Recent Trends in Manufacturing Innovation Policy for the Automotive Sector: A Survey of the US, Mexico, EU, Germany, and Spain

Patrick Galvin,
Elena Goracinova,
and **David Wolfe,**

Innovation Policy Lab
Munk School of Global Affairs
University of Toronto

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Executive Summary

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Introduction

A conventional discourse in the public consciousness is that developed nations are transitioning from manufacturing to service economies. Within this framework, manufacturing is often viewed as a low value added operation performed in developing economies. A growing body of literature however, focuses on novel trends in manufacturing and its relevance to innovation (Sirkin et al, 2011; Manyika et al, 2012). Furthermore, the 2008 economic crisis demonstrated the threat of overreliance on the financial sector, and the more resilient nature of regions with diversified economies (Christopherson et al, 2010). This has led to a renewed interest in industrial policy that aims to strengthen manufacturing competitiveness. At the same time, however, these policies must serve multiple objectives – restore growth and jobs, contribute to social objectives and facilitate the transition to a low-carbon economy and enhanced resource efficiency.

Leading economies, such as the US, the European Union (EU), Germany and Spain, are all moving towards establishing a 21st century manufacturing innovation policy designed to strengthen their respective automotive industries. Recent initiatives share a long-term focus on the continued development and diffusion of general purpose technologies, such as new materials, IT and batteries, which are transforming and greening the automotive industry (Tassey, 2014; Mazzucatto, 2013; Perez, 2013). In this sense, the reinvigorated automotive policy combines the horizontal basis for generating enabling technologies across a wide swath of manufacturing industries, with a more sectoral application on the automotive industry. These initiatives not only support basic knowledge generation, but also the subsequent competitive technology production, which helps companies cross the Valley of Death. As such, industrial policy instruments aim to address both market and systems failure (Crafts and Hughes, 2013). Automotive-related manufacturing policies have sought to address systems failures stemming from the difficulty of transitioning from the dominant internal combustion engine (ICE) paradigm to low carbon vehicles or the increasing incorporation of electronics in automobiles.

There is a commitment to the promotion of cross-disciplinary and inter-sectoral collaboration in response to the increasingly interdisciplinary nature of technological development and the reliance of automotive assemblers on partners providing supporting technologies and services. In other words, firm-centric policy supports are being displaced by policy developments focused on promoting linkages between firms, research institutions and government to stimulate platform-based and network-oriented innovations (O'Sullivan, 2013). Key policy tools are cluster initiatives and alternate forms of public-private partnerships that bring together cross-sectoral knowledge and expertise to "help build systems, create networks, develop institutions and align strategic priorities" (Warwick, 2013, p.4). Other measures, which feed into manufacturing innovation policies, concern the support of small and medium sized enterprises (SMEs), the supply of labor, finance and increased company access and presence on international markets. For multifaceted manufacturing innovation programs to succeed, officials work to improve policy coordination across multiple levels of governance and strategically important areas, such as basic and applied research, standardization measures as well as deployment and market access (European Commission, 2013, KET Report).

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Despite the common view that U.S. political institutions are less hospitable to industrial policy, network forms of organization are gaining prominence as mechanisms of governance and emerging as precisely the kind of innovation-focused mechanism U.S. policy is targeting. Non-market forms of coordination have traditional been more common in the German form of industrial organization, but are becoming more decentralized as Germany seeks to retain its leadership in high-growth markets. Lastly, Spain has developed innovative strategies to secure cooperation, despite the lack of strong non-market coordination mechanisms. The increasing prominence of network-focused industrial policy challenges the Varieties of Capitalism model, which contends that countries whose institutions fit either the liberal or coordinated market economy types have an advantage over countries whose institutions are mixed.

In the case of Mexico, policy makers have mainly focused on the attraction of foreign direct investment initially through the use of special automotive decrees, but then increasingly over the past two decades through the negotiation of preferential trade agreements (PTAs) with North America, the European Union and Japan (Manger, 2009). Notwithstanding, there are emergent efforts to facilitate greater regional cooperation for economic development through the support of clusters at different levels of governance (Carillo, 2009). This summary of the report outlines the contributing factors to the changing nature of manufacturing and their impact on the automotive industry. Secondly, it provides a general description of the essential features of current manufacturing-related policies in the US, Mexico, the EU, Germany and Spain.

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Changing Manufacturing Landscape

Firms today are faced with shorter product life cycles, hard to manufacture product designs and increasing technological parity, which require an exceedingly diverse range of capabilities. This leads a growing number of firms to focus on "core competences" and rely on foreign and domestic manufacturing and non-manufacturing firms for everything else in order to save time and resources, diversify exposure to risk and enhance flexibility (Herrigel, 2010).

