Advanced Manufacturing- Durham Region

Definition and Context

Advanced manufacturing is the production of goods and services using computer-controlled or micro-electronics-based equipment, including CAD design, robots and automated storage systems (OECD, 2012). According to the Government of Canada (2018), advanced manufacturing means that there is increased innovation and technological adoption involved the manufacturing process, encompassing new technologies such as 3D printing, machine learning and cybersecurity. This sector involves cutting-edge applied research and developing new technological projects and processes (Government of Canada, 2018), which can positively impact an organization's operational long-term sustainability and competitiveness (Millier Dickinson Blais Inc., 2013).

The advanced manufacturing supercluster is located in Southern Ontario, encompassing the Region of Durham. Local manufacturers are included in this initiative to promote innovation and new technologies (Next Generation Manufacturing Canada, 2018). Public and private funding have been used to implement technological advancements, scale existing technologies and create a network of support services in assisting the adoption of technologies (Next Generation Manufacturing Canada, 2018). Governmental initiatives to support advanced manufacturing also include support for start-up companies and SMEs (small-medium enterprises), optimizing production, accessing global markets for financial growth and competitiveness, attracting highly skilled and engaged workers, and developing stronger connections between research and businesses in the manufacturing and technology sectors (Next Generation Manufacturing Canada, 2018).

At the provincial level, advanced manufacturing has been identified as a priority sector (Government of Ontario, 2018). Over $500 million dollars in funding has been specifically allocated through the New Economy Fund to promote the growth of advanced manufacturing and other related industries through job retention, job creation and the attraction of private-sector investments (Government of Ontario, 2018). The Transformative Technology Partnerships Fund also supports the advanced manufacturing sector through boosting productivity in areas such as artificial intelligence (AI), advanced computing and quantum technologies (Government of Ontario, 2018). Supporting the innovation ecosystem through funding organizations such as Vector Institute and Ryerson University's Digital Media Zone, will provide the local economy with skilled workers to grow industries related to technology (Government of Ontario, 2018).

Highlights of Advanced Manufacturing in Durham Region

Each municipality within Durham Region contributes to the advanced manufacturing sector in some way. An example of the advanced manufacturing sector in each municipality is included.

Ajax: Autodyne Machinery Inc. design and build automated welding and assembly systems, serving clients in Canada, United States, Mexico and the U.K. Products they create include welding machines that can be used in constructing vehicle frame assemblies, laser welding systems that can be used in seat back assemblies, robotic welding solutions that can be used in cross car beam assemblies and automated assembly solutions for spark plug assembly systems. Additionally, other features of advanced manufacturing in this business include the use of innovative design software such as

SolidWorks Design and ePlan Design. Tooling and quality control are uniquely verified through 3D measurement tools such as the FARO measuring system and Zeiss microscope system. (Autodyne Machinery Inc., 2018).

Brock: Northern Metalworks in Sunderland is a full-service metal fabrication shop that has adopted a variety of innovative technologies in their manufacturing process. This business uses CAD to draft and modify their drawings for production and use robotic welding equipment as well. Other solutions this business offer include CNC plasma cutting, laser cutting and custom fabrication and repairs for equipment, from agricultural to residential. (Northern Metalworks, 2018).

Clarington: Durham Pattern & Model is an advanced manufacturing facility located in Bowmanville. This company specializes in the design and manufacturing of fixtures and gauges for automotive, aerospace and other applications. Computer-controlled systems including 3D modelling and surfacing, computer programming for custom manufacturing and multi-axis CNC milling machines are used to create various products (Durham Pattern & Model Ltd., 2018).

Oshawa: Research and development is central to success in advanced manufacturing, as it enables the development of new innovations and processes that increase efficiency and competitiveness. The University of Ontario Institute of Technology (UOIT) is a leader in automotive engineering, with the only accredited program in Canada that focuses on accelerating research and development of alternative technologies for vehicles (UOIT, 2018). In addition, the ACE (Automotive Centre for Excellence) is located on UOIT grounds, acting as an independent test facility for automotive proof of concepts (UOIT, 2019). This facility includes a five-storey climatic wind tunnel (CWT) which can test for a variety of conditions including arctic climates, severe ice or rain, or towing in intense heat (UOIT, 2019). The uniqueness and technological advancement of the ACE will bring economic growth to the region, as start-up companies and researchers nationally and internationally rent this facility in bringing their products to market (UOIT, 2019).

