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Supporting Industry Promotion Policies in APEC – Case Study on Mexico

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Prepared by:
Christopher Wood
Senior Research Analyst, Washington Core

Produced for:
Asia-Pacific Economic Cooperation Policy Support Unit
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 6891-9600 Fax: (65) 6891-9690
Email: psugroup@apec.org Website: www.apec.org

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EXECUTIVE SUMMARY

Global manufacturing value chains are a key driver of economic development and growth in the APEC region. Developing economies often begin their participation in these chains through “supporting industries,” which is to say firms that provide needed goods and services that facilitate the operation of local manufacturing operations by large multinational corporations (MNC).

Supporting industries are primarily composed of micro, small and medium enterprises (MSMEs) which are major contributors to employment and economic growth in APEC economies. By strengthening supporting industries, economies can encourage greater local investment from MNCs, and help local MSMEs to advance up the value chain to increase the value of manufacturing production retained by the local economy.

As part of the APEC project “Supporting Industry Promotion Policies in APEC,” this paper presents a review of manufacturing activity and corresponding government promotion efforts in Mexico to identify potential best practices for enhancing supporting industries in APEC economies. This effort will inform ongoing efforts by APEC to increase MSME participation in manufacturing global value chains (GVC). Mexico was selected as a case study to provide an example of an upper-middle income economy that has had success growing manufacturing in multiple complementary high-tech industries such as aerospace, automotive, and electronics (The World Bank (c), n.d.).

Supporting industries are valuable to an economy as components of a value chain that serve as “infrastructure” to support other industrial activities. Nguyen (2007) builds on the topic and splits supporting industry activities into three possible scopes. The “core scope” of supporting industry includes providers of intermediate goods (supplier within the “tier” classifications) and capital goods (tools, not including machines). “Broad scope 1” includes production services such as logistics, storage, distribution and insurance, while the wider “Broad scope 2” includes providers of machines and raw materials (Nguyen 2007, p.37). This study focuses on the core scope, which coincides most closely with the priorities of Mexican government efforts to promote supporting industry.

MSMEs, or firms with 250 or fewer employees, comprise 99.8% of all firms in Mexico, and account for 71.9% of the labor force and 52% of GDP. However, MSMEs in Mexico only account for 53.6% of value-added in manufacturing, which suggests that many MSMEs are primarily engaged in low value-added, labor intensive activities, as this share of value-added contributed by MSMEs is lower than all other OECD economies (Potter and Marchese 2013, p.188).

Mexico’s participation in many free trade agreements (FTA), proximity to the second largest export market in the world (the United States, second to the European Union), and low energy costs have made Mexico attractive as a base for manufacturing exports (Deloitte 2016, p.55). As competition has increased from other economies with lower wages, Mexico has focused increasingly on enhancing productivity and participation in higher value-added activities in strategic manufacturing sectors such as the aforementioned aerospace, automotive, and electronics (Secretaría de Economía (b), n.d., p.10). Recently, the combination of rising wages in China, the falling value of the peso, and improved productivity in Mexico have served to make the current cost of manufacturing in Mexico one of the lowest among large manufacturing-intensive economies (Deloitte 2016, p.55).

Within MNC value chains in Mexico, MSMEs typically participate as Tier 2 or 3 providers of basic intermediate parts or services to an original equipment manufacturer (OEM) or Tier 1 supplier. Despite the large influx of foreign direct investment (FDI) in MNC manufacturing operations in Mexico, local supplier participation in higher value-added activities has been modest, due to limitations in their skills and certifications, production capacity, and access to capital; as well as the tendency of OEMs and Tier 1s to import parts from already trusted overseas suppliers (Kraus 2014, p.44).

The Mexican government is interested in supporting MSMEs due to their large contribution to national GDP and employment, but also for the "infrastructure" that they form as supporting industries to MNCs, creating effective value chains to attract further FDI and support economic development. The government has prioritized industrial and commercial innovation policies to increase the productivity of mature sectors and to encourage the development of competitive and dynamic MSMEs and entrepreneurs (ProMexico 2016c, p.7). Government innovation support programs for MSMEs typically take the form of financing, skills development, R&D/technical support, business facilitation, and trade promotion. A few federal program examples follow below:

- **Financing:** The most comprehensive scheme is the SME Fund, administered by the Ministry of the Economy. The fund provides grants/incentives for projects, industrial infrastructure, and feasibility studies. The fund also provides training and consultancy services to increase MSME competitiveness and encourage their integration into larger value chains (World Bank 2010a, p.83).
- **Skills development:** The federal government encourages skills development in MSME manufacturers through a mixture of targeted grants/incentives, the provision of services and facilities, and fostering collaboration with OEMs. For example, the National System of Business Incubators provides MSMEs with opportunities for quality certification of their products, which can be restrictively expensive for small firms, as well as access to sophisticated technologies.

State governments participate in partnerships with federal agencies to administer funds and allocate their own resources towards MSME development and manufacturing support. For example, the Queretaro state government administers the Employment Promotion Trust to foster the development, productivity, competitiveness, productive investment and sustainability of MSMEs (Sistema Nacional de Programas de Combate a la Pobreza n.d.).

Mexico's experience demonstrates that collaboration amongst manufacturing ecosystem stakeholders is essential to sustain manufacturing growth, as the capabilities of MSMEs must be developed to match the production needs of MNCs (ProMexico 2016c, p.12). For example, the support of academic institutions is critical to produce enough qualified human capital. This occurs through programs such as the Industrial Design degree at Universidad Nacional Autónoma de México (UNAM), and the Aerospace Engineering and Aerospace manufacturing professional concentrations at Tecnológico de Monterrey (Tecnológico de Monterrey, n.d.)(Universidad Nacional Autónoma de México n.d.).

Industry support is important for opening doors for MSMEs to enter MNCs' value chains. Business facilitation programs such as the Transnational Company Alliances (ACT) Model and the Supplier Development Program help connect MSMEs with opportunities by identifying the intermediate products that the MNCs are currently importing, assessing the availability of qualified certified domestic suppliers, and matchmaking when possible. Furthermore, in cases where the current availability of qualified domestic suppliers is deemed insufficient to meet expected demand from MNCs, the program advises on steps to take to improve domestic capacity (ProMexico 2016c, p.24).

Based on the above characteristics of Mexico's manufacturing ecosystem, this report advises adopting and developing the following types of programs as key components of a successful strategy for developing competitive supporting industries and attracting MNC FDI:

- Government funding for MSMEs in supporting industries is seemingly best delivered through loan guarantees to increase access to credit, and targeted programs that allocate funds for innovative projects and sophisticated technology and services. Programs that require MSMEs to spend grants/incentives on high technology services or propose innovative projects to receive funds ensure that government resources are allocated efficiently to innovative, value-added projects.
- Certification support that can provide the evidence that MNCs and sophisticated global industries require of the quality and capabilities of Mexican manufacturing firms, especially in

- industries with safety and security concerns like aerospace, automobiles and electronics
- Business matchmaking/demand forecasting efforts like the ACT Model that can enable the government to anticipate the current and future needs of MNCs, and can match qualified, certified MSMEs with MNCs seeking their services

At the same time, noting that some Mexican MSMEs have expressed concerns about the usefulness of government programs, it is important to ensure that all government programs to promote supporting industry should be easily accessible to users and reflect that the needs of MSMEs vary across sectors (EY 2013, p.15) (INEGI 2016a).

The success of manufacturing in Mexico has benefitted greatly from a collaborative effort, and economies that can bring government, industry and academia together to pursue supplier development programs will be well poised to create an attractive environment for increasing the scope of MNC manufacturing activities and business opportunities for MSMEs.

1. ECONOMY PROFILE OF MEXICO

Mexico is the second largest economy in Latin America and has been growing steadily. In 2015, the gross domestic product (GDP) of Mexico was US\$1.144 trillion,¹ with a per capita GDP of US\$9,431. GDP growth rates for 2013, 2014 and 2015 were 1.36%, 2.25% and 2.46% respectively (The World Bank, n.d.). The growth rate is projected to reach 2.785% in 2017 and 2.96% in 2018, boosted by structural reforms and depreciation of the peso (The World Bank, n.d.).

Mexico is the 12th largest export economy in the world, exporting about US\$380 billion in 2015 (World Integrated Trade Solution, n.d.). Major exports of Mexico are shown in the Table 1:

Table 1: Mexico's manufacturing export values in 2016

Type of product	2016 Exports (US\$ millions)
Automobile parts (INEGI 2016b)	\$113,316.000
Electronics (INEGI 2016b)	\$71,754.000
Mechanical apparatuses, boilers and their parts (Ch. 84)	\$61,687.368
Combustible minerals and their products (Ch. 27- oil)	\$18,041.739
Fruits (Ch. 8)	\$5,540.525
Steel and Iron products (Ch. 73)	\$5,356.298
Beverages and vinegar (Ch., 22)	\$4,499.131
Metalliferous minerals (Ch. 26)	\$3,816.190
Trains, rail and their parts (Ch. 86)	\$3,126.298
Rubber and rubber products (Ch. 40) ²	\$2,505.728

Source: INEGI and email correspondence with Secretaría de Economía

The top destinations of Mexican exports as of 2014 are the U.S. (US\$291.6B), Canada (US\$24.5B), China (US\$7.89B), Spain (US\$6.18B) and Brazil (US\$5.35B). The top origins of imports into Mexico are the U.S. (US\$194B), China (US\$58.7B), Japan (US\$15.8B), Korea (US\$13.4B) and Germany (US\$12.8B) (MIT Media Lab, n.d.).

This robust volume of trade is fueled by Mexico's participation in a number of FTAs and related partnerships that reduce trade barriers. (ProMexico 2016a, p.58). For example, exports of goods to the U.S. have grown rapidly since the North American Free Trade Agreement (NAFTA) went into force in 1994, rising from US\$39.9 billion in 1993 to US\$294.7 billion in 2015 (Villarreal 2016, p.2).

