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Automotive Industry Labour Market Analysis:
Defining the Broader Automotive Sector

The project is a collaboration of the Canadian Skills Training and Employment Coalition, Prism Economics and Analysis, and the Automotive Policy Research Centre.

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This report was prepared for the Auto Labour Market Information (LMI) Project.

The goal of the Auto LMI project is to help stakeholders better understand the automotive labour market. The Project will create industry-validated, regional, occupational supply and demand analyses and forecasts and skill profiles for skilled trades and other key skilled occupations in the broader automotive sector including vehicle assemblers, parts manufacturers and technology companies that supply the industry. The project will also examine various labour market trends in the sector and facilitate discussions among stakeholders about how to address any forecasted skills shortages and other labour market challenges. The planned outcome of the project is enhanced regional LMI that will support colleges, employers, policy makers and other stakeholders in taking practical steps to address skills shortages and other labour market challenges in the automotive sector.

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Table of Contents

List of Tables

List of Figures

Introduction

The automotive industry supply chain is complex and dynamic. The industry includes not only assemblers, but also many parts suppliers including companies that might self-identify as producers of metal, plastic, rubber or glass products. The supply chain also includes computer and electronics manufacturers and software producers.

The largest and most visible segments of the supply chain include the vehicle assembly complexes of automotive Original Equipment Manufacturers (OEMs), some of which employ upwards of 6,000 people when operating at full capacity. These facilities in turn rely on a multi-tiered network of captive (facilities owned by OEMs such as Ford and Toyota) and independently-owned suppliers (e.g. Magna) for modules, components, parts, materials, and tooling. Many of the manufacturing facilities within these supplier networks are dedicated wholly to supplying the automotive industry (and in many cases dedicated wholly to supplying one vehicle assembly plant or higher-tier parts manufacturing facility on a just-in-time or just-in-sequence basis). However, many other manufacturing facilities supply several industries in addition to the automotive industry.

Given the complexity of the supply chain, it is challenging to properly quantify the economic impact of the automotive industry. One of the goals of this project, and the focus of this report, is to develop an approach that:

1) addresses the limitations of analyses of the automotive industry supply chain that rely on a limited number of NAICS codes;

2) identifies the wide network of automotive parts and technology supplier firms and their facilities and includes both traditional manufacturers and firms that produce and develop emerging automotive technologies; and

3) captures the total employment impact of the automotive industry supply chain in Canada.

In so doing, this report demonstrates that the total employment impact of Canada's automotive industry is substantially larger than previous reports by government or industry stakeholders suggest.

We are still working on how to define the sector and measure the size of the workforce. The industry is complex and changes quickly, and understanding the links between the various sectors that produce for the automotive industry means relying on data that may be a few years old. However, in other papers produced by this project, we are including the jobs in NAICS other than 3361 and 3363 that are dependent on the automotive sector and our preliminary research indicates that between 177,000 jobs and 188,000 jobs are dependent on the sector. Our preliminary work also indicates that included in those job numbers are over 20,000 skilled trades jobs and approximately 28,000 senior management, engineering and other jobs with a technical orientation. Our preliminary estimate of the economic

output of automotive assembly and exported automotive parts is well over $83 B per year.

The report is organized into three sections, each of which discusses the primary means that we use to identify the total employment impact of Canada's automotive industry. The first section discusses the use of NAICS codes to profile industries with complex supply chains, their limitations, and ways that researchers and analysts have attempted to overcome these limitations. The second section builds on the first, and discusses our 'bottom-up' establishment-level approach to profiling industries the automotive industry. This approach is also useful for profiling other manufacturing industries with complex supply chains (e.g. aerospace). To do so, we build a comprehensive database of vehicle assembly plants and automotive parts and technology manufacturing facilities in Canada and then compare the results to government statistics. The third section discusses our use of industry-level and NAICS-based Input-Output tables to better understand the linkages between the automotive industry and other related manufacturing industries. A summary and conclusion follow.