Pickering: Howard Marten Group of Companies is headquartered in Pickering, with seven other branch offices located across Canada (Howard Marten Company Ltd., 2019). Two main plants in Pickering are responsible for designing and building systems for power generation, mining and oil and gas (Howard Marten Company Ltd., 2019). This business is responsible for distributing fluid system solutions for both end users and original equipment manufacturers (OEMs) (Howard Marten Company Ltd., 2019). The engineering team innovates through new prototype and product development, custom designs for clients and 3D design using SolidWorks software programs (Howard Marten Company Ltd., 2019).

Scugog: Adamson Systems Engineering is located in Port Perry, employing more than 100 highly skilled workers in audio equipment manufacturing (Adamson Systems, 2017). Adamson manufactures advanced professional loudspeaker systems that continue to be innovative and technologically advanced (Adamson Systems, 2017). These loudspeakers have been used in global tours and festivals, and installed internationally at world-class venues (Adamson Systems, 2017). The company has a research and development team (R&D) who is always trying to stay ahead of the curve and lead market trends, rather than follow them (Adamson Systems, 2017).

Uxbridge: Agile Manufacturing Inc. Is located in Uxbridge, acting as the largest 3D Printing service in Canada, operating the largest fleet of 3D printing and additive manufacturing equipment (Agile

Manufacturing Inc., 2019). Agile Manufacturing is able to provide engineering services for a variety of applications, including castings for urethane and metal, CNC machining of plastic and metal parts, and laser scanning for inspection purposes (Agile Manufacturing Inc., 2019). In addition to service offerings, Agile also distributes 3D products and equipment including a variety of materials and printers for desktop and industrial purposes (Agile Manufacturing Inc., 2019). Agile is a leader in its field, and has expanded across North America, offering production and services that maximize the efficiency of the advanced manufacturing sector (Agile Manufacturing Inc., 2019).

Whitby: Aerotek Manufacturing has been located in Whitby for more than 30 years, and is a leading manufacturing company in aerospace (Aerotek Manufacturing, 2018). This company is a 5-star preferred supplier of aerospace and metal coatings to Bombardier, Sikorsky Aircraft Corp and Boeing (Aerotek Manufacturing, 2018). Aerotek is known for its fast turnaround times of seven business days per process, offering processing services such as electroplating, paint and heat treatment (Aerotek Manufacturing, 2018).

Advanced Manufacturing Employment by NOCS (2016)

The National Occupational Classification System (NOCS) is developed by the government of Canada, as the Canadian standardized taxonomy and framework for communicating about labour market information, and is sorted by skill levels and skill types (Government of Canada, 2018b). Occupations within this taxonomy are grouped by the type of work required for each job, including the employment requirements, job description and responsibilities, tasks and duties (Government of Canada, 2018b). Other factors that impact the classification of occupations include the complexity of the work, the types of services that are provided or the goods that are being made, and the responsibility required in the work (Government of Canada, 2018b). There are several levels to these occupational categories, beginning with a single digit, described as a broad occupational category code (e.g. 0 Management occupations) (Government of Canada, 2018b). The occupational codes become more specific as the number of digits increase: two-digits are major group codes (e.g. 00 Senior management occupations), three-digits are minor group codes (e.g. 001 Legislators and senior management) and four-digits identify the above three groups including a unit group (e.g. 0011 Legislators) (Government of Canada, 2018b).

The following table outlines the occupations represented in the advanced manufacturing sector, along with the total employed persons in Durham Region in those occupations, and their respective median and average employment incomes. This table contains the most recent data from the Statistics Canada Census by Place of Work (POW), meaning that all these jobs are within the Durham Region.

