

Canada's Automotive Cluster: Its Future in the Digital Age

Our project examined digital innovation in the Ontario automotive industry, which is dominated by slow-moving, foreign-owned incumbents. To understand path disruption our research investigated the behavior and policy approaches to 1) automotive original equipment manufacturers (OEMs), 2) automotive suppliers and 3) IT start-ups and established companies entering the connected/autonomous mobility space.

Government policies have been focused on attracting global automotive R&D by strengthening domestic research capabilities (Goracino et al., 2017). Building relationships with global corporations has been seen as necessary for the survival and digital transformation of Ontario's automotive industry. On the other hand, there have been relatively few systematic policy initiatives aimed at facilitating technology transfer to small and medium-sized suppliers through the kind of strong institutional support that exists in Germany, Japan, and even the United States and Mexico (Galvin, Goracino, and Wolfe, 2015). Only recently have policymakers seen an opportunity for Canadian technology companies to participate in future high-growth automotive areas: AV technology (electronics and software suppliers); battery cells and on-demand platforms. Canadian firms are also taking notice of this opportunity as tech sector start-ups and established companies have become interested not only in automotive innovation but also urban transit and automated transportation in general. Government policies have begun to provide support for these new entrants through initiatives such as the Autonomous Vehicle Innovation Network (AVIN).

In this institutional setting, the number of electronics suppliers has increased, but studies have found that the automotive parts industry, in general, has not been able to transform new technology into new products (Rutherford, Holmes and Carey, 2017). However, it is less clear if multinational companies have begun to perform higher-value added research-intensive activities in Ontario. Furthermore, we lack insight into how Ontario's ICT firms can capture the opportunity from the emergence of technologies and new business models associated with autonomous, connected and electric vehicles. The two main questions the research addressed are:

- 1) Has Ontario's growing automotive research capacity incentivized OEMs to increase their R&D footprint?
- 2) What are the opportunities for Canadian high-tech firms in emerging mobility supply chains?

We found evidence of an increase in foreign and domestic performed automotive R&D and stronger interactions between OEMs and local actors. OEMs have begun to draw on Ontario's deep pool of technical talent as they digitize vehicles and their operations. Still, the extent to which the major five OEMs operating in Ontario are dedicated to further expanding their R&D operations remains unclear. On the other hand, Ontario software suppliers face high barriers to entry in the automotive industry. This creates considerable uncertainty surrounding the role of Ontario's auto-tech companies in the automotive supply chain. However, the research showcased some of the strategies start-ups and established small and medium enterprises (SMEs) have employed to compete on the global stage. As mobility evolves, however, some Canadian tech firms might be better able to capture value outside the automotive industry. It is not just in-vehicle technologies where opportunities are opening for firms to address our transportation challenges. There is a window of opportunity for domestic companies to create solutions for sustainable mobility systems and build the intelligent infrastructure connected vehicles will depend on.¹

¹ Vehicles are connected to the internet to enable ADAS and in-vehicle infotainment functionalities. This widens the automotive software and system landscape beyond the physical vehicle boundaries, making the vehicle a part of an Intelligent Transportation System and thus an important example for a future internet of things (IoT).

Automotive multinationals and universities in Canada

Ontario has historically been a production location due to a set of structural conditions including its ownership structure, the scale of the Canadian parts sectors as well as the tariff structure. However, Canadian vehicle production contracted in the past two decades. In response, the Canadian government shifted its focus and began to attract R&D. These initiatives provide financial incentives for OEMs and Tier 1s to research software-rich, greener and more fuel-efficient vehicles in collaboration with universities (Rutherford & Holmes, 2007; Holmes et al., 2017).² In the first part of the research, we investigated the resulting automotive R&D trends in Ontario. Because much of the OEM's research is done in collaboration with universities, we conducted an in-depth study of these partnerships and their outcomes.

There are two main constraints to developing strong relationships between Ontario universities and OEMs. On the one hand, subsidiaries remain tightly controlled by their parent companies and can't get access to the resources necessary to pursue ambitious innovation projects. It is also challenging for subsidiaries to form long-term relationships with university researchers, who prioritize other goals such as training skilled personnel and continuing their research agenda.

Despite these difficulties, some subsidiaries are using the substantial increase in local university research capacity to lobby their parent companies for additional R&D mandates in Ontario (Goracinova & Wolfe, 2019). They are leveraging various capabilities – including their long-term production and R&D presence – as a source of power in their negotiations with their parent companies. But getting attention from the headquarters remains a difficult task. On the whole, automotive subsidiaries have to be proactive about innovation to win in the competition for mandates. The headquarters will support stronger subsidiaries only if they keep up with developments elsewhere. Otherwise, their mandates may be withdrawn resulting in a move down the mandate hierarchy (Gilmore et al., 2018).