NAICS Codes – Uses and Limitations

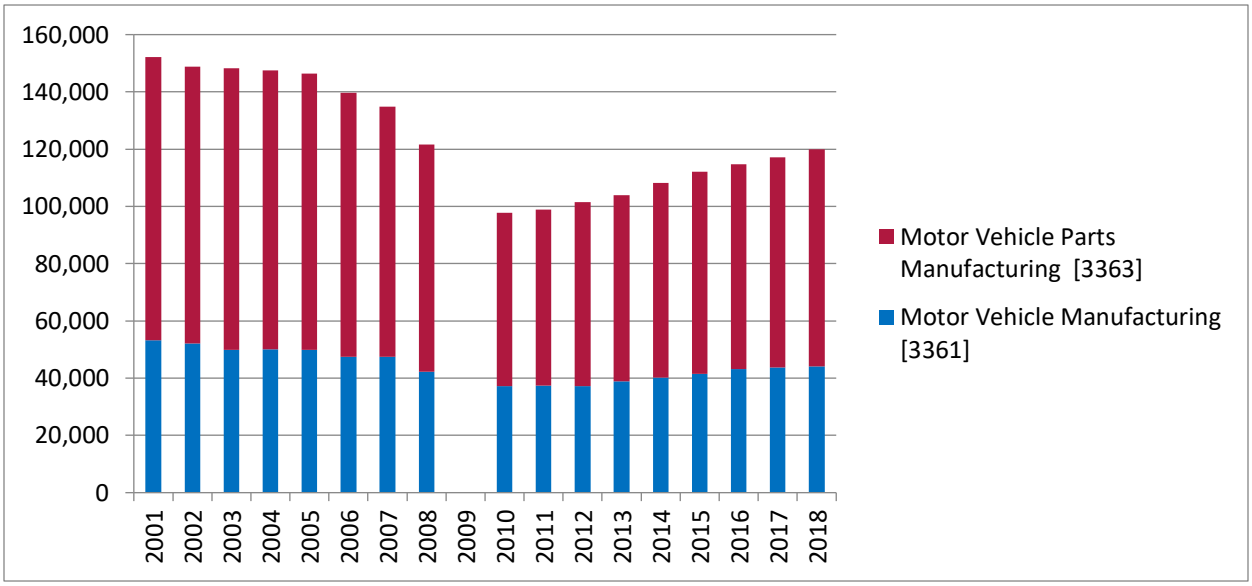
The most common way that researchers and policy-makers quantify the economic impact of a particular industry sector or sub-sector is through government statistics organized by North American Industrial Classification System (NAICS) codes. NAICS codes replaced Standard Industrial Classification (SIC) codes in Canada, the US, and Mexico shortly after the ratification of NAFTA. The NAICS system allowed for greater industry detail and for international compatibility within NAFTA and with the United Nations Standard Industrial Classification (ISIC) system (Boettcher, 1999).

In Canada, NAICS-based data are available through various surveys administered and published by Statistics Canada. These are the surveys that industry researchers and policy-makers are most likely to turn to for industry-level information. Examples of useful employment-related surveys include the employer-based Survey of Employment, Payroll, and Hours (SEPH) and Annual Survey of Manufacturing and Logging Industries, the household-based Labour Force Survey (LFS), the Labour Productivity Measures survey, and the Job Vacancy and Wage Survey (JVWS). Other useful surveys that organize data by NAICS codes provide accounts of GDP, international trade (ISED's Trade Data Online service also provides detailed and timely data related to international trade), business enterprise research and development spending, and the number and size (by number of employees) of establishments.

