and procedures throughout the software development life cycle to maximize the efficiency, effectiveness and overall quality of software products and information systems.

#### Systems auditors:

- Conduct independent third-party reviews to assess quality assurance practices, software products and information systems.

### Education/Employment requirements



A bachelor's degree in computer science, computer systems engineering, software engineering, business administration or a related discipline. Completion of a college program in computer science is usually required.

### EXAMPLE TITLES

**computer systems analyst**

**informatics consultant**

**informatics security analyst**

**information systems business analyst**

**information technology (IT) consultant**

**management information systems (MIS) analyst**

**systems auditor**

**systems security analyst**

**artificial intelligence analyst**

**artificial intelligence consultant**

**software quality assurance (QA) analyst**

**solutions architect – information technology (IT)**

## 2283 Information systems testing technicians

Information systems testing technicians execute test plans to evaluate the performance of software applications and information and telecommunications systems. They are employed in information technology units throughout the private and public sectors.

### Main duties

- Develop and document software testing plans
- Install software and hardware and configure operating system software in preparation for testing
- Execute, analyze and document results of software application tests and information and telecommunication systems tests
- Develop and implement software and information system testing policies, procedures and scripts
- Identify, report, track and propose solutions to product defects



### Education/Employment requirements

Completion of a college program in computer science, computer programming or network administration is usually required. College or other courses in computer programming or network administration are usually required. Certification or training provided by software vendors may be required by some employers.



### EXAMPLE TITLES

**application tester**

**application testing technician**

**software test coordinator**

**software tester**

**software testing technician**

**systems tester**

**systems testing technician**

**user acceptance tester**

**test coordination analyst**

**video game tester**

## 2132 Mechanical engineers

Mechanical engineers research, design and develop machinery and systems for heating, ventilating and air conditioning, power generation, transportation, processing and manufacturing. They also perform duties related to the evaluation, installation, operation and maintenance of mechanical systems. Mechanical engineers are employed by consulting firms, by power-generating utilities and in a wide range of manufacturing, processing and transportation industries, or they may be self-employed.



### EXAMPLE TITLES

**design engineer –  
mechanical**

**energy conservation  
engineer**

**mechanical  
maintenance engineer**

**robotics engineer**

**mechatronic engineer**

**cryogenics engineer**

### Main duties

- Conduct research into the feasibility, design, operation and performance of mechanisms, components and systems
- Design power plants, machines, components, tools, fixtures and equipment
- Supervise and inspect the installation, modification and commissioning of mechanical systems at construction sites or in industrial facilities
- Develop maintenance standards, schedules and programs and provide guidance to industrial maintenance crews
- Investigate mechanical failures or unexpected maintenance problems



### Education/Employment requirements

A bachelor's degree in mechanical engineering or in a related engineering discipline is required. A master's degree or doctorate in a related engineering discipline may be required. Licensing by a provincial or territorial association of professional engineers is required to approve engineering drawings and reports and to practise as a Professional Engineer (P.Eng.).

Engineers are eligible for registration following graduation from an accredited educational program, and after three or four years of supervised work experience in engineering and passing a professional practice examination.

## 2173 Software engineers and designers



Software engineers and designers research, design, evaluate, integrate, develop, and maintain software applications, technical environments, operating systems, embedded software, information warehouses and telecommunications software. They are employed in information technology consulting firms, information technology research and development firms, and information technology units throughout the private and public sectors, or they may be self-employed.

### Main duties

- Collect and document users' requirements and develop logical and physical specifications
- Develop data, process and network models to optimize architecture and to evaluate the performance and reliability of designs
- Plan, design and co-ordinate the development, installation, integration and operation of computer-based systems including mobile applications
- Assess, test, troubleshoot, document, upgrade and develop maintenance procedures for operating systems, communications environments and applications software
- May lead and co-ordinate teams of information systems professionals in the development of software and integrated information systems, process control software and other embedded software control systems

### Education/Employment requirements

A bachelor's degree, usually in computer science, computer systems engineering, software engineering or mathematics **OR** completion of a college program in computer science is usually required. A master's or doctoral degree in a related discipline may be required.



Licensing by a provincial or territorial association of professional engineers is required to approve engineering drawings and reports and to practise as a Professional Engineer (P.Eng.). Engineers are eligible for registration following graduation from an accredited educational program, three or four years of supervised work experience in engineering, and passing a professional practice examination.

### EXAMPLE TITLES

**application architect**

**computer software engineer**

**embedded software engineer**

**software design engineer**

**software architect**

**system architect**

**software design verification engineer**

**software testing engineer**

**systems integration engineer – software**

**technical architect – software**

## 2255 Technical occupations in geomatics and meteorology



Technical occupations in geomatics include aerial survey, remote sensing, geographic information systems, cartographic and photogrammetric technologists and technicians, who gather, analyze, interpret and use geospatial information for applications in natural resources, geology, environmental research and land use planning. Geomatics technologists and technicians are employed by all levels of government, utilities, mapping, computer software, forestry, architectural, engineering and consulting firms and other related establishments.