Occupation	Total Employed	Median Employment Income ($)	Average Employment Income ($)
0211 Engineering managers	315	128766	139333
0911 Manufacturing managers	825	73915	105322
2115 Other professional occupations in physical sciences	15		
2132 Mechanical engineers	1250	100598	97055
2133 Electrical and electronics engineers	645	108035	101369
2141 Industrial and manufacturing engineers	275	76615	97284
2142 Metallurgical and materials engineers	20		88072
2173 Software engineers and designers	295	89784	104999
2174 Computer programmers and interactive media developers	600	74043	69745
2232 Mechanical engineering technologists and technicians	495	110897	98509
2233 Industrial engineering and manufacturing technologists and technicians	210	59182	66867
2241 Electrical and electronics engineering technologists and technicians	595	104098	89645
2252 Industrial designers	80	63644	69212
5241 Graphic designers and illustrators	645	25466	32739

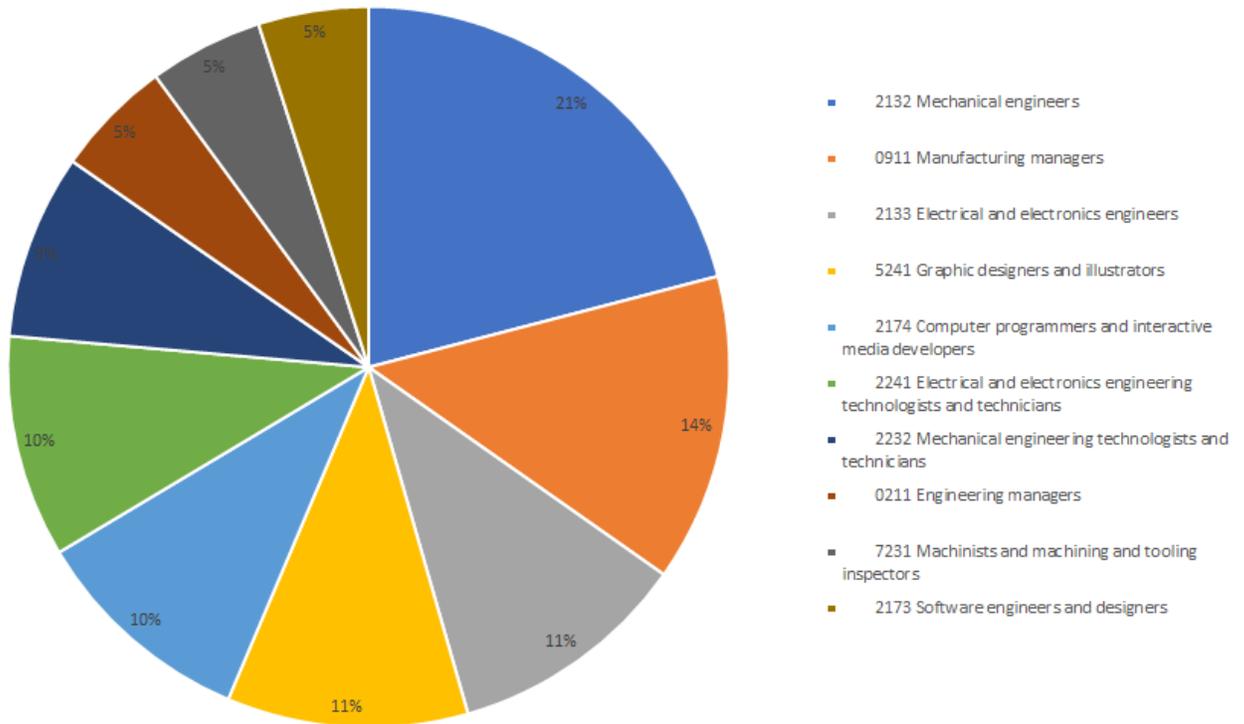|			
7231 Machinists and machining and tooling inspectors	305	59730	62537
7232 Tool and die makers	270	68472	69478
9411 Machine operators, mineral and metal processing	130	59823	61159
9416 Metalworking and forging machine operators	240	47843	47582
9417 Machining tool operators	95	42179	43768
9535 Plastic products assemblers, finishers and inspectors	125	33073	34035
9612 Labourers in metal fabrication	175	40354	41366

Source: Statistics Canada, 2016 Census, Data custom purchased by Durham Workforce Authority

*Note: NOCS were chosen in alignment with the Information and Communications Technology Council (2017) and the occupations they defined as additive manufacturing.

The advanced manufacturing occupation with highest employment is 2132 Mechanical engineers, with high median and average incomes of $100,598 and $97,055 respectively. The occupation with the highest wages and salaries is 0211 Engineering managers with median and average incomes of $128,766 and $139,333 respectively. These wages are in high contrast to the median and average wages of Durham Region, which are $38,893 and $50,161 respectively.