These sources of data provide useful and consistent time-series information about the number of employees employed in particular industries, their earnings and productivity, the number and size of establishments, and these establishments' contribution to GDP. For example, SEPH data (Table 14-10-0202-01) illustrates the

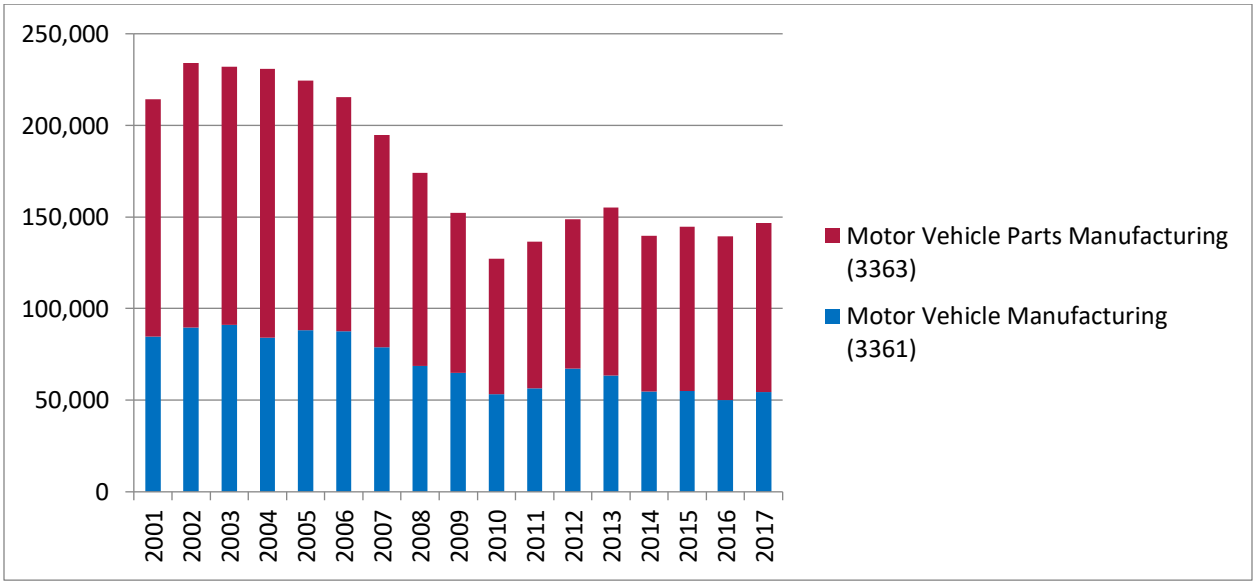
number of employees in three automotive manufacturing-related NAICS codes (Motor Vehicle Manufacturing and Motor Vehicle Parts Manufacturing) between 2001 and 2018. It shows peak employment of 152,073 in 2001 (the earliest year for which this data is available), a low of 97,788 in 2010 (note that data from 2009 – in the midst of a recession – is too unreliable to be published), and 119,991 in 2018. These data frequently provide the basis for profiles and accounts of automotive industry employment in Canada (see, for example, Tanguay, 2018).

Figure 1:Motor Vehicle and Motor Vehicle Parts Manufacturing Employment in Canada (SEPH), 2001-2018



A different survey administered by Statistics Canada provides additional insight into automotive industry employment in Canada. This survey illustrates the challenges and limitations of attempting to quantify industry employment using NAICS codes. Figure 2 shows Motor Vehicle Manufacturing and Motor Vehicle Parts Manufacturing drawn from the Labour Force Survey (via a request for customized information).

Figure 2: Motor Vehicle and Motor Vehicle Parts Manufacturing Employment in Canada (LFS), 2001-2017



As Figure 2 illustrates, the LFS data shows that the between 30,000 and 75,000 more people were employed in Motor Vehicle Manufacturing (NAICS 3361) and Motor Vehicle Parts Manufacturing (NAICS 3363) in any given year than the SEPH data.

This leads to questions regarding why the LFS data are so much higher than the SEPH data. Our initial hypothesis is that respondents to the LFS indicate that they work at an establishment that produces motor vehicles or motor vehicle parts, the surveyor assigns NAICS code 3361 or 3363 to their responses, but that the establishment in question is (appropriately, or at least defensibly) assigned a NAICS code other than 3361 or 3363 in other Statistics Canada surveys (e.g. the SEPH or the Business Register).