### Main duties

#### Aerial survey and remote sensing technologists and technicians:

- Operate analog or digital airborne remote sensing equipment such as survey film or digital cameras, laser or radar sensors and scanners to prepare images, data and graphic reports, maps and charts from airborne or satellite data
- Develop specialized analog and computer software specific routines to customize and integrate image analysis
- Inspect quality of recorded images, verify the integrity and accuracy of data contained in remote sensing image analysis systems, and adjust equipment as required

#### Geographic information systems (GIS) technologists and technicians:

- Operate specialized computer hardware and software and peripheral equipment to model, manage, analyze and display geospatial data
- Develop specialized computer software routines, Internet based GIS, database and business applications to customize geographic information
- Work with external organizations on data transfer and systems compatibility issues
- Integrate external software such as spreadsheets and statistical packages with GIS software
- Train and provide technical support for GIS users



### Education/Employment requirements

Geomatics technologists require completion of a two- to three-year college program in cartography, photogrammetry, aerial survey, remote sensing, geographic information system or geomatics. Geomatics technicians require completion of a one- to two-year college program in cartography, photogrammetry, aerial survey, remote sensing, geographic information system or geomatics.

### EXAMPLE TITLES

aerial survey technician

aerological technician

climate data processor

climate service technician

geographic information systems (GIS) technician

mapping technician

remote sensing (RS) technician

## 2282 User support technicians

Technicians in this group provide first-line, either electronically or in person, technical support to computer users experiencing difficulties with computer hardware and with computer applications and communications software. They are employed by computer hardware manufacturers and retailers, software developers, in call centres and in information technology units throughout the private and public sectors. Technicians in this group are also employed by independent technical support companies or they may be self-employed.



### Main duties

- Consult user guides, technical manuals and other documents to research and implement solutions
- Reproduce, diagnose and resolve technical problems encountered by users
- Provide advice and training to users in response to identified difficulties
- Provide business systems, network and Internet support to users in response to identified difficulties
- Participate in the redesign of applications and other software



### Education/Employment requirements

Completion of a college program in computer science, computer programming or network administration is usually required. College or other courses in computer programming or network administration are usually required. Certification or training provided by software vendors may be required by some employers.

### EXAMPLE TITLES

**call centre agent – technical support**

**client support representative – systems**

**computer help desk representative – systems**

**computer help desk supervisor**

**hardware installation technician**

**hardware technical support analyst**

**software installation technician**

**software technical support analyst**

**technical support analyst – systems**

## 2175 Web designers and developers

Web designers and developers research, design, develop and produce Internet and Intranet sites. They are employed in computer software development firms, information technology consulting firms, information technology units throughout the private and public sectors, advertising agencies or they may be self-employed.

### EXAMPLE TITLES

**e-business Web site developer**

**Internet site designer**

**Internet site developer**

**Intranet site designer**

**Webmaster**

**Web manager**

### Main duties

- Consult with clients to develop and document website requirements
- Develop website architecture and determine hardware and software requirements
- Source, select and organize information for inclusion and design the appearance, layout and flow of the website
- Create and optimize content for the website using a variety of graphics, database, animation and other software
- Plan, design, write, modify, integrate and test website-related code
- Conduct tests and perform security and quality controls

### Education/Employment requirements

A bachelor's degree, usually in computer science, communications or business OR completion of a college program in computer

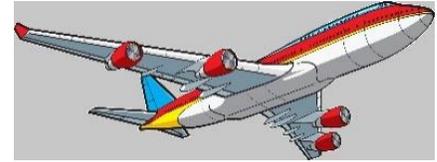
science, graphic arts, Web design or business is required. Experience as a computer programmer or graphic designer is usually required.



## Emerging Trends

### Aerospace

The aerospace industry is Canada's most innovative sector of manufacturing and is a world leader in the production of civil aircraft, helicopters, engines and flight simulators. In 2016, the industry directly



**“Canada’s aerospace industry is defined by its global leadership in the development of new technologies, which depend on the talents of the highly skilled men and women who work in this sector. Our highly skilled workforce is the reason Canada continues to be an attractive destination for global investments in aerospace. The innovations and business opportunities that are created as a result of these investments support well-paying middle-class jobs across the country.”**

**...The Honourable Navdeep Bains,  
Minister of Innovation, Science and Economic**

employed 87,200 people, with 25% of manufacturing jobs (either directly or indirectly related to the industry) located in Ontario. Since the industry must stay innovative to compete, Aerospace companies recruit more employees for innovation-related jobs than other manufacturing sectors, in addition to creating new technology at a rate that is more than double that of other manufacturing sectors (Aerospace Industries Association of Canada, 2017).