The following chart is a visual depiction of the top 10 advanced manufacturing occupations in Durham Region, by 4-digit NOCS (National Occupational Classification System). Please refer above for the full definition.

Top 10 Occupations in Advanced Manufacturing, Durham Region

- 2132 Mechanical engineers
- 0911 Manufacturing managers
- 2133 Electrical and electronics engineers
- 5241 Graphic designers and illustrators
- 2174 Computer programmers and interactive media developers
- 2241 Electrical and electronics engineering technologists and technicians
- 2232 Mechanical engineering technologists and technicians
- 0211 Engineering managers
- 7231 Machinists and machining and tooling inspectors
- 2173 Software engineers and designers

Source: Statistics Canada, 2016 Census, Data custom purchased by Durham Workforce Authority

Advanced Manufacturing Employment by NAICS (2016)

The North American Industry Classification System (NAICS) is a hierarchical classification system for industries, developed by the national statistical agencies of Canada, United States and Mexico. (Statistics Canada, 2017). This classification system divides the economy into 20 major sectors grouped by production criterion, which are further divided into 102 sub-sectors and 324 industry groups (Statistics Canada, 2017). The reason for the development of this system is to classify business establishments, and to segregate the establishments by the types of activities businesses specialize in (Statistics Canada, 2017). However, it is important to keep in mind that some large companies and enterprises may fall under several sectors in NAICS and cannot wholly be represented by one sector code (Statistics Canada, 2017). NAICS codes are available from broad categories of 2-digits (e.g. 31-33 Manufacturing) to more specific codes that are 6-digits (e.g. 335223 Major kitchen appliance manufacturing) (Statistics Canada, 2017). There are NAICS codes for 3-digits, 4-digits, and 5-digits (Statistics Canada, 2017).

The following table outlines the industries represented in advanced manufacturing, along with the total number of employed persons in those industries within Durham Region, and the respective median and average employment incomes, classified by 4-digit NAICS. This table contains the most

recent data from the Statistics Canada Census (2016) by Place of Work, meaning that all these jobs are located within Durham.

Industry (NAICS)	Total Employed	Median Employment Income ($)	Average Employment Income ($)
3241 Petroleum and coal product manufacturing	80	74957	69941
3251 Basic chemical manufacturing	145	64580	72484
3252 Resin, synthetic rubber, and artificial and synthetic fibres and filaments manufacturing	30		
3254 Pharmaceutical and medicine manufacturing	750	63071	78453
3259 Other chemical product manufacturing	85	59782	70872
3271 Clay product and refractory manufacturing	20		
3279 Other non-metallic mineral product manufacturing	45	56295	71457
3311 Iron and steel mills and ferro-alloy manufacturing	575	76804	77770
3313 Alumina and aluminum production and processing	185	69342	69542
3315 Foundries	50	61012	61311
3331 Agricultural, construction and mining machinery manufacturing	115	56713	61772
3332 Industrial machinery manufacturing	150	58251	63452
3333 Commercial and service industry	100	44110	59557