This hypothesis is corroborated by several studies of North American industries with complex supply chains. These include studies of the automotive manufacturing in Canada (Sweeney and Mordue, 2017) and the United States (Klier and Rubinstein, 2010), aerospace manufacturing (Davis, 2006), forest products manufacturing (Quesada and Gazo, 2006), and mining (Mining Industry Human Resources Council, 2018). These studies confirm that in such industries, and particularly automotive manufacturing, there are a large number of firms that manufacture parts and components that are assigned a NAICS code that is not reflective of the end use of the product they manufacture. Rather they are assigned a NAICS code that is consistent with the material or medium (e.g. rubber product manufacturing, plastic product manufacturing, alumina and aluminum production and process, steel product manufacturing from purchased steel, glass and glass product manufacturing) or the process (e.g. foundries, die casting) used to manufacture that product. In their recent study of Canada's automotive manufacturing industry, Sweeney and Mordue (2017) estimated that at least 30% of employees manufacturing motor vehicle parts in Canada were employed in establishments assigned a NAICS code other than 3363 in most Statistics Canada surveys. Sweeney and Mordue also identified several large and well-known automotive parts manufacturing establishments owned and operated by automotive OEMs (e.g. FCA's Etobicoke Castings facility) or by major automotive parts manufacturers (e.g. Magna, Toyoda Gosei) that were assigned a NAICS code other than 3363 (more on this below).

This illustrates one of the most significant challenges or limitations of NAICS codes: that the NAICS code assigned may reflect the end use or the material or medium used or the process used to manufacture that product. This is particularly challenging when we consider manufacturing industries with complex supply chains. Ambiguity exists regarding the NAICS code that is applied to a particular manufacturing establishment and that there is an element of human judgement when a Statistics Canada surveyor or data analyst assigns a NAICS code to an employee or an establishment. How might, for example, a Statistics Canada employee determine which NAICS code to assign to an establishment that produces rubber products destined for the automotive supply chain? Should that establishment be considered a Motor Vehicle Parts Manufacturer (NAICS 3363) or a Rubber Products Manufacturer (NAICS 3262)? This is especially challenging considering that both answers are, effectively, correct.

There are additional limitations related to the availability of information. The former SIC system provided data at the four-digit level. NAICS codes are designed to provide

general data at the two- and three-digit level, and more specific data at the four, five, and six-digit level. While many Statistics Canada surveys make data at the two, three, and four-digit level publicly-available, many do not provide data at the five- and six-digit level. This may be because of issues related to data collection (i.e. some surveys do not collect information at the five or six digit level), privacy issues, quality concerns, the suspension or termination of surveys or programs that once provided employment data at the six digit level, or simply the cost associated with compiling data at such a detailed level. These reasons aside, the lack of detailed employment data at the five- and six-digit level presents challenges for researchers and policy-makers alike when quantifying employment in the automotive industry.

One of the most immediate challenges related to the lack of data at the five- and six-digit level is that there is little data available for NAICS code 326193 (Motor Vehicle Plastic Parts Manufacturing), a subset of NAICS code 3261 (Plastic Product Manufacturing) that is dedicated primarily to supplying the automotive industry. Three sources of data available from government sources suggest that such establishments employ a significant number of people in Canada. First, Statistics Canada's Business Register (Canadian Business Count) data counted 98 Motor Vehicle Plastic Parts Manufacturing establishments in Canada in July 2019 (74 were in Ontario and 15 were in Québec). These establishments are categorized by size (number of employees) in Table 1. Based on these data, they employed a minimum of 10,786 people in 2019. The actual number is likely much higher. Second, ISED's trade data shows that Canada exported over $2.4 billion worth of motor vehicle plastic parts in 2018. An industry sub-sector that exports so much is likely to employ a substantial number of people. Third, Statistics Canada's Annual Survey of Manufacturing and Logging Industries (ASML) last published employment data at the six-digit NAICS code level in 2010. In this year, 11,546 people were employed in Motor Vehicle Plastic Parts Manufacturing establishments. In the same year, according to this survey, 56,290 people were employed in Motor Vehicle Parts Manufacturing establishments. The size of the Motor Vehicle Plastic Parts Manufacturing workforce was therefore 21% of the size of the Motor Vehicle Parts Manufacturing workforce in 2003 (CANSIM Table 301-0006). If we assume that this ratio is consistent across time and apply a similar multiplier to the 2018 SEPH data (i.e. Motor Vehicle Parts Manufacturing employment * 0.21), we can estimate that there are nearly 16,000 people employed in Motor Vehicle Plastic Parts Manufacturing establishments in Canada. These employees alone represent a substantial number of persons employed in the automotive industry supply chain that are not included in profiles of the industry that rely solely on the NAICS codes associated with Motor Vehicle Manufacturing and Motor Vehicle Parts Manufacturing.