However, the aggressive offloading of low value added manufacturing operations to developing countries has begun to hollow out supply chains in industrial economies. Out-migration has expanded to include higher value-added production operations and services, bringing into question the dichotomous view of economic activities in terms of the production of goods and services (Andreoni and Gomez, 2012). In the case of the automotive industry, Klier and Rubinstein (2014) express concern that the loss of production in Michigan may lead to the outflow of automotive R&D. At the core of these developments has been the inability to completely separate R&D/design and manufacturing processes because of complementary relationships between product and process innovation (Breznitz and Cowhey, 2012; Pisano and Shih, 2009; 2012). Another factor has been the gradual development of the national innovation systems (the organized collection of public and private assets that create and utilize technologies) in emerging economies, which can provide the environment

where companies can transfer both low and high value-added operations (Tassey, 2010). These developments compromise the ability of advanced economies to capture economic value and generate employment, since product evolution often occurs elsewhere. Even advanced economies with substantial support for manufacturers (e.g. Germany) are facing rising competition from emerging economies.

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Lastly, developments in key enabling technologies are rapidly changing the competitive basis for manufacturing industries. A case in point is the transformation of the automotive industry from a "modestly complex set of hardware components into today's modern automobile, which contains 17 subsystems for which electronics is a central element" (Tassey, 2014, p. 29-30). Furthermore, the dwindling of natural resources has increased demand for product and manufacturing energy and resource efficiency. Tassey (2014) underlines the relevance of public funding for enabling technologies since the technical and market risks associated with their development lead firms to under invest in the platform and infratechnologies required for successful commercialization.

Restructuring in the Automotive Industry

Shifting automotive production map

Current automotive production is strongly geographically concentrated with North America, Europe and East Asia making up 90 percent of the total production (Dicken, 2013). Developments in the past four decades have led to the spectacular growth of the Japanese and Chinese automobile industries, while the US market share has fallen dramatically. Dicken also notes the significant growth of automobile production in Spain, Mexico, South Korea, Brazil, India, Russia and the emerging market economies of Eastern Europe. Furthermore, while the 2008-09 financial crisis hurt automotive production in developed economies, output grew in developing countries such as Brazil, China and India. The consumption side is characterized by similar trends, with slowing demand in the mature European and North American markets, while Asia is expected to be the source of major growth.

Technological change in the automotive industry

The automotive industry transitioned from the mass production model of manufacturing automobiles to an age of lean production, based on the modularization of certain components, the development of component systems and standardized platforms. This shift prompted today's era of intensified competition, during which processes of consolidation have reduced the number of transnational producers.

Automotive suppliers today have to create parts and subassemblies that are specific to a particular brand's model, making it more difficult to reuse the same components and profit from economies of scale. This is both a result of how cars function, but also of the desire of brand companies to retain a distinctive look. Notwithstanding this fact, competition and overcapacity lead firms to "hive off" as many functions as possible to a complex, tiered network of suppliers (Berger, 2005,

p.58). The ongoing pressure on suppliers to participate in product development, while reducing costs and improving quality, has increased consolidation as a way for firms to keep up with customer demands (Andreoni and Gomez, 2012).

Finally, the move toward electric mobility is confronting manufactures with another period of radical changes along the automotive sector's entire value chain. The integration of electric components, advanced materials, batteries and new high performance electronic architectures into their products make automotive manufacturers reliant on suppliers from a cross-section of other industries.

Production geographies and supplier customer relationships

Distance continues to matter in the automotive industry (Schmitt and Van Biesebroeck, 2011). A production location in proximity to an assembly plant increases the chances that a supplier is awarded an outsourcing contract because it diminishes transportation costs, product development time and helps avoid costly misunderstandings (Winden et al, 2012). This contributes to a common trend – particularly prevalent in North America and Europe, but also to a certain extent in East Asia- or the continued regionalization of production and distribution in the automotive industry.

Notwithstanding these developments, Dicken argues that production geographies and supplier-customer relationships are influenced by the national context and specific histories. Major European automobile producers are strongly Eurocentric in comparison to the more heavily transnationalized character of US automotive OEMs. Berger notes that in comparison to their German or Japanese counterparts, American companies hand over more of the responsibility for module design and assembly to their first tier suppliers (2005, p. 86).

Impact of offshoring

The production facilities of suppliers in lower wage regions are not limited to performing low value added operations, but there is a practice, which blends R&D/ design and manufacture capabilities across global production locations. When it comes to the question of establishing R&D, it is useful to see it in the context of an evolutionary process. Jürgens and Krzywdzinski (2009) argue that plants often begin as simple production sites, which gradually assume independent responsibility for monitoring the production process, and finally develop a small capacity for R&D. As automotive firms in developing economies upgrade, increasing portions of the supply chain in advanced economies, including service activities, become vulnerable. Overall, offshoring has hollowed out automotive supply chains and made it more difficult for assemblers to source components locally, which can also prompt them to re-locate assembly operations. These trends in both the technological basis of automotive production and the organization of the industry over the past four decades have prompted major policy shifts among the leading automotive producing nations. The next section of the report outlines the differences and similarities in policy responses to the ongoing transformation of the automotive industry.