In recent years, economic activity in Mexico has been resilient to low oil prices, weak world trade growth and monetary policy tightening in the U.S, due to strong domestic demand supported by structural reforms that have cut prices to consumers. However, growth in 2017-2018 may be challenged due to lower investment and consumer confidence, stemming from uncertainties about current global sentiment toward FTAs. Banco de Mexico has tightened macroeconomic policy to counter inflationary pressures in response to these uncertainties (OECD 2016, p.205). Issues of crime, corruption and structural reform implementation also hinder growth and are being discussed extensively as Mexico's 2018 general election approaches (The Economist Intelligence Unit, n.d.).

Manufacturing is a key driver of economic growth in Mexico. The total value of Mexican manufacturing production in 2014 was US\$834,719 million, up from US\$818,210 million in 2013 (INEGI 2016a).³

¹ In this report, in cases where original sources provide amounts in Mexican pesos, these amounts are converted to US\$ by using the U.S. Internal Revenue Service (IRS) yearly average currency exchange rate table.

² These chapters refer to the "El Sistema Armonizado de Designación y Codificación de Mercancías" used by INEGI to document exports.

³ Gross production data comes from: Cuentas nacionales > Producto interno bruto trimestral, base 2008 > Valores a precios corrientes > Actividades secundarias > 31-33 Industrias manufactureras

Mexico’s daily exports are valued at nearly US\$1 billion, nearly 70% of which are manufactured goods. In 2015 the total value of Mexico’s exports of goods and services was estimated at US\$380 billion, equivalent to about one-third of GDP. Out of this, 84% was exported to the U.S (Secretaría de Economía). As of 2015, the manufacturing value-added sector of Mexico’s economy accounted for 16.8% of GDP, down from 17.3% in 2006 (Stratfor, 2015).

Average output growth in the manufacturing sector in Mexico was 2.53% between 1994 and 2016. Mexico’s manufacturing sector is expected to experience about 3.5% compounded annual growth between 2015 and 2034 (Deloitte 2015, p.9). Growth is largely driven by the automotive industry, which also drives growth in supporting industries such as rubbers, plastics and fabricated metals (MAPI 2015). Strong automotive and aerospace production growth rates are both expected to continue for the next several years (Stratfor, 2015). Electronics manufacturing is also expected to grow significantly as productivity gains and a depreciating peso have offset rising wages (Deloitte 2015, p.12). Another factor likely to boost manufacturing growth is that the growth of household incomes above US\$35,000 in Latin America is expected to at least double between 2014 and 2030, creating more demand for high-value manufactured goods from Mexico (Deloitte 2015, p.22).

Table 2: Gross production by industry sector 2016

Industry	2016 Gross production (US\$ millions)
Food Manufacturing	\$158,633
Auto Parts Manufacturing	\$41,343
Chemical Manufacturing	\$63,516
Petroleum and Coal Products	\$23,240
Primary Metal Manufacturing	\$38,855
Computer and Electronic Manufacturing	\$10,000
Aerospace Manufacturing	\$5,088

Source: INEGI 2016a⁴ and email correspondence with Secretaría de Economía

⁴ Gross production data comes from: Cuentas nacionales > Producto interno bruto trimestral, base 2008 > Valores a precios corrientes > Actividades secundarias > 31-33 Industrias manufactureras

2. OVERVIEW OF GLOBAL MANUFACTURING SUPPLY CHAIN ACTIVITY IN MEXICO

2.1 Appeal of Mexico as a manufacturing location

Mexico is an attractive destination for manufacturers due to a number of policies and circumstances that allow for the cheap importation of inputs, access to a significant share of the world's export markets, and a cost-effective and flexible labor force. Trade facilitation policies such as special economic zones (SEZs) and import duty suspension schemes allow for inputs to flow freely into the economy, while a multitude of trade agreements allow final products to be exported with preferential treatment to many economies, which become increasingly attractive given the peso/dollar exchange rate.

Mexico placed eighth in the Deloitte 2016 Manufacturing Competitiveness Index, with an index score of 72.9 out of 100. The 2020 projected index scores show Mexico rising to the 7th position with a score of 75.9, surpassing both Chinese Taipei and the UK (Deloitte 2016, p.4). The most commonly cited factors making Mexico a competitive manufacturing destination are low labor costs (as little as 1/6 of the U.S and Canada and recently about 20% lower than China), proximity to the U.S. and Canadian markets, and liberal trade policies. Additionally, Mexico is attractive to manufacturers due to low energy costs, as Mexico pays U.S. prices for natural gas, which are currently very low. Industrial gas prices in Mexico are 63% lower than in China, while electricity costs are 4% lower (Deloitte 2016, p.55).

Mexico's competitiveness is expected to increase due to a series of labor, legal, energy, economic and political structural reform. Regulatory reform is directed by the Committee for Regulatory Improvement (COFEMER), which examines process and cost issues concerning business activities such as opening a firm, registering a property, and complying with regulations (Comisión Federal de Mejora Regulatoria 2016, p.2). The strategic objectives laid out by COFEMER in its 2017-2018 policy document include reducing regulatory costs, increasing the ease of doing business, preventing corruption and digitizing export procedures.

Additionally, the agency is seeking to identify certain regulatory measures that could be created, modified or deleted and updating the Federal Registry for [regulatory] Procedures and Services, which groups all federal regulatory procedures in a single location, classified by administrative unit. Since its establishment 16 years ago, COFEMER has analyzed 18,000 regulations, 31,000 federal regulatory procedures, generating over \$4 billion in investment and creating 359,000 firms and 945,000 jobs (Comisión Federal de Mejora Regulatoria 2016).

A recently introduced bill, the Productivity Law, is focused on bridging the existing productivity gap, which is especially high in manufacturing. By one measure, Mexican firms are only 24% as productive as U.S. firms (OECD 2013, cover). The law aims to support technological innovation, entrepreneurship and MSMEs, particularly in the manufacturing sector (Cámara De Diputados, p.5). This legislation encourages coordination between the public, private and social sectors in the National Committee of Productivity to increase investment, strengthen supply chains, support MSMEs and increase the technological and value-added content in the national economy (El Economista 2015).

The continuing synchronization between Mexico's different manufacturing clusters, including automotive, electronics, and transportation equipment, is another key to rising competitiveness, as supply chains become more integrated and complementary production capabilities can be harnessed for multiple types of products (Deloitte 2016, p.56).

There are some factors however which could weigh on Mexico's manufacturing competitiveness. Most significantly, there is a limited base of qualified suppliers to support more robust high-value added

manufacturing operations for MNCs, leading MNCs to take the inefficient approach of relying heavily on imported parts. In 2014, Mexico received a 3.13 on the Logistics Performance Index by Deloitte, which measures the ground efficiency of the supply trade chains, while China received a 3.53 and the U.S a 3.92 (Deloitte 2016, p.56).

A contributing factor to the MNCs' reliance on imported parts is that, according to OECD, the education level of the Mexican workforce is below OECD average, due to an educational system that does not adequately provide students with required skills and thus leads to high rates of dropping out in higher education (Deloitte 2016, p.56). Although labor productivity is improving, it has not yet caught up with advanced manufacturing economies such as the U.S., Japan and Germany (Deloitte 2016, p.56).

Free trade agreements

Mexico has a vast network of trade facilitation arrangements with various economies, including 12 FTAs, 32 Reciprocal Investment Promotion and Protection Agreements (RIPPAs), and nine trade agreements within the framework of the Latin American Integration Association (ALADI). Additionally, Mexico is a member of the proposed Trans-Pacific Partnership (TPP).

These agreements allow Mexican goods preferential access to the markets of 46 economies accounting for 60% of the world economy and make Mexico a competitive base for manufacturing exports (ProMexico 2016a, p.58). They have also exempted many manufacturers in Mexico from import duties that were previously 15-20%, allowing inputs and materials to flow freely into the economy (ProMexico 2016a, p.15).

For example, NAFTA has significantly liberalized trade between Mexico, the U.S. and Canada. NAFTA is very important to Mexico's economy, given Mexico's proximity to the U.S. and Canadian markets as well as the size and sophistication of both economies as potential partners, suppliers and customers. This is evident in the over 600% increase in exports from Mexico to both the U.S. and Canada between 1994 and 2015 (MIT Media Lab 2014).

NAFTA plays a key role in enabling automotive exports from Mexico to the U.S. Between 1995 and 2015, the share of Mexican vehicles as imports to the U.S. rose from 10% to 26%. In the same period, the Mexico's share of auto parts imported by the U.S. rose from 23% to 35%, surpassing both Japan and Canada to become the U.S.'s main source for auto parts. Both the aerospace and electronics industries are also enjoying competitive advantages from NAFTA.

Another important FTA is the Economic Partnership, Political Coordination and Cooperation Agreement (the Global Agreement), which entered into force between Mexico and the EU in 1997. In a 2011 study, Copenhagen Economics, an economic consulting firm, found that this agreement had increased EU imports of Mexican products by up to 92% (Bergstrand et al. 2011, p.10). Around 8% of Mexico's total trade took place with the EU in 2015, making it Mexico's second largest trading partner (European Commission, n.d.).

Mexico is also a member of the Pacific Alliance, a regional integration initiative formed by Chile, Columbia, Mexico, and Peru in 2011. Mexico accounts for much of the economic strength of the group, representing 70% of the Alliance's combined exports (Villarreal 2016, p.9). In 2014, Mexico exported 2.39% of its total export value to Pacific Alliance member economies (MIT Media Lab 2014).

A caveat to Mexico's advantages regarding trade policy is its dependency on sustained support for free trade in developed economies. Recent anti-globalization sentiments and calls for protectionist trade measures have resulted in uncertainty over the future of Mexico's manufacturing sector, as tariffs on Mexico's products could make the economy a less attractive destination for manufacturing.

Favorable legal environment

Mexico recently placed 47th on the Ease of Doing Business ranking from the World Bank, ranking above its Latin American counterparts (The World Bank (d), p.7). Mexico has shown consistent growth in this ranking as it increases collaboration between federal, state and local authorities to accelerate regulatory reform (The World Bank (d), p.28). For example, simplification of the permitting process for construction has allowed manufacturing firms to construct facilities more rapidly by permitting the expedition of projects under a certain square-meter limit (Comisión Federal de Mejora Regulatoria 2012, p.54). In 2011 Tier 1 aerospace supplier Fokker Aerostructures completed a 75,000 square-foot factory on a greenfield site in six months, much faster than would have been possible for Fokker in Europe (Mecham, 2013).