Table 1:Motor Vehicle Plastic Parts Manufacturing Establishments, Establishment Size, and Minimum Number of Employees in Canada, July 2019 (Source: Statistics Canada Table 33-10-0214-01)

Number of Employees	Establishments	Minimum Employment
1 to 4	6	6
5 to 9	12	60
10 to 19	6	60
20 to 49	8	160
50 to 99	18	900
100 to 199	18	1,800
200 to 499	24	4,800
500+	6	3,000
Total	98	10,786

Publicly-available government statistics that rely on NAICS codes are therefore limited in their ability to comprehensively capture automotive industry employment in Canada. In order to better understand the number of persons employed in Canada's automotive industry we use additional sources of information. The following section describes our 'bottom-up' establishment-level approach whereby we create a database of vehicle assembly and automotive parts and technology manufacturing facilities in Canada to more accurately quantify automotive industry employment in Canada.

Establishment-Level Data

To address the shortcomings of NAICS-based government statistics and more accurately profile employment in Canada's automotive industry we created an establishment-level database of vehicle assembly plants and manufacturing facilities that provide parts, components, or value-added services (e.g. sub-assembly, sequencing) to vehicle assembly and higher-tier automotive parts and components manufacturers. This approach is similar to that of Sweeney and Mordue (2017) and Klier and Rubinstein (2010). The database includes ten light vehicle assembly establishments, nine bus and truck manufacturing establishments, ten OEM-owned parts and components manufacturing establishments, over 400 'primary' automotive parts and components manufacturing establishments that supply the automotive industry exclusively, and over 300 'diversified' manufacturing establishments that supply several industries including the automotive industry. The database also

includes over 250 establishments that manufacture tooling and automation products used in vehicle assembly and automotive parts manufacturing processes, nearly 100 establishments that produce or develop emerging automotive technologies (including software), seven tire manufacturing establishments, and several facilities that produce and supply raw materials (e.g. steel, aluminum, compounded rubber) to the automotive industry supply chain.

Each entry includes information related to several variables for each establishment. These variables include geographic location, ownership, nationality of ownership, products manufactured, manufacturing processes used, number of employees, and importantly, the establishment's NAICS code. All of the information in the database is drawn from publicly-available sources. These sources include company websites and documents (e.g. Annual Information Forms, ISO Certificates), industry association publications (e.g. APMA, JAMA, CAMM, CTMA), and government reports and publications. One of the most useful sources of information are National Pollutant Release Inventory (NPRI) reports published annually by Environment Canada. These reports provide information about several of the above-mentioned variables, including geographic location, number of employees, and NAICS code.

This database shows that in 2018, over 188,000 people were employed in over 1,000 establishments that supplied the automotive industry (see Table 2). All of those employed in light vehicle, truck, and bus assembly worked in establishments classified as NAICS 3361 (Motor Vehicle Manufacturing). Slightly more than 75% of those employed in OEM parts and components manufacturing facilities worked in establishments classified as NAICS 3363 (Motor Vehicle Parts Manufacturing). Slightly more than 78% of those employed in 'primary' automotive parts establishments worked in establishments classified as NAICS 3363. Of those employed in 'diversified' automotive parts manufacturing establishments, slightly fewer than 13% worked in establishments classified as NAICS 3363. No automotive tooling and automation equipment manufacturing nor raw material suppliers in our database were classified as NAICS 3361 or 3363. All tire manufacturing establishments were classified as NAICS 326210 (Tire Manufacturing). Less than one percent of those employed in the 'Emerging Automotive Technologies' category worked in establishments classified as NAICS 3361 or 3363. The database illustrates the complex and diversified nature of the automotive industry and the problematic nature of using NAICS-based statistics to comprehensively capture complex manufacturing and technology supply chains.