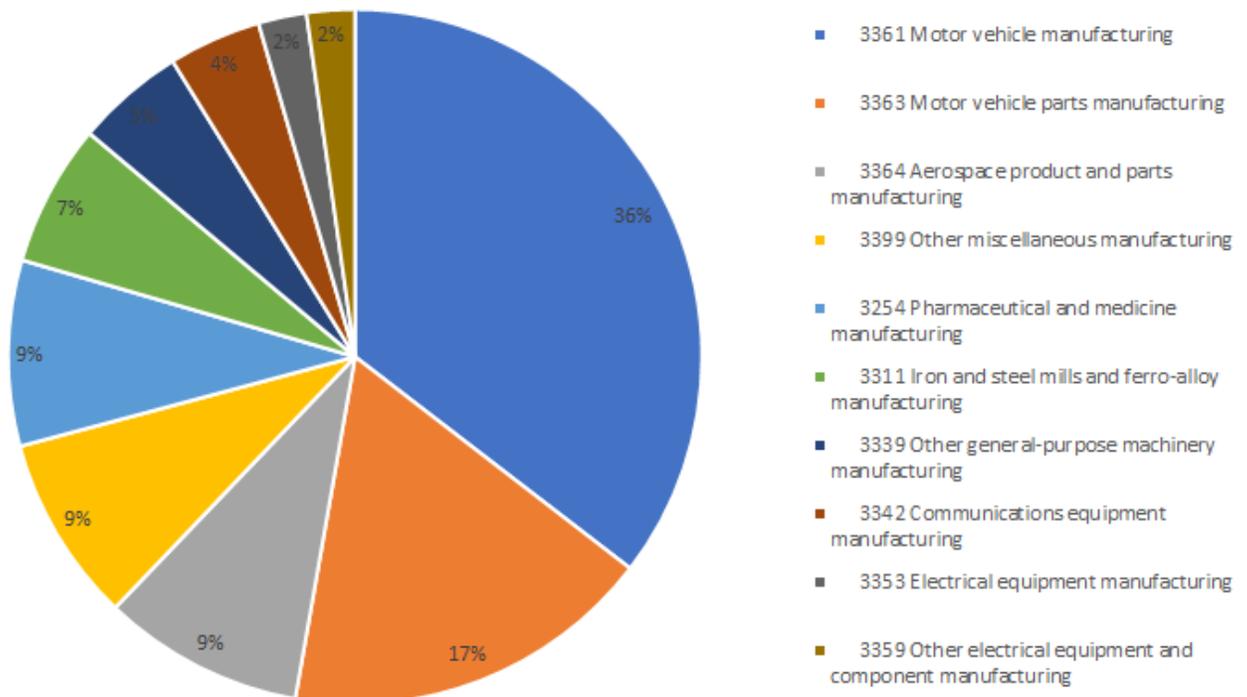|			
machinery manufacturing			
3336 Engine, turbine and power transmission equipment manufacturing	45	26575	43303
3339 Other general-purpose machinery manufacturing	440	46812	53017
3341 Computer and peripheral equipment manufacturing	85	54275	59857
3342 Communications equipment manufacturing	375	50439	72942
3343 Audio and video equipment manufacturing	85	43230	130483
3344 Semiconductor and other electronic component manufacturing	155	41391	51853
3345 Navigational, measuring, medical and control instruments manufacturing	140	76912	88487
3346 Manufacturing and reproducing magnetic and optical media	10		
3351 Electric lighting equipment manufacturing	15		
3352 Household appliance manufacturing	15		
3353 Electrical equipment manufacturing	195	57378	61249
3359 Other electrical equipment	195	53286	70612

and component manufacturing			
3361 Motor vehicle manufacturing	3075	81461	82043
3362 Motor vehicle body and trailer manufacturing	145	43503	49362
3363 Motor vehicle parts manufacturing	1505	50182	53910
3364 Aerospace product and parts manufacturing	815	76863	84689
3365 Railroad rolling stock manufacturing	10		
3366 Ship and boat building	40	22996	24454
3369 Other transportation equipment manufacturing	10		
3391 Medical equipment and supplies manufacturing	130	37525	47491
3399 Other miscellaneous manufacturing	755	39992	63725

Source: Statistics Canada, 2016 Census, Data custom purchased by Durham Workforce Authority

The highest employed and highest paid advanced manufacturing industry in Durham Region is 3361 Motor vehicle manufacturing with 3075 persons employed, and high median and average incomes of 81,461 and 82,043 respectively. The high pay is likely due to the high rate of unionization in automotive industries.

The following chart is a visual representation of the top 10 advanced manufacturing industries in Durham Region by 4-Digit NAICS (North American Industrial Classification system). Please refer above for the full definition.

Top 10 Advanced Manufacturing Industries, Durham Region

Legend:
- 3361 Motor vehicle manufacturing
- 3363 Motor vehicle parts manufacturing
- 3364 Aerospace product and parts manufacturing
- 3399 Other miscellaneous manufacturing
- 3254 Pharmaceutical and medicine manufacturing
- 3311 Iron and steel mills and ferro-alloy manufacturing
- 3339 Other general-purpose machinery manufacturing
- 3342 Communications equipment manufacturing
- 3353 Electrical equipment manufacturing
- 3359 Other electrical equipment and component manufacturing