The Mexican government has also implemented favorable trade policies, such as reducing or eliminating various import duties. In 2014, the Mexican government lowered the average tariff on all imports from 13% to 7.5% (ProMexico 2016b, p.90). According to the World Trade Organization, Mexico's Most-Favored Nation (MFN) tariff is 7.1% in 2015, which is lower than other developing economies such as Brazil, China, and India (respectively 13.5%, 9.9%, and 13.4 % all in 2015) (World Trade Organization, n.d.).

Other important trade facilitation efforts include the Law for the Support of the Manufacturing Industry and Export Services (IMMEX- suspension of value-added tax [VAT] duties), Draw Back (recovery of taxes paid on importing inputs) and a Ministry of Economy program for tariff simplification to bring tariffs in line with important trading partners, especially the U.S. (ProMexico 2014b, p.19). The government does not impose any "local partner" rules to limit foreign ownership of manufacturing operations; instead the "maquiladora" factory system allows foreign companies to control 100% of their businesses (Mecham, 2013). Mexico has also signed a number of treaties regarding the enforcement of Intellectual Property (IP) rights and is a member of the World Intellectual Property Organization (EY 2014, p.39).

Cost-effective and flexible labor force

Another key appeal of Mexico as a manufacturing location is competitive costs. Since the mid-1990s multinational manufacturers from North America, EU and Asia have sought to take advantage of Mexico's cost-effective labor force (Secretaría de Economía, p.11). Due to rising wages in China and the devaluation of the peso, average manufacturing labor costs in Mexico are currently almost 20% lower than in China, a reversal of the situation in 2000, when Mexico's labor costs were 58% more expensive (Stratfor, 2015).

Manufacturing costs savings are evident in the selected industries as well. In the automotive industry, for example, manufacturing costs in Mexico are lower than the U.S. by 12.3% for auto parts, 16.3% for metal components, 9.8% for precision components and 15.2% for plastic supplies (ProMexico 2016b, p.90).

Production capacity in Mexico is also highly flexible, allowing for the production of a wide range of models and fast adaptation to changing consumer demand (PwC Mexico 2014, p.15). Continuing with auto parts, supply chains are well developed and there is a sufficient supply of skilled labor to staff them. Although not without its critics, Mexico's university system, with 2.7 million students in around 4,000 universities, is internationally competitive and increasing its cooperation with the private sector to suit industries' needs (ProMexico 2016b, p.94). Universidad Nacional Autónoma de México (UNAM) and Tecnológico de Monterrey (ITESM) ranked 4th and 7th respectively in the QS Top University Ranking in Latin America for 2016 (Quacquarelli Symonds, 2016).

Economic stability and mature infrastructure

Mexico's low foreign exchange rate makes it an attractive economy to produce and export from, and recent devaluations in the peso against the dollar have further lowered the costs of manufacturing in Mexico (Spoon 2015). Mexico is currently in a projected period of economic stability and tax certainty, due to the Fiscal Certainty Agreement in 2014, which promised not to propose new taxes or eliminate existing tax benefits until November 2018 (PwC, 2016 and PwC Mexico 2014, p.15).

Mexico also features the communications, highway, rail and port infrastructure to support a robust manufacturing sector, linking clusters to each other and to the U.S, Guatemala, Belize, the Pacific and the Caribbean. The growth of the IT and electronics industries in Mexico also supports increasingly sophisticated manufacturing production in other industries such as automobiles. For example, as the number of cars with network connectivity rises, the value of electronic components as a percentage of the total value of cars is expected to rise from 30% to 50% by 2030 (Automotive High-Tech Cluster Mexico n.d., p.4 and PwC 2013, p.12).

2.2 Key industry and geographic concentrations

Since the early 2000s, Mexico has faced intense competition from other economies for low-cost manufacturing. Mexico has responded by focusing more on higher value-added manufacturing sectors such as automotive, electronics, and most recently aerospace products. From 2002 to 2012, dramatic NAFTA-fueled increases in the values of Mexico's automotive exports (\$27.9 billion to \$70.3 billion) and electronic exports (\$43.3 billion to \$74.9 billion) have more than offset a large decline in clothing exports (Stratfor, 2015). Recently, the huge automotive sector has experienced steady double-digit export growth every year since 2010 (Stratfor, 2015). Although much smaller, Mexico's aerospace industry has grown even faster, increasing exports about 20% from US\$2,977.4 million in 2013 to US\$3,544.1 million in 2016 (The International Trade Administration, 2016a). These export oriented and high-end manufacturing sectors cluster in northern Mexico (in states such as Baja California, Chihuahua, Nuevo Leon and Tamaulipas) due to proximity to the U.S. market (Stratfor, 2015).

Basic profiles and characteristics of the aerospace, automotive, and electronics industries are provided below.

2.2.1 Characteristics of aerospace industry in Mexico

Although still only a small fraction of the size of the automotive and electronics industries in Mexico, aerospace manufacturing has grown rapidly since its start in the mid-2000s, owing to concerted government support and experience with synergistic industries like automotive. The production value of the Mexican aerospace industry is expected to reach US\$3,895.2 million in 2016, increasing 7.9% from US\$3,610.4 million in 2013 (ProMexico 2016a, p.3).

Table 3: Profile of aerospace industry in Mexico

Production value (2015)	\$5,556 million ¹
Export value (2014)	\$6,363 million ²
Key products	Electrical cable accessories, fuselage, engine, propellers, interior equipment ³
Number of facilities	310 ⁴
Number of employees	24,917 ⁵
Key states	Baja California, Chihuahua, Nuevo Leon, Queretaro, Sonora ⁶
Major MNC OEMs and Tier I Suppliers	Aernnova (Spain), Bombardier (Canada), Embraer (Brazil), Fokker (Netherlands), General Electric (U.S.), General Dynamics (U.S.), Gulfstream (U.S.), Honeywell (U.S.), Safran (France), Textron (U.S.) ⁷
Mexican MSME examples	Soisa (interior production), Altaser (turbine components production) ⁸
MSMEs key roles	Design and fabrication of basic parts and components, such as screws, glass panes, and seat covers ⁹

Source: 1 & 5) INEGI- Banco de Informacion Economica, 2) ProMexico 2016e, 3) Brown-Grossman, Flor and Domínguez-Villalobos, Lilia 2012, 4) The International Trade Administration 2016, 6) PwC 2015, 7) Deloitte 2015, 8) Interview with Chihuahua Aerospace Cluster, 9) Secretaría de Economía 2012, p.18

The Mexican aerospace industry started out manufacturing basic components, small parts and harnesses and continues to focus heavily on such items, but now has the capacity to produce engines, cockpit parts, wings, composite airframes, turbines and landing systems (The International Trade Administration, 2016a). Table 4 below breaks down production amounts by value, illustrating the diversified production mix in the Mexican aerospace industry.

Table 4: Mexico aerospace product production mix

Product	Percentage of total production value
Electrical cable accessories and harnesses	20%
Aerostructure components fuselage	14%
Aeroengine and aerostructure subassemblies	14%
Raw material supply and material manufacture	12%
Propellers/rotors	10%
Standard parts	8%
Avionics	6%
Aircraft interiors equipment furnishings	6%
Hydraulic systems and equipment	6%
Safety and survival equipment	4%

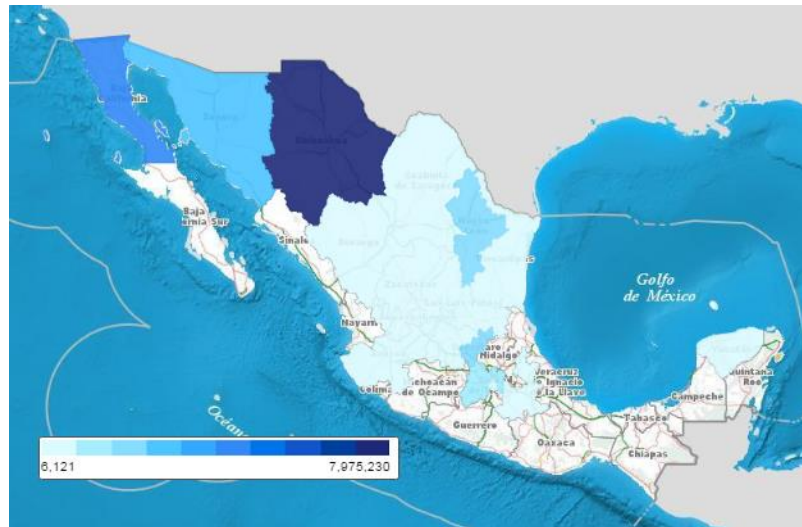
Source: Brown-Grossman and Domínguez-Villalobos 2012, p.12

Using some examples as illustration, Bombardier’s Mexico operations produce large metallic and composite structures (fuselage), as well as electrical harnesses for commercial aircraft (ProMexico 2016a, p.120). Safran Group manufactures plane cables for Boeing and Airbus, motor and engine parts and landing gear, alongside two maintenance, repair, and operations centers (ProMexico 2016a, p.122).

Currently 79% of firms in the aerospace sector in Mexico are involved in manufacturing, 11% in maintenance, repair, and overhaul (MRO) activities and the remaining 10% in research and development (ProMexico 2014b, p.17). In the long term, the ultimate goal of key players in Mexico is the production of finished commercial aircraft (PwC 2015, p.5). All the major Mexican aerospace clusters are all focused on enhancing and diversifying their capabilities. The Chihuahua Aerospace Cluster is currently working on expanding its MRO activities to meet rising global demand, and is developing an R&D technology park, aircraft painting, and demolition/recycling facilities, with plans to create a final assembly plant (ProMexico 2016a, p.58). These expansions seek to provide a full

complement of goods and services across the whole life-cycle of the aircraft, making the cluster a convenient location for MNCs.