Overall, OEM-university collaborations may not result in a significant flow of knowledge to the region or regional companies. Because of this, policymakers must also consider focusing their efforts on increasing domestic SME access to research institutions.

Mobility value chains

Connected/Autonomous car solutions involve an ecosystem with traditional value chain players – OEMs, Tier one suppliers, systems integrators, solution providers – as well as an evolving digital ecosystem of service providers delivering new driver experiences, mobility services, insurance models, and more. However, the move toward autonomous/connected vehicles also depends on the evolution of the **smart-city** architecture layer upon which cities of the future depend, as autonomous **cars** and other trends reshape urban mobility.³ Opportunities for Canadian companies are not limited to the provision of in-vehicle technologies but include urban transit and the underlying digital infrastructure.

The focus of the following supply chain analysis is on Canadian capabilities in the rapidly growing segments of the sustainable mobility ecosystem. The overview focuses on 1) electronics and electrical drive systems and 2) emerging software ecosystems. When it comes to the first category, Canada has automotive electronics capabilities (e.g. Magna) but lacks strong homegrown battery and semiconductor manufacturing/design essential to the future production of autonomous vehicles.

² In a similar vein, automakers have also taken advantage of government support for research and development through generous tax credits (Holmes et al., 2017).

³ Vehicles are connected to the internet to enable ADAS and in-vehicle infotainment functionalities. This widens the automotive software and system landscape beyond the physical vehicle boundaries, making the vehicle a part of an Intelligent Transportation System and thus an important example for a future internet of things (IoT).

When it comes to the second, recent years have seen an evolving digital ecosystem of service providers delivering not just in-vehicle technologies,⁴ but also working to build urban transport solutions and the smart-city architecture layer. Across the board, SME entrants combine their competences with technology companies, telecommunications providers or automakers to develop new applications for vehicles and the smart city infrastructure. Except for QNX, none of these companies has a significant market share or revenue from the automotive industry, but a number are growing in the smart city/mobility space. Furthermore, there is a lack of homegrown AV technology. BlackBerry has their innovation centre for AVs and is working with the University of Waterloo to test self-driving technology lovingly called the Autonomoose, but projects like these are fewer and far between compared to other leaders in the technology space.

The new Canadian entrants can be divided into two broad categories discussed below:

- 1) Established companies that provide technologies that are already mature in other applications (in broadcasting, fleet operators, education, hospitality), but are looking for a way to enter automotive or smart mobility/cities. They are opening their firm boundaries to access the partnerships they need to enter the mobility space.
- 2) Startups that are working on automotive (and other) applications for more groundbreaking technologies (e.g. blockchain, quantum computing). However, it has so far proven hard for software start-ups to implement their digital innovations in the vehicles as they face multiple barriers after the project. So, startups widen their perspective and look for customers outside the automotive space. These include customers in the telecommunications industry, which play a significant role in the development of the connected car. To prove the product and market, some startups also choose to go to the aftermarket (this often means auto retail).

Overall, these companies are operating in emerging spaces where a dominant player has yet to emerge.⁵ Scholars predict that given the immense upfront capital investments and the nature of network effects intrinsic to data-intensive platforms, the autonomous mobility-as-a-service system or smart city platforms tend toward natural monopolies. Firms are likely to pursue both horizontal and vertical integration strategies to achieve sustained market leadership. In line with this, our interviews with Ontario auto-tech companies indicate that new, radical, change is controlled by automakers outside of Ontario and Canada. In this sense, automakers (or other large players) can act as a gate-keeper for innovation and limit the opportunities for growth in this space.⁶ It is unclear how large a share Canadian SMEs will be able to capture. For more details on the supply chain see the next page.

1) Upgrading in the Traditional Supply chain (Automotive electronics)

Canada has a few significant automotive electronics suppliers (Ozelkan, 2019). Magna is one of them and produces a broad range of auto parts and equipment. While Magna manufactures industry-specific products under many of the company's product segments, the majority of Magna's automobile electronics production comes from its vision and electronic systems product segments. Industry-specific products in this segment include advanced parking assistance and blind spot detection cameras, keyless car entry technologies, GPS systems, liquid level sensors (i.e. systems to detect how much gasoline is in a vehicle's gas tank) and other electronic parts and systems.