Pie chart values: 36%, 17%, 9%, 9%, 9%, 7%, 5%, 4%, 2%, 2%

Source: Statistics Canada, 2016 Census, Data custom purchased by Durham Workforce Authority

Canadian Business Counts (December 2018): Advanced Manufacturing

The Canadian Business Counts are published twice annually, and are available publicly available at the national and provincial levels (Statistics Canada, 2018). Canadian Business Counts by Census Subdivision (e.g. Durham Region) are purchased collectively by the Workforce Planning Boards of Ontario, including Durham Workforce Authority. These counts provide information about the number of businesses, as classified by three-digit industrial classification (NAICS) and employment-size categories (e.g. 1 to 4 employees), and are taken from the Statistics Canada Business Register (Statistics Canada, 2018). Each operating location is classified as a separate business, so if a company has more than one location (e.g. headquarter office, 2 branches), they will each be counted individually (Statistics Canada, 2018). Using the Canadian Business Counts is beneficial in understanding the composition of businesses in the Durham Region by industry, as well as the number of SMEs (small and medium enterprises) and their role in the local economy.

The following table outlines the number of businesses represented in the advanced manufacturing sector, categorized by 3-digit NAICS (North American Industrial Classification System) and number of employees. This table contains the most recent data from the Canadian Business Register in December 2018 by Place of Work (2018), meaning that all these businesses are located within the Durham Region.

Industry	Without employees	1-4	5-9	10-19	20-49	50-99	100-199	200-499	500 +
324 - Petroleum and coal product manufacturing	5	1	1	2	2	0	0	0	0
325 - Chemical manufacturing	20	4	5	7	4	3	0	2	0
327 - Non-metallic mineral product manufacturing	11	4	4	4	7	1	0	1	0
331 - Primary metal manufacturing	5	2	0	1	1	0	0	2	0
333 - Machinery manufacturing	67	27	16	8	11	7	4	1	0
334 - Computer and electronic product manufacturing	28	15	4	2	5	2	1	1	0
335 - Electrical equipment, appliance and component manufacturing	26	6	3	0	1	3	1	1	0
336 - Transportation equipment manufacturing	39	8	2	5	4	2	1	3	3
339 - Miscellaneous manufacturing	126	40	12	9	4	4	1	0	0

Source: Statistics Canada, 2018 Canadian Business Counts, Data custom purchased by Durham Workforce Authority

The majority of advanced manufacturing businesses in Durham Region are 339 Miscellaneous manufacturing, without employees (n=126), followed by businesses in 333 Machinery manufacturing, without employees (n=67).

Educational Attainment (Census, 2016)

Educational attainment in the agri-business sector varies due to the varied skill requirements and tasks associated with the breadth of occupations. The following table outlines employment in the Agri-Business sector in Durham Region by highest level of educational attainment and 3-Digit NAICS (North American Industrial Classification System). Please refer above for the full context and definition of NAICS.

Occupation	No certificate, diploma or degree	Secondary (high) school diploma or equivalency certificate	Apprenticeship or trades certificate or diploma	College, CEGEP or other non-university certificate or diploma	University certificate or degree (bachelor and above)
0211 Engineering managers			10	40	260
0911 Manufacturing managers	40	190	60	310	160
2115 Other professional occupations in physical sciences					10
2132 Mechanical engineers			10	70	1160
2141 Industrial and manufacturing engineers		10	20	40	170
2142 Metallurgical and materials engineers					20
2173 Software engineers and designers		20		70	210
2174 Computer programmers and interactive media developers		90		200	300
2232 Mechanical engineering technologists and technicians	10	70	80	280	40
2233 Industrial engineering and manufacturing technologists and technicians		50	20	90	50

Occupation					
2241 Electrical and electronics engineering technologists and technicians		90	90	310	90
2252 Industrial designers		20		20	30
5241 Graphic designers and illustrators	20	90	20	340	170
7231 Machinists and machining and tooling inspectors		70	100	100	20
7232 Tool and die makers	30	30	80	120	
9411 Machine operators, mineral and metal processing	20	70		20	20
9416 Metalworking and forging machine operators	60	100	20	50	10
9417 Machining tool operators		50	10	20	10
9535 Plastic products assemblers, finishers and inspectors	30	60	10	10	10
9612 Labourers in metal fabrication	40	80	10	30	

Source: Statistics Canada, 2018 Canadian Business Counts, Data custom purchased by Durham Workforce Authority

When examining the advanced manufacturing industries in Durham Region by occupation, the educational attainment profile workers leans towards higher education, with 39 percent having obtained a university bachelor's degree or higher, and 30 percent who have obtained a college or

non-university certificate or diploma. In fact, less than 4 percent of workers had no certificate, diploma or degree.