Figure 1: Areas of aerospace manufacturing concentration



Note: The darker areas indicate a higher value of aerospace production.
Source: INEGI, 2014

The map above shows that the aerospace industry in Mexico is concentrated primarily in the states of Baja California, Chihuahua, Nuevo Leon, Queretaro, and Sonora. Examples of prominent MNCs include Gulfstream and Honeywell in Baja California, Cessna and Fokker in Chihuahua, and Bombardier and GE Aviation in Queretaro (ProMexico 2013, pp.53-64, MFG n.d., company websites).

The U.S. is the destination of the majority of exports from these states. Other exports go to Canada, England, France and Germany, among other economies (ProMexico 2013, p.54). Facing strong competition for the U.S. market from the other states located closer to the border, Querétaro is attempting to diversify and increase exports to Europe (Lyla et al. 2015, p.19).

2.2.2 Characteristics of automotive industry in Mexico

The automotive manufacturing sector has long been Mexico's largest by value of production. Mexico's terminal (final assembly) and auto parts industry represented 3% of total GDP and 18% of manufacturing GDP in 2015 (ProMexico 2016b, p.45). The automobile sector accounted for 27% of Mexico's exports in terms of value. Mexico's automotive industry trade balance in 2015 reached a surplus \$52,503 million, up from \$26,911 million in 2010, nearly a 100% increase (INEGI and AMIA 2016, p.26).

Mexico is the 7th largest producer of automobiles in the world, and in 2015 produced 3.6 million light vehicles and exported 2.9 million. Heavy vehicle production reached 191,000 in 2015, making Mexico the world's 5th largest producer in this niche (ProMexico 2016b, p.49). Other key industry characteristics are shown in Table 5 below.

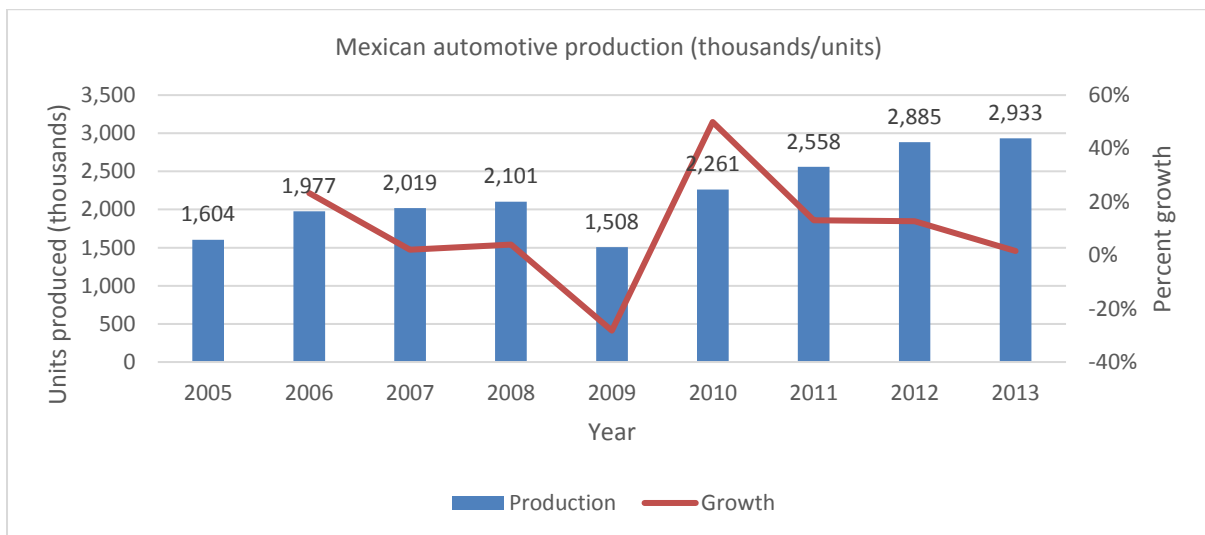
Table 5: Profile of auto parts industry in Mexico

Production value (2016)	\$41,343 million ¹
Export value (2016)	\$113,316 million ¹
Key products	Light vehicles, Heavy vehicles, auto-parts (examples: seats, engine parts, break systems, axles, electrical components, stamping and fuel systems) ²
Number of facilities	Over 2,500 ³
Number of employees	687,543 ¹
Key states	Coahuila, Estado de México, Guanajuato, Nuevo León, Puebla, Sonora ⁴
Major MNC Tier I Suppliers include	Bosch, Dacomsa, Delphi, Denso, Faurecia, Hitachi, Jatco, Magna, Michelin, Nemak, TRW ⁵
MSMEs key roles	Stamping, forging, machining, pressure injection, smelting, plastic injection ⁶

Source: 1) INEGI Banco de Informacion Economica, 2) ProMexico 2015b, p.102, 3) ProMexico 2015, p.20, 4) ProMexico 2016b, p. 62, 5) ProMexico 2016b, p.98, 6) ProMexico 2016b, p.46

Figure 2 below shows steady growth in automotive production in Mexico, rising by 82.9% between 2005 and 2013.

Figure 2: Mexico Auto Production Growth

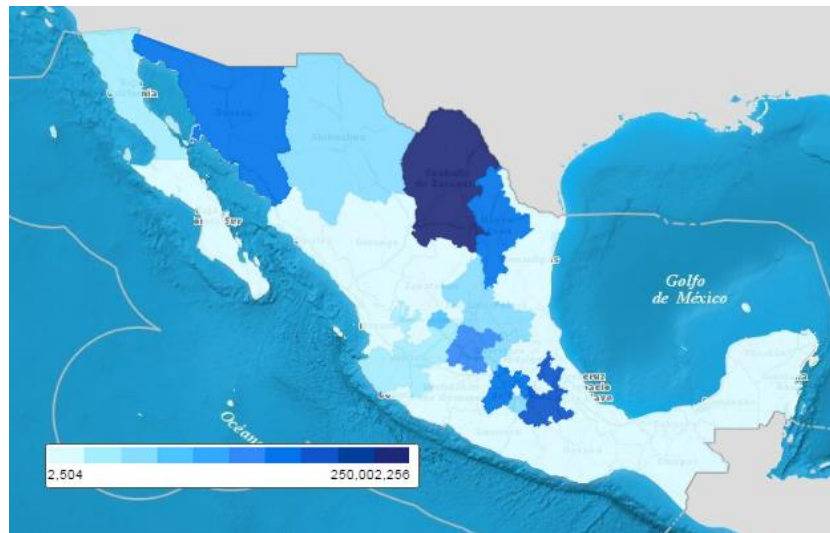


Source: (PwC Mexico 2014, p.2)

Automotive manufacturing in Mexico encompasses all activities across the automotive supply chain, from basic component manufacturing to final assembly of vehicles and engines. There are 20 light vehicle production complexes in 14 Mexican states, where armor-plating, die-casting and stamping to final assembly occur (ProMexico 2016b, p.46). Sophisticated design activities are also located in Mexico, with 30 auto design centers located throughout the economy (ProMexico 2016b, p.48).

The heavy vehicle industry is engaged primarily in the stamping, assembly and production of bodywork, with 10 heavy vehicle and two engine production facilities located in eight Mexican states (ProMexico 2016b, p.49).

Figure 3: Map of automotive manufacturing concentration by total gross production



Note: The darker areas indicate a higher concentration of production value.

Source: INEGI, 2014

As the map above shows, major automotive manufacturers are concentrated in the states of Chihuahua, Coahuila, Estado de México, Guanajuato, Nuevo León, Puebla, and Sonora. Examples of prominent MNCs include Ford in Chihuahua, Fiat-Chrysler and General Motors (GM) in Coahuila, BMW and Volvo in Estado de México, Honda and Mazda in Guanajuato, Kia and Mercedes-Benz in Nuevo León, and Audi and Volkswagen in Puebla (Company websites).

North America is the primary destination for exports by a large margin, but exports to other Latin American economies have been rising by volume. Exports to Argentina and Chile increased the most in 2015, posting annual growth of 53.2% and 41.0% respectively (ProMexico 2016b, p.53). Table 6 below provides a breakdown of light vehicle exports for 2015.

Table 6: Destinations of Mexican light vehicle exports

Destination	Units 2015	Share of total light vehicle exports
U.S.	2,283,502	82.7%
Canada	290,430	10.5%
Latin America	225,538	8.2%
Europe	145,263	5.3%
Asia	79,902	2.9%
Africa	2,319	0.1%
Other	22,372	0.8%
TOTAL	2,758,896	100%

Source: ProMexico 2016b, p.54

2.2.3 Characteristics of electronics industry in Mexico

After the automotive sector, electronics is one of Mexico's largest manufacturing sectors, representing 3.2% of GDP as of 2015 (INEGI Banco de Informacion Economica). Production is forecasted to reach \$73.5 billion in 2017, increasing 36.1% from \$54.0 billion in 2010 (Centro de Reflexión y Acción Laboral 2015, p.7). Mexico was the world's top exporter of flat screen television sets and the fourth largest exporter of computers, microphones, speakers and headphones as of 2014.