#### Some occupations in this field include:

- 2233** Industrial engineering and manufacturing technologists and technicians
- 2244** Aircraft instrument, electrical and avionics mechanics, technicians and inspectors
- 2271** Air pilots, flight engineers and flying instructors
- 2146** Aerospace engineers

#### Additive Manufacturing (AM, aka 3D printing)

3D printing has had a huge impact on manufacturing, which is the largest industry in Canada and is responsible for 9% of total employment. Due to the adoption of AM, we see fewer traditional manufacturing and production jobs, and more in the field of engineering and architecture; AM is changing the scope of jobs, as opposed to simply replacing them (ICTC, 2017). As with other fields, there is less of a focus on monotonous, low skill tasks and a greater focus on the need for a higher level of digital literacy to perform the more complex tasks involved.

**“A once-shuttered warehouse is now a state-of-the art lab where new workers are mastering the 3-D printing that has the potential to revolutionize the way we make almost everything.”**

**...Former US President Barack Obama**

There is a shortage of highly skilled AM workers, especially those with the ability to work with metal (as opposed to plastic), although both types of positions can be difficult to fill. The ICTC (2017) has identified eight groups of AM workers which have a skills gap that must be addressed, these are: IT, technical, engineering, materials, operations, skilled trades, design, applications and commercial.

### Some occupations in this field include:

- 0211** Engineering managers
- 2133** Electrical and electronics engineers
- 2174** Computer programmers and interactive media developers
- 2173** Software engineers and designers

### Artificial Intelligence (AI)

AI technology creates the ability for a machine or software to perform human-like behaviours such as: analyzing data, perceiving their environment, talking, and making decisions. Many of us interact with such technology on a regular basis and don't even know it. It has been implemented in such forms as: robotic medical assistants, personal assistants, e-commerce (online shopping), financial forecasting software, and being used in health informatics, analyzing big data, and many other applications.

### Some occupations in this field include:

- 2171** Information systems analysts and consultants
  - artificial intelligence analyst
  - artificial intelligence consultant
- 2173** Software engineers and designers
  - artificial intelligence (AI) designer
  - artificial intelligence designer

In a way, AI is both closer and farther off than we imagine. AI is closer to being able to do more powerful things than most people expect -- driving cars, curing diseases, discovering planets, understanding media. Those will each have a great impact on the world, but we're still figuring out what real intelligence is.

...Mark Zuckerberg

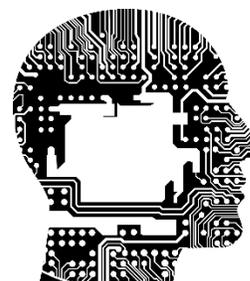
### Automation and Robotics

Robotics is a subfield of AI which is gradually replacing human labour, especially for dangerous, repetitive, or labour-intensive tasks, while substantially increasing productivity. Robotics involves the conception, design, manufacturing and operation of robots with far-ranging applications across many industries, and is especially important in the industrial automation/manufacturing industry (ICTC, 2017).

According to The ICTC (2015), fewer younger Canadians are viewing manufacturing as a potential career path, despite the fact that this is an area where the available supply of workers will not meet the demand. As machines become more sophisticated, many believe that these machines will not completely replace human workers, but that we will see humans and machines working together. The more monotonous work will be performed by machine, while tasks requiring judgement and creative solutions will fall to the human workers. (Deloitte & HRP, 2017)

### Some occupations in this field include:

- 2232** Mechanical engineering technologists and technicians
  - automation technologist
  - home automation technician



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## Appendix A

Current and Projected ICT Employment in Greater Sudbury CMA, employees and self employed

NOC	Occupation	2016 (# jobs)	2018 (# jobs)	Hourly Wage (\$)	% Change
0213	Computer and information systems managers	115	118	46	↑ 2.6
2147	Computer engineers (except software engineers and designers)	57	58	38	↑ 1.8
2281	Computer network technicians	140	136	32	↓ 2.9
2174	Computer programmers and interactive media developers	259	267	36	↑ 3.1
2172	Database analysts and data administrators	55	54	34	↓ 1.8
2242	Electronic service technicians (household and business equipment)	185	163	22	↓ 11.9
2171	Information systems analysts and consultants	251	246	38	↓ 2
2283	Information systems testing technician	17	19	34	↑ 11.8
2132	Mechanical engineers	121	116	38	↓ 4.1
2173	Software engineers and designers	36	35	46	↓ 2.8
2255	Technical occupations in geomatics and meteorology	32	28	28	↓ 12.5
2282	User support technicians	236	244	28	↑ 3.4
2175	Web designers and developers	42	37	28	↓ 11.9