The following table outlines employment in the Advanced Manufacturing sector in Durham Region by highest level of educational attainment and 4-Digit NOCS (National Occupational Classification System). Please refer above for the full context and definition of NOCS.

Industry (NAICS)	No certificate, diploma or degree	Secondary (high) school diploma or equivalency certificate	Apprenticeship or trades certificate or diploma	College, CEGEP or other non-university certificate or diploma	University certificate or degree (bachelor and above)
324 Petroleum and coal product manufacturing		30	0	25	
325 Chemical manufacturing	60	330	50	410	435
327 Non-metallic mineral product manufacturing	55	215	80	140	55
331 Primary metal manufacturing	60	300	135	245	65
332 Fabricated metal product manufacturing	190	515	305	370	150
333 Machinery manufacturing	120	435	135	325	185
334 Computer and electronic product manufacturing	100	230	20	280	190
335 Electrical equipment, appliance and component manufacturing	40	130	40	90	100
336 Transportation equipment manufacturing	430	1945	490	1460	1165
339 Miscellaneous manufacturing	125	360	50	230	105

Proportionally, very few advanced manufacturing workers in Durham Region have no certificate, diploma or degree (9%). The majority of workers have a secondary school diploma or equivalent (34%), followed by workers with a college or non-university certificate or diploma (27%).

Workforce Age Breakdown by NAICS (Census, 2016)

The following table illustrates employment in the Advanced Manufacturing in Durham Region (POW) by age group and 3-Digit NAICS (North American Industrial Classification System). Specifically, for people who work in the advanced manufacturing industries within Durham Region, this chart shows approximately the age distribution by 3-Digit NAICS.
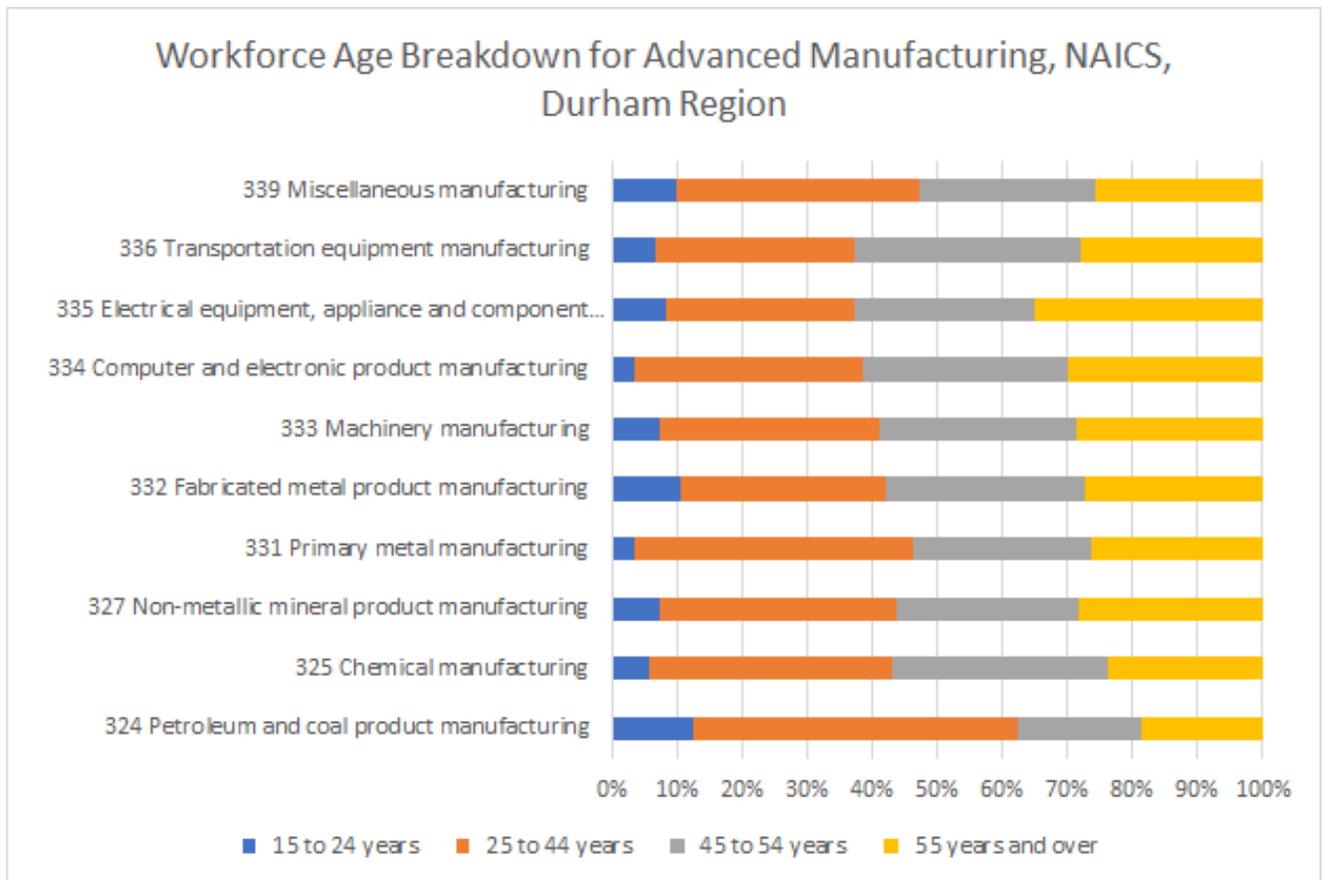
The workforce distribution is relatively similar among the four age groups and across all advanced manufacturing industries. 324 Petroleum and coal product manufacturing in particular, has a larger youth (15 to 24 years) and core-aged (25 to 44 years) working population in Durham Region. The advanced manufacturing industry with the highest proportion of older adults (45 years and over) is 336 Transportation equipment manufacturing.