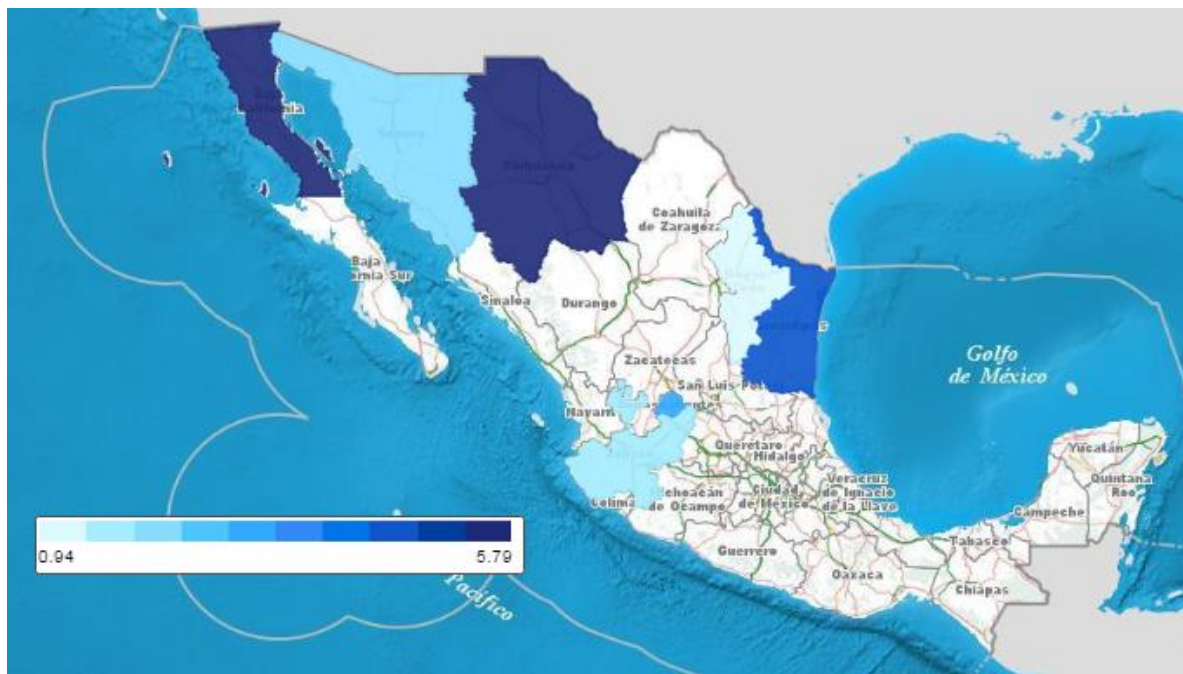
Table 7: Profile of electronics industry in Mexico

Production value (2016)	\$10,000 million ¹
Export value (2016)	\$71,754 million ¹
Key products	Flat screen television sets, computers, microphones, speakers, and headphones ²
Number of facilities	766 ³
Number of employees	273,071 ⁴
Key states	Baja California, Chihuahua, Jalisco, Tamaulipas. ⁵
Major MNC OEMs and Tier I Suppliers	Foxconn, Flextronics, HP, Jabil, LG, Panasonic Samsung, Sony ⁶
MSME key roles	Parts and component supplier, such as printed circuit board production, metal stamping and finishing, plastics and thermoplastics manufacturers, label and manual printers, and cable production. ⁷

Source: 1 & 4) INEGI Banco de Informacion Economica based on email correspondence with Secretaría de Economía, 2) ProMexico 2015a, p.13, 3) ProMexico 2015a, p.33, 5) ProMexico 2015a, p.13, 6) ProMexico 2015a, p.12, 7) Arber et al. 2009, p.14

In 2014, there were 766 economic units⁵ in the manufacturing industry operating in Mexico (ProMexico 2015a, p.32), and in 2016, 694 companies were registered as manufactures of electronic products in the PROSEC electronic register. 9 out of the world’s 10 largest electronics manufacturing services (EMS) MNCs have facilities in Mexico (ProMexico 2014a, p.26). In 2014, Flextronics made an investment of \$20 million in Mexico. Samsung invested \$100 million in October 2014 to reinforce its production of Smart TV and LCD screens.

Figure 4: Map of electronics manufacturing concentration by total gross production



Note: The darker areas indicate a higher production value.

Source: INEGI, 2014

As the above map shows, major electronics companies are mainly located in states bordering the U.S., such as Baja California, Chihuahua, and Tamaulipas. One exception is Guadalajara in Jalisco, sometimes referred to as “Mexican Silicon Valley,” an important cluster of over 380 specialized

⁵ Economic units can refer to plants and commercial and sales offices.

Overview of global manufacturing supply chain activity in Mexico

suppliers focused on high-tech industries and IT (Mexico EMS n.d., p.3). Examples of prominent MNCs include Samsung and Sony in Baja California, Flextronics and Foxconn in Chihuahua, HP and Motorola in Jalisco, and LG in Tamaulipas (ProMexico 2014a, p.54).

The electronics industry covers a wide range of products from consumer electronics, such as televisions, cell phones, and computers, to embedded electronics in vehicles, medical devices, and IT infrastructure. Table 8 below provides a breakdown of the production mix in Mexico.

Table 8: Mexico electronics product production mix in 2016

Product	Percentage of total production value
Electronic components	26.8%
Audio and video	12.8%
Computer equipment	23%
Communication equipment	16.4%
Measurement, control, and navigation instruments and medical equipment	18.8%
Magnetic and optical media	2%

Source: INEGI Banco de Informacion Economica

The vast majority of Mexican electronics exports are shipped to the U.S., which absorbed 85% of the total value in 2014. The U.S. is followed by Canada, Colombia, France and the Netherlands, each of which consumed 1-2% of the exports in 2014 (ProMexico n.d. (a), p.18).

3. THE ROLE OF MSMEs IN THE GLOBAL MANUFACTURING SUPPLY CHAIN IN MEXICO

3.1 Characteristics of MSME participation in aerospace, automotive, and electronics manufacturing supply chains

MSMEs are an important part of the Mexican economy and the manufacturing sector, primarily due to the large amount of employment and GDP they contribute. The advantages of Mexican MSMEs for economic development include their flexibility in changing levels of production and technical processes, as well as dispersed location across all regions of the economy. ProMexico considers Mexico's MSMEs as having significant potential in supporting industries to attract investments, promote exports and supply the domestic market (ProMexico, n.d. (b)).

In the Mexican manufacturing sector, under the core scope, MSMEs integrate themselves into the supply chain as providers of intermediate parts and components to an OEM or a supplier in a tier above them. Although a firm can participate in multiple tiers depending on the supply chain, domestic firms in Mexico mostly integrate at lower tiers of the supply chain, producing basic parts and providing molds and tools.

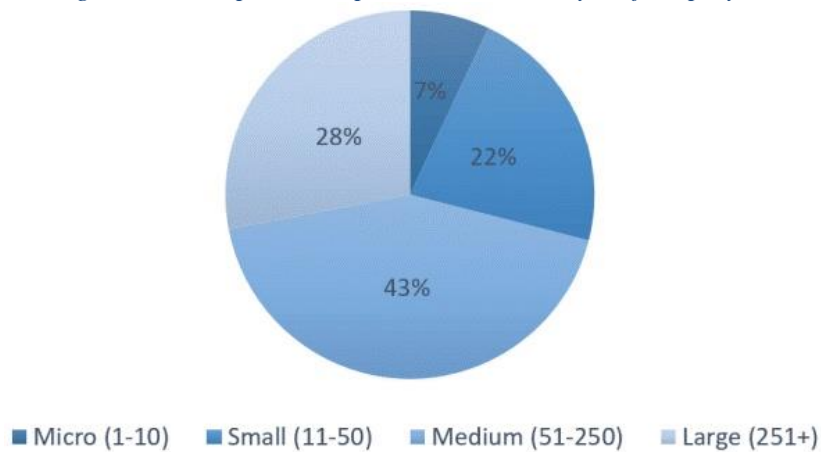
As various manufacturing industries continue to become more sophisticated and expand their operations, opportunities can be created by MNCs to include MSMEs in their value chains, especially when these large firms open a facility in developing economies. However, to maximize the benefit of this FDI, the receiving economy must leverage current workforce skills, government support and other local advantages so as to provide local supporting industries that meet the expectations of MNCs (Kraus 2014, p.33). Despite the large influx of FDI into Mexico and establishment of many MNC manufacturing operations, the development of local supporting industries has been comparatively slow and many MNCs have chosen to continue importing components or bring in their foreign suppliers rather than do business with local MSMEs. This can be attributed to factors internal and external to the MSME suppliers, such as their own knowledge and production capacity, access to capital and government support and the priorities of industry leaders themselves (see also 4.2 below) (ProMexico 2013, p.26).

The typical roles of domestic MSMEs and their integration in the GVC in each industry will be explained below.

Aerospace

In the Mexican aerospace industry, MSMEs largely integrate themselves into the GVC as suppliers for OEMs, Tier 1 or 2 suppliers (ProMexico 2016a, p.46). OEMs in the aerospace GVC are responsible for assembling the final aircraft, although this level of activity is thus far very limited in Mexico. Much more prevalent are Tier 1 suppliers, which conduct the assembly and fabrication of high-value added components and the integration of large subsystems, such as aerostructures, avionics systems, engines and landing gears. Tier 2 suppliers are specialized in various sub-assembly processes and sections that are later integrated into the larger subsystems produced by Tier 1 suppliers. As seen in Figure 5, 72% of aerospace companies in Mexico are MSMEs (250 employees or less).

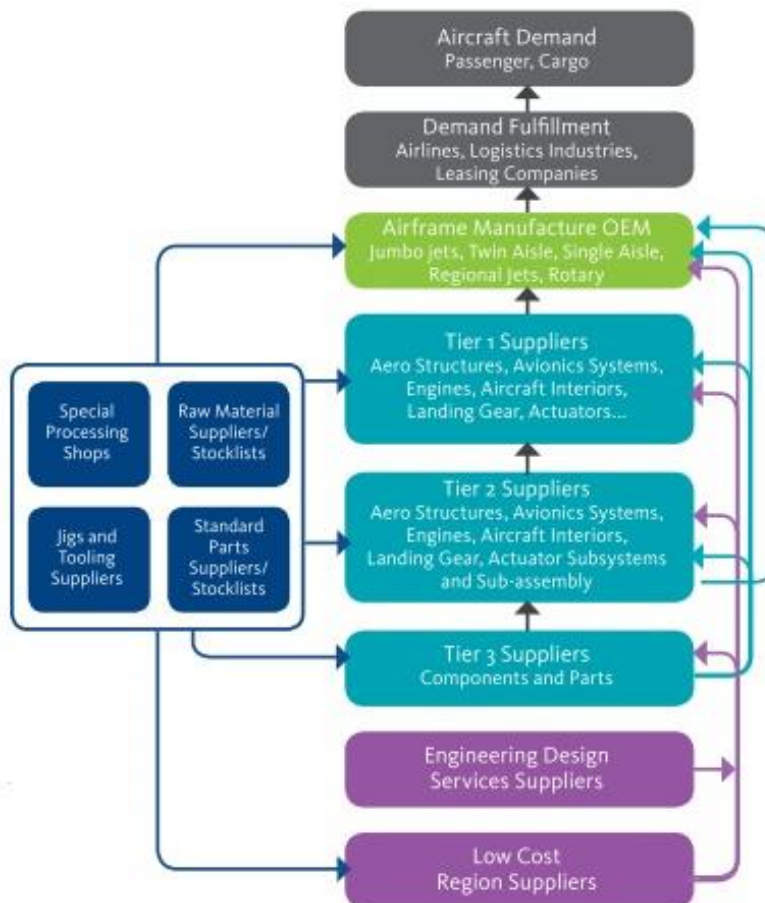
Figure 5: Aerospace Companies in Mexico by # of Employees



Source: Heir 2016

Figure 6 below shows how the supply chain functions in the aerospace industry. Mexican MSMEs specialize in the design and fabrication of more basic parts and components, such as screws, glass panes and seat covers (Secretaría de Economía 2012, p.18). Although beyond the focus of this study, MSMEs also offer services such as coating processes, machining services, and painting for components, as well as MRO (ProMexico 2014b, p.31 and ProMexico 2016a, p.127).