Table 2: Automotive Industry Employment by Category, 2018

Category	Employment
Light Vehicle Assembly	32,000
Bus and Heavy Truck Assembly	5,000
OEM Parts and Components Manufacturing	6,000
Primary Automotive Parts Manufacturing	>95,000
Diversified Automotive Parts Manufacturing	>25,000
Automotive Tooling and Automation	>20,000
Tire Manufacturing	5,300
Emerging Automotive Technologies	>5,000
Raw Materials	>15,000
Total	>188,000

This database is useful as a means to better understand the scope and magnitude of the automotive industry in Canada. However, it too has limitations. First, compiling the data is labour intensive. Moreover, manufacturing is dynamic, and the database must be updated and verified regularly. Second, there is no source of consistent data for each establishment within the database. There tends to be a substantial amount of data for the largest establishments. There also tends to be more information for establishments that are unionized and establishments that have received government investment incentives in the past decade. However, it can be challenging to find data – particularly related to employment and the NAICS code – for smaller facilities. Third, it is difficult, if not impossible, to accurately determine what proportion of Diversified and Raw Material suppliers' business is related to the automotive industry, and by extension, what proportion of their employees should be included in our analysis. In order to further test our hypothesis and corroborate the findings of our establishment-level database, we draw upon Statistics Canada's input/output tables. This is the focus of the next section.

Input-Output Tables

Statistics Canada publishes input/output tables annually (Table 36-10-0001-01). These tables trace the production of goods and their use by industries. In our approach, we draw upon these data to determine the dollar amount of goods consumed by the Motor Vehicle Manufacturing (NAICS 3361) and Motor Vehicle Parts Manufacturing (NAICS 3363) industries in Canada. From this we can use other Statistics Canada data – namely the ASML – to calculate the proportion of the output from a particular industry that is consumed by the Motor Vehicle Manufacturing industry, and by extension, the proportion and number of those industries' employees that are dedicated to the automotive industry. These input/output tables also provide the basis for subsequent models of Canada's automotive industry that we will use to forecast the supply of and demand for key occupations.

Based on the data in the input/output tables, we identify several industries other than Motor Vehicle Manufacturing (NAICS 3361) and Motor Vehicle Parts Manufacturing (NAICS 3363) that are important suppliers to the automotive industry. These industries supply automotive parts and components, materials (e.g. steel), and products used in the operation of production facilities including the manufacturing process. In addition to Motor Vehicle Parts Manufacturing (NAICS 3363), some of the most important suppliers to the automotive industry include Motor Vehicle Parts Wholesalers-Distributors (NAICS 415), Plastic Product Manufacturing (NAICS 3261), Navigational, Measuring, Medical, and Control Instruments Manufacturing (NAICS 3345), Foundries (3315), Iron and Steel Mills (3313), Machine Shops (3327), and Hardware Manufacturing (3325). Based on this analysis, the number of employees in 23 NAICS codes outside of NAICS 3361 and 3363 dedicated to the automotive industry are illustrated in Table 3. When combined with NAICS 3361 and 3363, this model suggests that over 176,000 people in Canada are employed directly in occupations related to automotive manufacturing. Moreover, this model is focused on manufacturing, and does not capture those involved in automotive-related R&D activities, which we estimate to be more than 5,000 people. A subsequent report that presents this model and its methodology in greater detail is forthcoming in 2020.