Key Performance Indicators: Durham College

Each year, Durham College produces a Graduate Employment Report based on information compiled from the KPI survey. The information contained in the report profiles the employment status of Durham College graduates from post-secondary programs in 2016. Six months after graduation, graduates are contacted by an independent consulting firm (hired by the Ministry of Training, Colleges and Universities), regarding their employment status. The table below represents programs within the agri-business sector.

Program Name	Total Graduates	Percentage Working (Related)	Percentage Working (Total)
Computer Programmer (CPGM)	6	0	0
Computer Programmer Analyst (CPA)	33	71	71
Computer Systems Technician (CSTC)	24	25	63
Computer Systems Technology (CSTY)	25	60	70
Electrical Engineering Technician (EETN)	61	25	67
Electrical Techniques (ELEC)	21	55	82
Electro-Mechanical Engineering Technology (EMTY)	19	67	89
Electronics Engineering Technician (fast-track)(ELYF)	8	25	25
Electronics Engineering Technician (ELTC)	20	67	67
Electronics Engineering Technology (ELTY)	16	0	100
Mechanical Engineering- Non-Destructive Evaluation (fast-track) (NDEF)	7	50	100
Mechanical Technician- Mechanical Maintenance and Control (MTNM)	26	58	83
Mechanical Engineering Technician- Non-Destructive Evaluation	26	36	64

Mechanical Engineering Technician (METC)	17	29	71
Mechanical Engineering Technology (METY)	23	63	100
Motive Power Technician- Service and Management (MPTN)	14	67	100

Source: Durham College, 2017, Graduate Employment Report

Key Performance Indicators: UOIT

UOIT is also responsible for publishing Key Performance Indicators for undergraduate programs, including employment rates 6 months and 2 years following graduation. Although there is less detail than the Durham College KPI data, the indicators still provide a basic understanding of what programs of study are related to higher employment. The table below represents programs within the agri-business sector, and is the most recent publicly available data, for graduates from 2014.

Program	Employment Rate (2 Years)	Employment Rate (6 Months)
Computer Science	94.74%	84.62%
Engineering	95.73%	82.46%

Source: UOIT, 2016, Key Performance Indicators, Employment Rate of 2014 Graduates in Undergraduate Programs

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