Figure 6: Aerospace Industry Supply Chain



Source: Autodesk 2009

The state of Chihuahua offers some examples of success stories of MSME integration into upper levels of aerospace value chains. One is Soisa, a former jean manufacturer that was approached by Zodiac, a French Tier 1 aerospace manufacturer producing systems and equipment for aircraft, and then General Dynamics in search of a sewing-machine operation to manufacture seats and seat covers. Zodiac assisted Soisa in acquiring the proper certifications, and Soisa now manufactures seats and seat covers for 60 different airlines, as well as flotation cushions, foam inserts, cup holders, armrests, carpets and wall panels. Soisa also designs their own projects and has received international acclaim for designs such as an ottoman seat for Emirates Airlines. They have since grown to 400 employees and now run their own engineering center (Washington CORE interview with Chihuahua Aerospace Cluster 2017).

Another MSME success story is Altaser, originally involved in machining steel parts. They are now manufacturing critical small steel parts including turbine components for companies like Honeywell and GE (Washington CORE interview with Chihuahua Aerospace Cluster 2017).

Automotive

There are about 20 OEMs producing automobiles in Mexico, supported by over 350 Tier 1 companies with over 600 plants. These Tier 1 companies are composed of 10-30% Mexican owned firms, and are supported by around 400 Tier 2 companies, of which 30% are Mexican owned (Automotive High-Tech Cluster Mexico n.d., p.7).

MSMEs in the automotive industry account for 2,290 of 2,811 firms, or 81.4% (El Empresario, 2014). They are mainly involved in supporting industries such as machining (Estado de Mexico and Nuevo Leon), assembly (Coahuila and Nuevo Leon), stamping (Coahuila and Nuevo Leon), welding (Coahuila and Nuevo Leon), plastic injection (Nuevo Leon), and smelting (Nuevo Leon) (ProMexico 2015b, p.21).

Figure 7 below shows the total demand for various processes in the automotive industry in Mexico, with the grey section of each bar representing the domestically provided portion of the demand for that particular product or service. For example, out of \$16.5 billion in demand for die-cutting and/or stamping, Mexican manufactures supply \$5.8 billion, or 35.1% of demand. This shows that the majority of the most in-demand processes in Mexico are imported, implying low MSME participation.

Figure 7: Mexico automotive industry supply chain investment opportunities



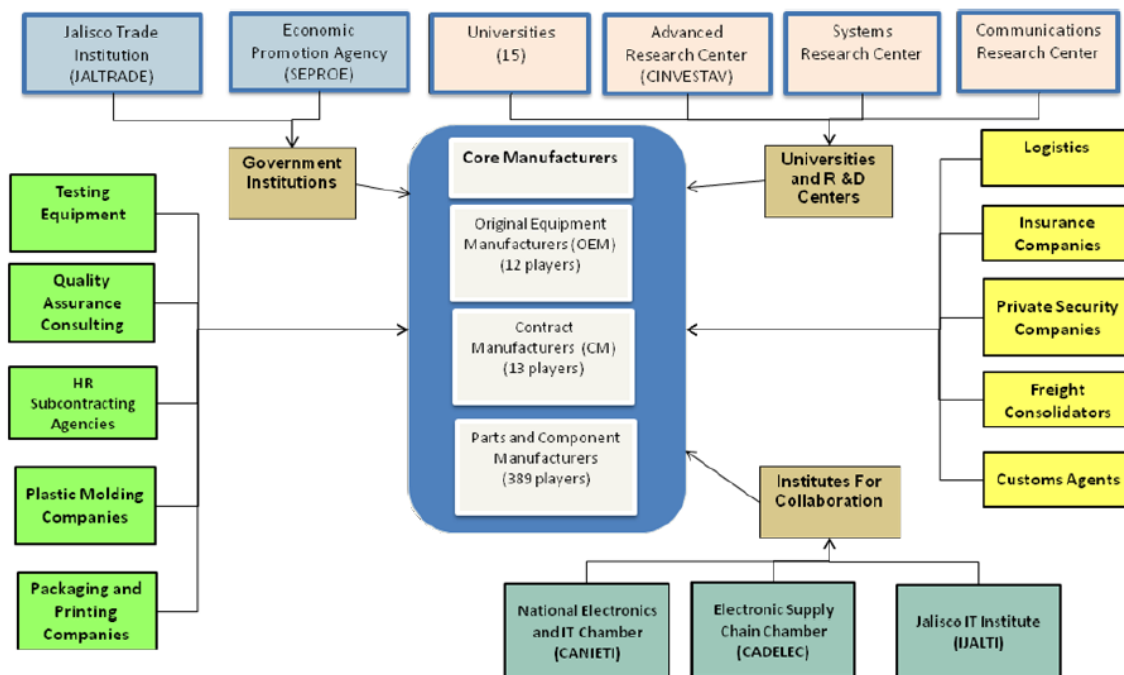
Source: (ProMexico 2016b, p.78)

An example of MSME success in automotive value chains in Mexico is Katcon. Katcon was founded in 1993 in Monterrey as a very small manufacturer of catalytic converters. By 2001, it had earned the GM Supplier of the Year Award twice, and by 2005 had shipped 5 million catalytic converters from its Mexico plant. In 2007, Tier 1 GM supplier Delphi closed its catalytic converter manufacturing operations in the U.S., and outsourced production to Katcon, which then became Delphi's largest catalytic converter supplier. Katcon eventually purchased Delphi's exhaust business (Katcon, n.d.).

Electronics

In the electronics industry in Mexico, there are a number of large OEMs and contract manufacturers (CMs), as well as a large base of smaller suppliers. Since electronics products are usually cost sensitive, the preferred value chain is decentralized and involves a lot of cost-competitive CMs. For example, in Guadalajara, there are 12 OEMs and 13 CMs with 389 parts and component manufacturers in 2009 (Arber et al. 2009, p.14). OEMs buy components and equipment from CMs and then sell the assembled items under their own brands. The key activities of MSMEs include metal stamping and finishing, plastics and thermoplastics manufacturing as well as label and manual printing (see Figure 8 below).

Figure 8: Guadalajara electronics industry cluster map



Source: (Arber et al. 2009, p.14)

In 1997, the National Chamber of the Electronics, Telecommunications and Information Technology Industry (CANIEIT- an industry association) reported that 65% of its membership self-identified as micro or small enterprises, while 9% identified as mid-sized (Secretaría de Economía (e), n.d., p.37).

Technology adoption is a key to MSME competitiveness. For example, after the internet technology bubble burst in 2001, many MNCs in Guadalajara carried out industrial upgrading and acquired the ability to produce higher value products, more advanced processes, and a host of new functions and services. Local suppliers did not effectively make this transition and employment continued to languish below 2001 levels as of 2010 (Sturgeon and Kawakami 2010, p.26). This is partly because knowledge spillover from large companies to MSMEs is quite limited.

In the electronics industry, some successful MSMEs employ about 100 people or more, but the vast majority of suppliers is much smaller. An example of a successful larger domestic firm is Delta

Conectores, an electrical manufacturer with over 120 employees. It manufactures over 100 product lines with 2000 different products including electrical substations connectors, terminals, splices, shunts, pin connectors, transformer outlets, brackets and ground system connectors for large companies such as Siemens, GE, and Alstom. The company is ISO 9002 and ISO 9000:2008 certified, and also maintains compliance with the Mexican and international standards (Norma Mexicana (NMX) and National Electrical Manufacturers Association (NEMA)) to demonstrate its reliability as a supplier (Delta Conectores n.d.) Obtaining such certifications is expensive and serves as an obstacle to MSME integration into value chains.

Another example is Magnotex, an assembly company with over 140 employees that has been one of the leading suppliers operating in Baja California for over 25 years. On top of manufacturing harnesses and printed circuit boards (PCBs), which are typical products for assembly companies, Magnotex also produces microprocessor and microcontroller cards, magnetic products and components with coils or toroids. Its plant was originally set up for providing ballasts for Panasonic televisions, but it has diversified its portfolio to include traffic lights.

3.2 Challenges to greater MSME participation in aerospace, automotive, and electronics manufacturing supply chains

Participating as a supplier in the value-chains of sophisticated global manufacturing industries requires certain capacities, including skills, technology, knowledge and relationships. Factors external to firms themselves also play a key role of facilitating the proper business environment to allow integration, such as government support and regulatory concerns.

Mexican MSMEs face a number of obstacles to participate in GVCs in the selected industries, including: 1) lack of skills/education/training, 2) poor access to credit, 3) regulatory burdens, 4) inability to meet the high quality, marketing and innovation requirements of serving export markets, 5) low R&D spending (below OECD average) and productivity, 6) low adoption of information technology (IT), and 7) difficulty understanding and accessing government support resources (OECD (a), p.17) (OECD 2013, p.40).

All this contributes to a lack of a strong base of domestic suppliers, which limits the productivity and growth of manufacturing in Mexico (ProMexico 2016b, p.84, 94) (Deloitte 2016, p.56). According to a 2008 study, the productivity of manufacturing industries in Mexico is only 24% of their counterparts in the U.S. (OECD 2013, cover). This gap is largely attributed to the low productivity of the “traditional” firms that account for 95% of manufacturing employment in Mexico (OECD 2013, p.29). For example, in the automotive sector, subcontractors with ten or fewer employees accounted for 80% of enterprises and 40% of employment as of 2013 and are roughly 10% as productive as modern parts suppliers (OECD 2013, p.10).