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Automotive Policies in the US, Mexico, Germany, EU and Spain

United States

In the past few decades the US placed less emphasis on the relevance of manufacturing in comparison to its German counterparts. Moreover, the commercialization stage of innovation was largely seen as the purview of the private sector. This contributed to a lack of a coherent national industrial policy, which has made the initiation and coordination of collaborative efforts across agencies and government levels difficult to achieve (Bonvillian, 2012). The weak institutional basis contributes to the ad hoc basis of numerous networking initiatives. A study conducted by the MIT Production in the Innovation Economy (PIE) Project concludes that US local ecosystems differ from industrial districts in Northern Italy or Southern Germany, where producers draw on the close ties they develop with actors in their local ecosystems such as suppliers, customers or regional innovation centers (Locke and Wellhausen, 2013). The 2008 crisis prompted a reevaluation of the US industrial structure and brought the relevance of the automotive manufacturing industry, among others, to the forefront. In addition to the automotive industry bailout, the federal government has launched initiatives that are organized around a number of national priorities. They are not automotive sector-specific, but aim to promote manufacturing and energy-efficient technologies and train talent, which are key to the modernization of the automotive industry and the revitalization of regional economies.

Leading US R&D agencies, including the Departments of Defense and Energy, have intensified their efforts in the advanced manufacturing space. Initiatives encourage closer cross-agency and industry-university-government coordination (Bonvillian, 2012; 2013). These take the form of public-private partnerships including both federal and sub-national cluster strategies with a focus on developing and strengthening regional industrial ecosystems. Federally funded regional cluster initiatives are a relatively novel development since support for regionally embedded industries has traditionally been under the purview of state or local governments. The aim is not just to produce breakthrough research, but also to leverage federal-regional partnerships in its development, commercialization and diffusion. An example is the new Energy Regional Innovation Cluster effort in the Philadelphia Naval Yards, in which the DoE is leading six other federal agencies in an effort to leverage, and align federal, state, and regional resources in the development of innovation zones. It is complemented by the establishment of the Advanced Research Projects Agency for energy, known as ARPA-E intended to speed up the commercialization of clean-energy technologies. Another essential initiative is the National Network for Manufacturing Innovation, as part of which regional Institutes for Manufacturing Innovation will attempt to accelerate the development and adoption of advanced manufacturing technologies. Unlike Germany, US federal and state governments encourage the development and commercialization of novel technologies through substantial production and purchasing subsidies and incentives. Overall, non-market coordination – often associated with Coordinated Market Economies- has been a staple of the US 21st century industrial policy and built on previous federal government collaborative initiatives such as the Manufacturing Extension Partnership Program (MEP).

Mexico

Policy makers have mainly focused on the attraction of foreign direct investment initially through the use of special automotive decrees, but then increasingly over the past two decades through the negotiation of preferential trade agreements (PTAs) with North America, the European Union and Japan (Manger 2009). Human capital availability and efficient logistics in the central region automotive cluster have contributed to the proliferation of higher value activities like engineering and design in addition to low-skills part manufacturing. The push for research activities, however, has been dominated by foreign owned OEMs, which limits decision power for generating and transferring technology and demonstrates the difficulty of the periphery achieving core status. Notwithstanding this challenge, both the national and municipal governments have begun to establish intermediary organizations, such as Sintonia, that attempt to capture the synergies between the automotive industry, the knowledge infrastructure and regional governments as the basis of regional economic development.

European Union

In the post-2008 crisis period, the EU has renewed its interest in industrial policy. This is evident in the Europe 2020 growth strategy, which influences the allocation of funds through instruments such as the Research Framework Program and the Cohesion Policy. In light of the EU's status as the largest producer of motor vehicles, the CARS 2020 Action Plan for the automotive industry was the first deliverable of the new European Industrial Policy. Major initiatives within the Research Framework Programs, like the European Green Cars Initiative and its successor, the European Green Vehicles Initiatives, take a non-territorial approach and often function as public-private partnerships. They encourage cross-country collaborative research projects to advance and integrate automotive, energy, ICT, and smart grid technologies. EU Cohesion Policy initiatives are characterized by a place-based smart specialization approach, which supports cluster initiatives that leverage the regional industrial base and institutional strengths. The objective is to develop and deploy key enabling technologies, such as automotive electronics and hydrogen and fuel cell technology leading to the transformation of regional economies around new cross-sectoral domains, such as electromobility. In summary, EU initiatives support the private-public co-development of general purpose technologies, which could lead to the greening of the automotive industry.