Table 3: Proportion of Sales and Number of Employees Allocated to Automotive Manufacturing, Select NAICS Codes

NAICS Code	NAICS Name	% Dedicated to Auto	Number of Employees
3361	Motor Vehicle Manufacturing	100	38,447
3363	Motor Vehicle Parts Manufacturing	100	71,254
Sub-Total; Motor Vehicles and Motor Vehicle Parts Manufacturing			*109,701*
3255	Paint, Coating, and Adhesive Manufacturing	16.33	1,403
3261	Plastic Product Manufacturing	14.52	12,323
3262	Rubber Product Manufacturing	18.02	1,139
3272	Glass and Glass Product Manufacturing	17.93	1,442
Sub-Total, Non-Metal Materials Manufacturing			*18,051*
3311	Iron and Steel Mills and Ferro-Alloy Manufacturing	26.22	4,036
3312	Steel Product Manufacturing from Purchased Steel	5	412
3315	Foundries	45.56	4,333
3321	Forging and Stamping	9.34	474
3322	Cutlery and Hand tool Manufacturing	14.03	350
3323	Architectural and Structural Metals Manufacturing	2.47	1,717
3325	Hardware Manufacturing	48.86	2,901
3327	Machine Shops, Turned Product, and Screw, Nut, and Bolt Manufacturing	10.96	3,732
3328	Coating, Engraving, Heat Treating, and Allied Activities	7.49	896
Sub-Total, Metal Product Manufacturing			*18,852*
3341	Computer and Electronics Product Manufacturing	2.38	119
3342	Communications Equipment Manufacturing	11.35	1,227

3344	Semi-Conductor and Other Electronic Component Manufacturing	10.11	1,444
3345	Navigational, Measuring, Medical, and Control Instruments Manufacturing	56.86	10,719
3351	Electric Lighting Equipment Manufacturing	3.61	171
3353	Electrical Equipment Manufacturing	3.48	496
3359	Other Electrical Equipment and Component Manufacturing	19.56	2,335
Sub-Total, Computer and Electronics Manufacturing			*16,510*
415	Motor Vehicle and Motor Vehicle Parts and Accessories Merchant Wholesalers	18.75	12,196
5413	Architecture, Engineering, and Related Services	0.3	589
5415	Computer System Design and Related Services	0.12	235
5416	Management, Technical, and Scientific Consulting Services	0.24	217
Sub-Total, Other			*13,236*
Total Employment			**176,350**

Conclusion

The automotive manufacturing industry is an extremely important employer in Canada. While government statistics that rely on NAICS codes suggest that the industry employs approximately 120,000 people, our analysis suggests that this number is likely much higher. This is because NAICS-based analyses do not necessarily capture those employed in establishments with NAICS codes other than 3361 (Motor Vehicle Manufacturing) and 3363 (Motor Vehicle Parts Manufacturing) that supply the automotive industry. In order to address these shortcomings, we draw upon two additional sources of data: a database of establishments involved in the automotive manufacturing supply chain and a model based on I/O tables that helps to identify the proportion that other industries dedicate to the automotive industry. These approaches suggest that total employment in Canada's automotive

industry supply chain is much higher than government statistics suggest, and that Canada's automotive industry directly employs between 178,000 and 188,000 people.

References

Boettcher, J. 1999. Challenges and Opportunities Presented by NAICS. Journal of Business and Finance Librarianship, 5(2), pp. 3-13.

Davis, J. 2006. The Impact of the Defense Industry Consolidation on the Aerospace Industry. Master's Thesis. Air Force Institute of Technology.

Klier T. and J. Rubinstein. 2010. The Changing Geography of North American Motor Vehicle Production. Cambridge Journal of Regions, Economy, and Society, 3(2), pp. 335-347.

Quesada, H. and R. Gazo. 2006. The Impact of Mass Layoffs and Plant Closures in the US Wood Products and Furniture Manufacturing Industries. Forest Products Journal, 56(10), pp. 101-106.

Mining Industry Human Resources Council. 2018. Canadian Mining Labour Market Outlook 2019. MIHRC: Kanata.

Sweeney, B. and G. Mordue. 2017. The Restructuring of Canada's Automotive Industry, 2005-2014. Canadian Public Policy, 43(S1), pp. S1-S15.

Tanguay, R. 2018. Drive to Win: Automotive Advisor Report. Canadian Automotive Partnership Council: Ottawa.