A 2015 survey by INEGI collected the perspectives of MSMEs as to why they struggle to grow. As seen in Table 9, the surveyed MSMEs indicated a number of challenges, which vary in prominence depending on firm size.

Table 9: Reasons firms aren't growing, by company size

Challenge	Micro	Small	Medium
Lack of credit	22.7%	9.2%	6.0%
Low demand	16.7%	11.7%	12.9%
Excessive paperwork/taxes	12.2%	24.4%	24.0%
Lack of security	6.8%	7.5%	5.3%
Informal sector	19.3%	14.9%	14.6%
No problems	12.5%	16.8%	20.0%

Source: INEGI 2016a⁶

It is evident that access to credit and competition from the informal sector diminish in significance as firms grow, while paperwork and taxes grow in significance. Some challenges faced by MSMEs will be explained in greater details below.

3.2.1 MSMEs capabilities and challenges

Limitations in the production capabilities of Mexican MSMEs makes it difficult for them to get involved in GVCs. MNCs engaging in FDI in Mexico usually prefer to bring their preexisting suppliers with them to replicate their existing GVCs in other economies, taking advantage of Mexico's favorable trade policy and lack of local ownership requirements. In this way, MNCs work around the knowledge, equipment and certification deficiencies of local MSMEs. These local firms face difficulties in optimizing product mixes, improving quality and increasing efficiency due to lack of scale and insufficient investment in technology. Inasmuch as they do participate in GVCs, they are so far down the GVC from top MNC, OEMs and Tier I suppliers that they feel little pressure to raise productivity and quality, and MNCs lack incentives to coach and develop them due to the ability to cheaply import intermediate goods (OECD 2013, p.37).

As an example of Mexican supplier limitations, a 2016 survey on production capabilities within the aerospace GVC in Mexico found that domestic MSMEs lack the capacity to meet multiple requirements of the industry. Notably, more than 40% of respondents pointed out deficiencies in chemical processes, development of fiberglass, heat treatment, and raw material distribution (ProMexico 2016a, p.16).

Complicating efforts to address these deficiencies is the generally low level of educational achievement amongst MSME employees in Mexico. Only 30% of the 11.5 million employed in MSMEs have completed the preparatory schooling for higher education, and only 15% have finished a higher education program. On top of this, only 13% of the economy's manufacturing MSMEs provide training to employees (INEGI n.d.).

Low usage of IT is also a barrier for smaller Mexican MSMEs, with 73% of MSMEs not utilizing computer equipment. This problem is almost entirely limited to micro-firms, many of which cite lack of knowledge or financing to purchase equipment (INEGI n.d.). Correspondingly, internet use is also quite low among micro firms, with only 24.1% having an internet connection. Larger MSMEs appear to quickly outgrow this problem, as 92.4% of small firms and 98.4% of mid-sized firms have internet service (INEGI 2016a).

Lack of performance monitoring is another challenge for MSMEs, as it makes it more difficult to improve performance and to demonstrate capabilities to MNCs. A survey found that 21.4% of MSMEs do not record any accounting information, and 25.5% of firms who do have yet to digitize this process (INEGI 2016a). More than 64% of all Mexican MSMEs do not monitor any performance indicators.

⁶ These numbers reflect the percentages of surveyed MSMEs that selected each challenge as a major obstacle to growth. As respondents could select multiple challenges, the percentages for each size range do not add up to 100%.

This problem is especially acute amongst micro-firms, but even for small- and mid-sized firms only 50% and 68% respectively monitor any indicators (INEGI n.d.).

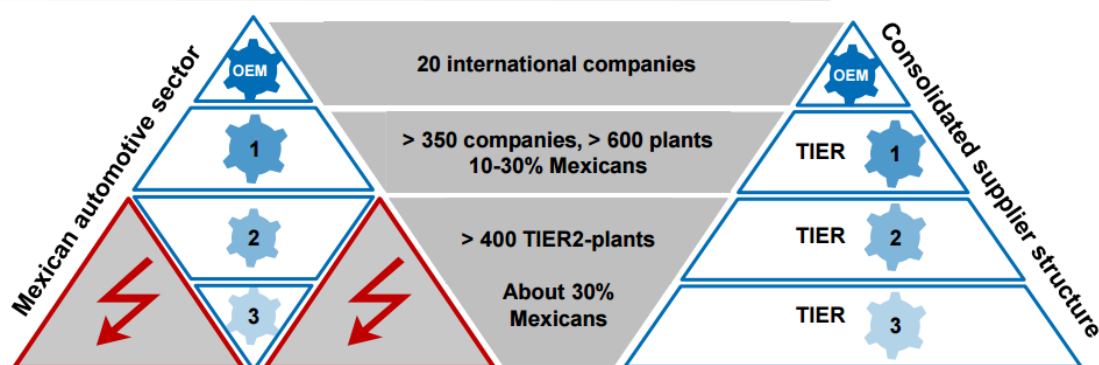
Additionally, there are some cultural barriers to MSME growth. Taking the example from the aerospace industry, Benito Gritzewsky, Chairman of the Mexican Federation of Aerospace Industries (FEMIA), points out that the industry has a “different culture” where “patience and commitment are key”, and therefore many MSMEs, unused to this culture, tend to focus instead on supplying less sophisticated industries (ProMexico 2016a, p.96). A program manager from Queretaro-based aerospace parts supplier Especialistas en Turbopartes (ETU) echoed this sentiment, noting that MSMEs in Mexico are unfamiliar with medium to long-term planning and seek profitability in a year, while the aerospace industry focuses more on long-term contracts of 3-5 years. She suggested the Mexican government take action to bridge this gap by promoting the potential of Mexico’s aerospace supporting industries to MNC OEMs, and encourage MSMEs to commit to deliver products in the timely fashion the industry expects (ProMexico 2016a, p.128).

Although acknowledging significant improvement in recent years, most large manufacturers in Mexico still see the local talent pool as insufficient to suit the highly-specialized needs, especially in high mix, low demand industries such as aerospace (Kraus 2014, p.42). For example, Airbus invited trusted supplier Prysmian to join their venture in Mexico (ProMexico 2014b, p.38). In the state of Querétaro, 50% of the large aerospace firms have brought foreign suppliers along, with 40% of them stating they have no plans to develop local suppliers (Lyla et al. 2015, p.22).

The large companies in the automotive industry also prefer to bring their own suppliers (although to a lesser degree), due to aggressive competition between OEMs, who strive for economies of scale that are best achieved by their preexisting Tier 1 suppliers (Kraus 2014, p.43). OEMs and Tier 1 suppliers report facing difficulties in sourcing sufficient quantities of high quality components locally, an issue that can be linked to deficiencies in the numbers and capabilities of the Tier 2 and 3 supplier base such as gaps in product and process offerings, insufficient technological capability and quality control, and limited access to capital. More specifically, there is a clear shortage of expertise on essential production processes such as stamping, foundry, forging, machining, injection molding, aluminum die casting, hot cutting, laser forming, fasteners and high glossed paint parts. There is also a shortage of logistics capacity across all levels of the local supply chain (Roland Berger 2016, p. 19, 23).

The low number of qualified MSME suppliers in Tier 2 and 3 leads the automotive supply chain structure in Mexico to be shaped more like a diamond than the typical pyramid. Normally there would be a small number of OEMs at the top, followed by a moderate number of Tier 1 suppliers, and then large numbers of Tier 2 and 3 suppliers. However, as seen in Figure 9 below, there are fewer Tier 2 than Tier 1 suppliers in Mexico, leaving unmet demand at the lower tiers that OEMs and Tier 1 suppliers must satisfy with imports.

Figure 9: Mexico Automotive Sector Supply Pyramid



Source: (Automotive High-Tech Cluster Mexico n.d., p.7)

As a result, close to half of inputs in the automotive industry in Mexico are imported, as opposed to 37% for Germany, another major automotive manufacturing economy (Automotive High-Tech Cluster Mexico n.d., p.7). Another illustration of this supply chain gap (and opportunity for domestic suppliers) is final vehicle production in Mexico is projected to grow 9% compounded annual growth rate (CAGR) in the near future, while auto-parts production is only expected to grow at 1% CAGR. This represents a domestic auto-parts investment opportunity of approximately \$25 billion by 2020 (Roland Berger 2016, p. 16).

The consequence of this heavy reliance on international supplier and imports is that local MSMEs miss out on knowledge spillovers, acquiring quality certifications and internationalizing themselves. Since MNCs in the auto industry largely operate in Mexico to cut costs and satisfy NAFTA content requirements, MSMEs participate little in product development and management and are primarily relegated to low value-added labor intensive activities such as assembly and the production of low-tech components (Kraus 2014, p.44).

Similarly, most of the supplies for electronics manufacturing in Mexico are imported from Asian economies. According to a study conducted by ProMexico in 2012, 94% of the components of televisions are imported (Centro de Reflexión y Acción Laboral 2015, p.9). Similar to the other sectors, this runs the risk that Mexican MSMEs will remain “unchained” from the electronics GVC and, in the words of an executive of Foxconn Latin America, remain “nothing more than a large assembly plant” (Ornelas 2016, p.26). However, there has been an initiative since 2014 to increase the national content of the television industry and reduce dependence on imports by including new processes in their production plants or by purchasing from national suppliers some components through commercial facilitation mechanisms granted by the Ministry of Economy (Secretaría de Economía 2017).

3.2.2 Access to Credit

The ability of MSME suppliers to finance the production cycle is fundamental, as after goods are delivered, most buyers demand 30 to 90 days for payment (OECD 2008, p.33). Additionally, sophisticated foreign firms demand specialized products that comply with industry specific certifications and that may require expensive equipment, human capital and time to produce (Kraus 2014, p.42). Turner Davila, the Secretary for Economic Development for the state of Nuevo Leon, considers the lack of long-term loans at flexible rates as one of the major long term hindrances for MSMEs to integrate into aerospace value chains (ProMexico 2016a, p.93).