Germany

In addition to a strong commitment to basic research, Germany has institutionalized investment in intermediaries such as the Fraunhofer Institutes and AiF (German Federation of Industrial Research Associations), which conduct applied research to aid companies cross the Valley of Death. Concerns however, have arisen over the automotive industry's ability to modernize considering the dominance of large corporate actors in research networks and the resulting technological lock-in in the ICE technological paradigm. Despite its status as an important player in environmental policies, the relevance and power of the automotive sector have also created strong resistance to limiting CO2 emissions from cars. Notwithstanding, policies encompassed in the recently introduced High-Tech Strategy (HTS) have the potential to address the technological lock in the automotive industry. Weyner (2013) argues that the HTS extends research policy to an integrated and coordinated industrial policy geared towards competitiveness

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and innovation. It is committed to increasing subsidies to research and demonstration projects aligned with missions such as mobility and climate change, which are particularly relevant to the automotive industry. Novel initiatives are also shaped by ongoing processes of regionalization prompted by EU integration and attempts to reform German federalism by increasing the scope for sub-national autonomous political action.

The German federal and state governments have adopted a smart specialization approach and promoted regional public-private initiatives including clusters to strengthen multilevel networks within and across sectors. Automotive-related projects are also part of federal level comprehensive strategies to advance green growth and catch up to competitors including the National Electromobility Development Plan and the 6th Energy Research Program. In other words, the federal government develops macro-frameworks for the promotion of specific missions. Simultaneously, there are state level thematic strategies under which public officials mobilize and coordinate regional actors to establish cross-sectoral demonstration and R&D projects as well as compete for federal and EU funds. Consequently, local governments in Germany (as in many other Western European countries) have become increasingly involved in developing networks and new relationships with business interests. There has also been an emphasis on promoting science-industry collaboration across the board, which has brought about relatively novel roles for German universities governed by the Länder. Even though German federalism is described as consensus driven, these relatively novel collaborative initiatives stimulate interregional competition and make intergovernmental cooperation more conflict ridden (Staehler et al. 2007, Eickelpasch & Fritsch 2005). Despite the large R&D effort, production subsidies and consumer incentives for EVs have been limited. This reflects a generally less interventionist position of German governments, but it may also be due to more pragmatic reasons since German carmakers have no electric vehicles on offer and a purchase subsidy would use German taxpayers' money to buy almost exclusively French and Japanese cars. The National Electromobility Development plan has continuously underlined the relevance of financial incentives, especially in the 2014-17 market ramp up phase and considering the goal of 1 million EV vehicles by 2020.

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Spain

The Spanish government has not shied away from intervention in the automotive industry in the past decade. In comparison to other peripheral regions, Spain has experienced changes in its institutional environment conducive to the presence of high-value added automotive operations. Overall, industrial policies in Spain have had a strong territorial and sectoral orientation as well as an emphasis on facilitating science-industry-public sector collaboration, despite the lack of strong non-market coordination mechanisms. In 2009, Spain introduced the Comprehensive Plan for the Automotive Industry (PIA) that supports automotive manufacturers both through a scrappage program and a Competitiveness Plan aimed at the modernization and adoption of advanced production systems, the industrialization of new products and processes – including Green Vehicles- as well as the training of new staff. Furthermore, in contrast to its US and German counterparts, the Spanish government advanced an explicit industrial policy strategy characterized by a combination of horizontal and sectoral

policy measures in late 2010. The strategy identifies the automotive industry as key to the Spanish economy and allocates substantial funds to continue the redefinition of the automotive industry. Another key element of the auto industry development in Spain are the nationally and regionally funded automotive clusters in various regions of Spain aimed at promoting cooperation, project development and joint ventures across actors from related sectors. Overall, during the last decade Spain has done much to develop its regional innovation systems and European Union funding has been essential to this process.

Conclusion

In conclusion, the research findings presented in this report shed new light on the automotive policies of some of Canada's leading competitors. Automotive policies are responding to the increasing internationalization and agglomeration of economic activities, as well as the emergence and diffusion of radical new enabling technologies, which are driving an industrial revolution in manufacturing. Within this context, the internal innovation capacities of automotive firms need to be complemented by strategic R&D alliances or new forms of inter-sectoral and interdisciplinary co-operation between public and private research institutions. Given unique country historical institutional and economic trajectories, there are shared and distinct challenges as well as approaches to modernizing the automotive industry. Germany, Spain and the US engage in systematic efforts to enhance coordination and create more innovation-based manufacturing platforms in new and emerging technologies across a range of actors. The complex and networked character of recent public policies and firm organization also reflect emergent and hybrid institutional arrangements. Mexico has taken a more trade-focused approach that seeks to capitalize on its lower labor costs and export platforms, but has begun to establish public private partnerships that build on regional assets in attempts to boost industry competitiveness.

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