While the Automobile Electronics Manufacturing industry in Canada is relatively small, with only 134 establishments in 2018, there are many small manufacturers competing for market share. According to Statistics Canada, 86.5% of all

⁴ New driver experiences, mobility services, insurance models

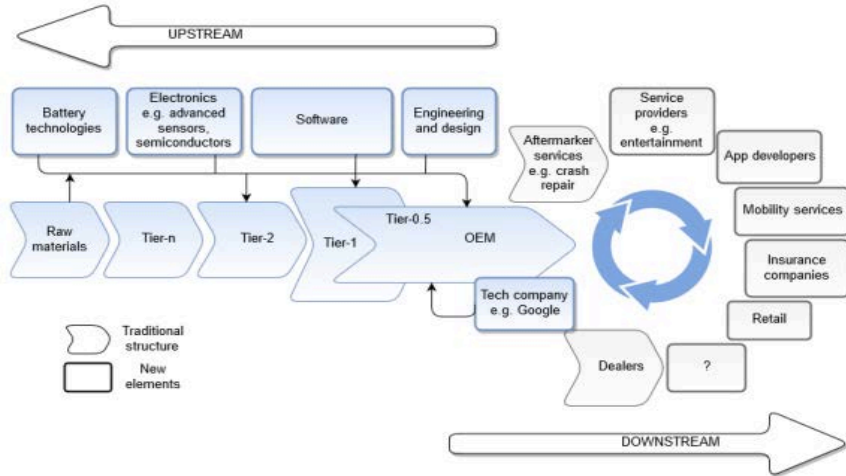
⁵ Miovision, a Canadian start-up, competes with the Sidewalk Labs' Flow product in the traffic modeling and optimization space.

⁶ Furthermore, many of the high-tech companies don't have strong linkages with the foreign subsidiaries in Canada. They have to negotiate with the headquarters to get a contract.

industry establishments employ less than 100 people with 50.6% of all establishments employing less than five. Therefore, the industry is characterized by numerous small-scale production facilities that cater to niche markets or specialize in particular automotive technologies. Within this landscape, some companies have amassed a substantial market share alongside the dominance of Magna (Dixie Electric, International Inc.).

2) New entrants

The graphic below showcases the evolving value chain of producing a vehicle.



Source: Pitkäaho (2016)

Canada’s most significant upstream automotive software vendor is QNX, whose infotainment operating systems are used in vehicles around the world. There are a number of other high-tech companies with high-profile automotive customers, but mobility applications are still not a major part of their revenue. These companies are software designers and developers, networking and network security companies. Some of them have broken into the upstream end of the value chain (provision of middleware, telematics), but most of them are downstream (provision of mobility services, app developers and e-commerce companies).⁷ One method of entering the market has been through partnerships with technology companies. Startups have become M&A targets by filling voids in the development capabilities of carmakers (TrustPoint Innovation Technologies, Praval Networks).⁸ However, we have yet to see Canadian start-ups scale in the space.

Policy implications

Canada’s strengths in automotive and ICT give it an edge in the digital transformation of the mobility sector, but don’t guarantee Ontario firms will survive in the automotive market. Power is concentrated in the hands of OEMs and Tier 1 suppliers and high-tech small and medium sized enterprises have difficulties entering the industry. Because of these dynamics, the policy discussion should not be limited to automotive innovation but extend into Canada’s role in building sustainable mobility solutions for an emerging autonomous, on-demand world.

The key policy focus for governments should be how to integrate Canadian firms into autonomous vehicle supply chains, but also on the architecture upon which smart cities will function. Initiatives should not only be geared to start-ups but also support the scale up of existing firms that are trying to enter the

⁷ For instance, there is a rich set of companies in the vehicle telematics space. Used in trucks, cars, and logistics, vehicle telematics systems collect data to provide fleet managers with actionable information and guidance. OEMs benefit from this type of onboard connectivity because it helps consolidate vehicle data and identify new business opportunities. OEMs, such as GM with OnStar, have begun to develop their own telematics solutions. Other automakers, however, rely on telematics companies, including Ontario ones, to help them develop smart telematics solutions.

⁸ Startups often have a shortage of managerial resources. Combined with asymmetric information, insufficient bargaining power, economic incentive conflicts and associated opportunistic behavior, this is likely to result in SMEs being squeezed in the negotiation rounds and exit, or be acquired (Christensen, 2006)

connected mobility ecosystem. The latter have more experience and revenue streams which could improve their chances of experimenting in untapped markets. Policymakers should be careful to avoid scenarios where large-scale initiatives like the SuperClusters crowd out the needs of smaller enterprises. Initiatives that encourage smaller-scale networks (micro-clusters) might be more successful in meeting the needs of participants.

Finally, it is also critical to identify where Ontario has gaps in these emerging supply chains and to attract investment in those key areas. Economic policies surrounding mobility should take a more holistic and strategic approach to the evolving transportation system.

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