**Red denotes a decrease in number of people employed**

**Source: EMSI Analyst 2017.1. Accessed on August 7, 2017**

## Appendix B

Overview of NOC codes, occupations and example titles (with corresponding page number)

<b>NOC</b>	<b>OCCUPATION</b>	<b>EXAMPLE TITLES</b>	<b>PAGE #</b>
<b>0213</b>	Computer and information systems managers	data centre manager data processing and systems analysis manager data processing director electronic data processing (EDP) manager management information system (MIS) manager software development manager software engineering manager systems development manager	4
<b>2147</b>	Computer engineers (except software engineers and designers)	computer hardware engineer hardware development engineer telecommunications hardware engineer fibre-optic network designer hardware technical architect wireless communications network engineer hardware circuit board designer systems designer - hardware	5
<b>2281</b>	Computer network technicians	computer network technician computer network technicians' supervisor data centre operator Internet Web site technician LAN (local area network) administrator LAN (local area network) technician network administrator network support technician system administrator Web technician	6
<b>2174</b>	Computer programmers and interactive media developers	business application programmer computer game developer electronic business software developer interactive media developer multimedia developer operating systems programmer scientific programmer software developer systems programmer	7
<b>2172</b>	Database analysts and data administrators	data administrator database administrator (DBA) database analyst database architect data warehouse analyst technical architect – database	8
<b>2242</b>	Electronic service technicians (household and business equipment)	alarm system technician audio-video service technician computer service technician	9

		electronic products field service technician electronic service technician apprentice office equipment service technician radio and television service technician	
2171	Information systems analysts and consultants	computer systems analyst informatics consultant informatics security analyst information systems business analyst information technology (IT) consultant management information systems (MIS) analyst	10
2283	Information systems testing technicians	application tester application testing technician software test co-ordinator software testing technician systems tester systems testing technician user acceptance tester	11
2132	Mechanical engineers	design engineer – mechanical energy conservation engineer mechanical maintenance engineer robotics engineer thermal design engineer	12
2173	Software engineers and designers	application architect computer software engineer embedded software engineer software/systems architect software testing engineer systems integration engineer – software technical architect - software	13
2255	Technical occupations in geomatics and meteorology	aerial survey technician aerological technician geographic information systems (GIS) technician mapping technician remote sensing (RS) technician	14
2282	User support technicians	call centre agent – technical support client support representative – systems computer help desk representative – systems hardware installation technician software installation technician software technical support analyst technical support analyst – systems	15
2175	Web designers and developers	e-business Web site developer Internet site designer Internet site developer Intranet site designer Web manager Webmaster	16

Source: *The National Occupational Classification 2016*

## Appendix C

Number of IT employees, in Ontario and nationally, along with average hourly wages\*

*Red denotes a decrease in number of people employed  
 EMSI Canada Data 2017.1. Accessed November 1, 2017.*

NOC	Occupation	Ontario 2016	Ontario 2018	Avg. Hourly Wage (\$)	Canada 2016	Canada 2018	Avg. Hourly Wage (\$)
0213	Computer and information systems managers	34,758	↑ 36,849	49	65,867	↑ 69,759	48
2147	Computer engineers (except software engineers and designers)	10,732	↑ 10,825	38	22,108	↑ 22,570	38
2281	Computer network technicians	23,083	↓ 22,954	32	58,068	↑ 58,456	31
2174	Computer programmers and interactive media developers	62,609	↑ 64,799	36	137,085	↑ 142,460	35
2172	Database analysts and data administrators	16,492	↑ 17,355	34	31,740	↑ 33,116	33
2242	Electronic service technicians (household and business equipment)	20,588	↓ 19,949	22	49,318	↓ 46,981	23
2171	Information systems analysts and consultants	77,683	↑ 82,477	38	159,155	↑ 166,317	38
2283	Information systems testing technicians	6,141	↓ 6,136	34	11,805	↑ 11,890	28
2132	Mechanical engineers	15,188	↑ 15,350	38	34,104	↑ 34,396	39
2173	Software engineers and designers	25,316	↑ 26,039	46	46,806	↑ 48,384	43
2255	Technical occupations in geomatics and meteorology	1,831	↓ 1,783	29	8,386	↑ 8,599	32
2282	User support technicians	40,985	↑ 41,788	28	93,331	↑ 95,636	27
2175	Web designers and developers	8,572	↑ 8,617	28	21,549	↑ 21,777	27

\*This table does not include self-employed as wage data is not available for this employment category. Highest numbers of employed in Ontario are generally seen in Toronto, Ottawa-Gatineau, Hamilton, Kitchener-Cambridge-Waterloo, and Oshawa.