Limited access to private capital hinders the growth opportunities for MSMEs of all sizes. Firms are wary about seeking credit, largely due to high costs related to interest rates and collateral, and are also frequently rejected for loans due to limited income and credit history (INEGI 2016a). While some challenges such as proof of income diminish as firms grow, debt becomes a larger obstacle to accessing credit (INEGI 2016a).

Table 10: Reasons firms are denied credit, by company size

Reason for denial	Micro	Small	Medium
Lack of collateral	25.2%	22.7%	21.7%
Inability to prove income	20.7%	2.8%	1.2%
Bad credit history	13.9%	14.4%	13.7%
Lack of credit history	13.7%	15.2%	7.3%
Too much debt	5.3%	14.4%	23.6%

Source: INEGI 2016a⁷

⁷ These numbers reflect the percentages of surveyed MSMEs that selected each challenge as a major obstacle to growth. As respondents could select multiple challenges, the percentages for each size range do not add up to 100%.

Despite the urgent need for capital, Mexican firms are also wary about accepting credit from banks in order to grow their businesses, with only 33% indicating they would accept credit in 2015. The cost of receiving such credit is the most cited barrier at 51.6%, followed by lack of need (34.1%) and lack of confidence in the banks (7.6%) (INEGI 2016a).

3.2.3 Certifications

The need for technical certifications is another obstacle for MSMEs seeking to join GVCs. As an official of the Chihuahua Aerospace Cluster pointed out, MSMEs face a chicken and egg situation - they must obtain certifications to demonstrate quality and reliability to get business with OEMs and Tier 1 suppliers, but they must also commit to start operations in order to produce records needed for auditing by the certification agency, which requires a customer. This means that these companies require assistance from OEMs, Tier 1s and the government during this process by offering them funding or small projects. Even in the best cases, it takes about 7-10 years to receive a return on investment in the aerospace industry, due to the certifications, quality controls and monthly calibrations of equipment.

The certifications themselves are very expensive, with a basic NADCAP/AS9100 certification for aerospace suppliers ranging from \$6,000 to \$50,000, depending on the number of processes that must be verified. Some equipment requires weekly calibration, and the cost of maintaining these quality control systems certified to industry requirements and engineering specifications incur more costs after the initial certification is received. Furthermore, many OEMs/Tier 1s have their own highly specific certifications for various processes; for example, Boeing, Airbus, Cessna and Embraer all have their own certification processes for chemical processing and surface treatment of air-structures. Looking at just one piece of equipment, the cost to calibrate an infrequently used heat-treating oven for one MSME can go up to \$1,500 a week (Washington CORE interview with Chihuahua Aerospace Cluster 2017).

3.2.4 Regulatory issues

The complexity of the content of regulations and compliance procedures can impose burdens on MSMEs that have limited knowledge, human capital and time available to deal with them. Business registration and construction are both costly and time-consuming procedures in Mexico. OECD data indicates the cost of registering a business in Mexico is 10% of the average annual per capita income, compared to 1.4% in the U.S. and 4.5% in Chile. Construction permits cost three times average per capita income vs. 67% in Chile. It takes 74 days to register property in Mexico, which is twice that needed in Chile and five times the U.S. average. These costs and requirements can vary greatly by region, indicating the need for standardization (OECD 2013, p.52).

The tax system in Mexico is complex, with overlapping taxes and complicated pay schedules that require MSMEs to use costly tax accountant services. Additionally, the effectiveness of certain fiscal incentives is diminished as many MSMEs need to hire a tax advisor to take advantage of them (OECD 2013, p.58). State and municipal procedures for regulatory compliance can overlap and be inconsistent, burdening MSMEs and complicating the implementation of reforms (OECD 2013, p.61). For example, a Mexico City business owner indicated he has to spend a day out of the working week to ensure compliance (OECD 2013, p.54).

3.2.5 Program delivery

In order to deal with these obstacles above, it is essential that direct support be provided to these firms to prepare them for integration into GVCs. Without support mechanisms, such as financial support, matchmaking with MNCs, specialized training programs in universities and providing access to capital for equipment, training and certifications, Mexican domestic firms will continue to add relatively little value to the economy's exports. In addition, MNCs in Mexico will continue to heavily source inputs from competing economies, imperiling Mexico's long-term manufacturing competitiveness.

However, some of the existing Mexican government programs designed to help MSMEs reportedly need enhancements to optimize their effectiveness. Some programs face challenges due to limited funding, ineffective management and lack of proper evaluation (Kraus 2014, p.38). For example, a PricewaterhouseCoopers study found government policy to promote the auto-parts industry in Mexico to be deficient in terms of programs to develop qualified technical labor and financing to develop supply sources (PwC Mexico 2014, p.15).

Furthermore, coordination between the various programs is weak, with each program following separate sets of rules that make it difficult to share information on beneficiaries. This increases paperwork and confusion on the part of MSMEs and the duplication of government efforts as well as inefficient use of scarce resources (Secretaría de Economía (d) n.d.). For example, the National Institute of the Entrepreneur (INADEM- a government agency created in 2013 to support entrepreneurs and MSMEs) found that there are 53 MSME support funds distributed across 8 separate institutions, causing confusion, lack of awareness and low adoption of programs (EY 2013, p.5).

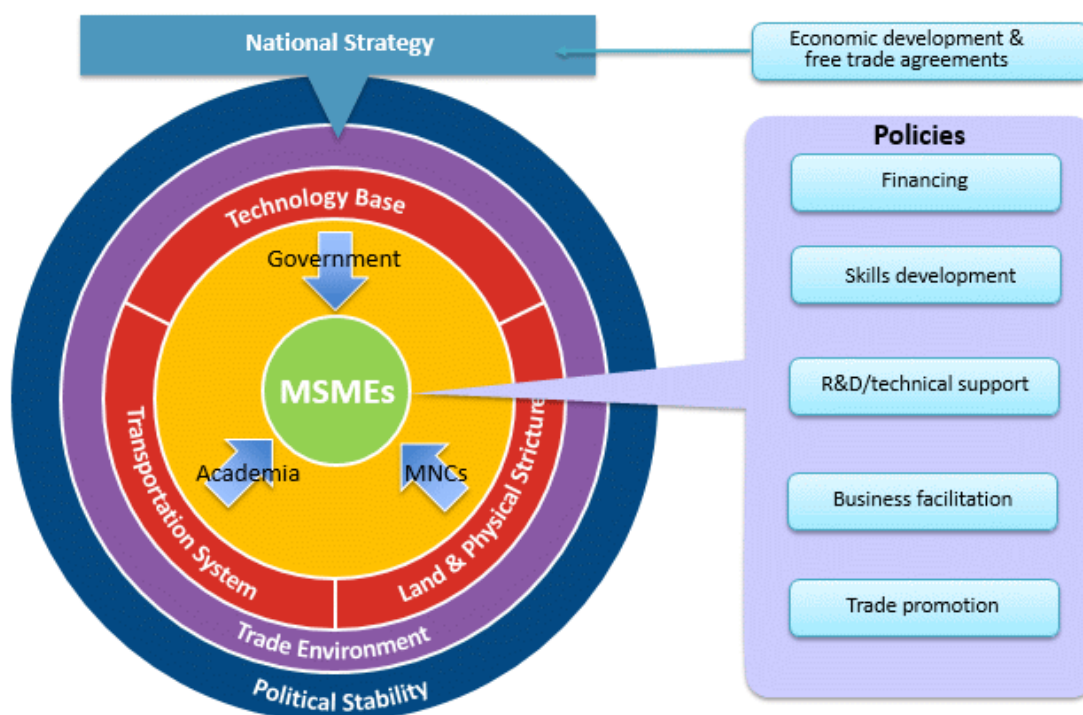
Only 14.3% of surveyed Mexican firms indicate that they were aware of any government support program. Of this, only 12.4% are manufacturing firms. Between 2013 and 2014, only 2.2% of small- and 5.6% of mid-sized firms participated in value chains, with lack of information being cited as the primary reason for non-participation cited. In 2014, only 1.4%, 2.4% and 2.9% of micro, small and mid-sized firms respectively solicited federal support (INEGI 2016a).

4. POLICIES AND PROGRAMS TO DEVELOP SUPPORTING INDUSTRY

4.1 Overview of policies and programs to develop supporting industry

The Mexican national strategy for economic growth has been based on trade and the opening of markets, with major trade liberalization beginning in the 1990s and continuing to the present. Mexico is part of many free trade agreements such as NAFTA, the Economic Partnership, Political Coordination and Cooperation Agreement with the EU and numerous bilateral agreements (ProMexico 2016a, p.58). This network of agreements gives companies operating from Mexico preferential access to markets accounting for one billion customers and two-thirds of global GDP (ProMexico 2016c, p.7). In the past two decades, Mexico has increased trade's share of GDP from 27% to 63%. Trade liberalization allowed Mexico to convert from a major oil exporter to a manufacturing leader, with the manufacturing sector accounting for 89% of exports (ProMexico 2016c, p.23).

Figure 10: Overview of policies and programs to develop supporting industry



Source: Washington CORE

These national trade liberalization policies were designed to attract MNCs to invest in manufacturing in Mexico, creating a need for supporting industries, ideally of Mexican origin, to provide parts and services to manufacturing operations. Mexico has been successful in the first goal, but had mixed results with the second. Manufacturing and the need for supporting industries have certainly exploded in Mexico, but to date this need has been fulfilled mainly by foreign suppliers, many with preexisting relationships with these OEMs.

Therefore, the Mexican government is focused on enhancing the capabilities of Mexican MSMEs to help them assume larger roles in manufacturing supply chains in Mexico. As Figure 10 above shows, the federal and state government(s) have formulated various policies to strengthen this sector of the

economy, both directly through finance, skills development, R&D/technical support, and business facilitation, and indirectly through trade promotion.

National strategies for MSMEs are reviewed in the sections below, followed by corresponding policies in the areas of: 1) financing, 2) skills development, 3) R&D/technical support, 4) business facilitation, and 5) trade promotion.

4.2 National strategies for promotion of manufacturing MSMEs

The Ministry of Economy has set out a number of strategic objectives and priorities for supporting manufacturing and MSMEs. Key efforts are explained below.

4.2.1 Sectoral Planning

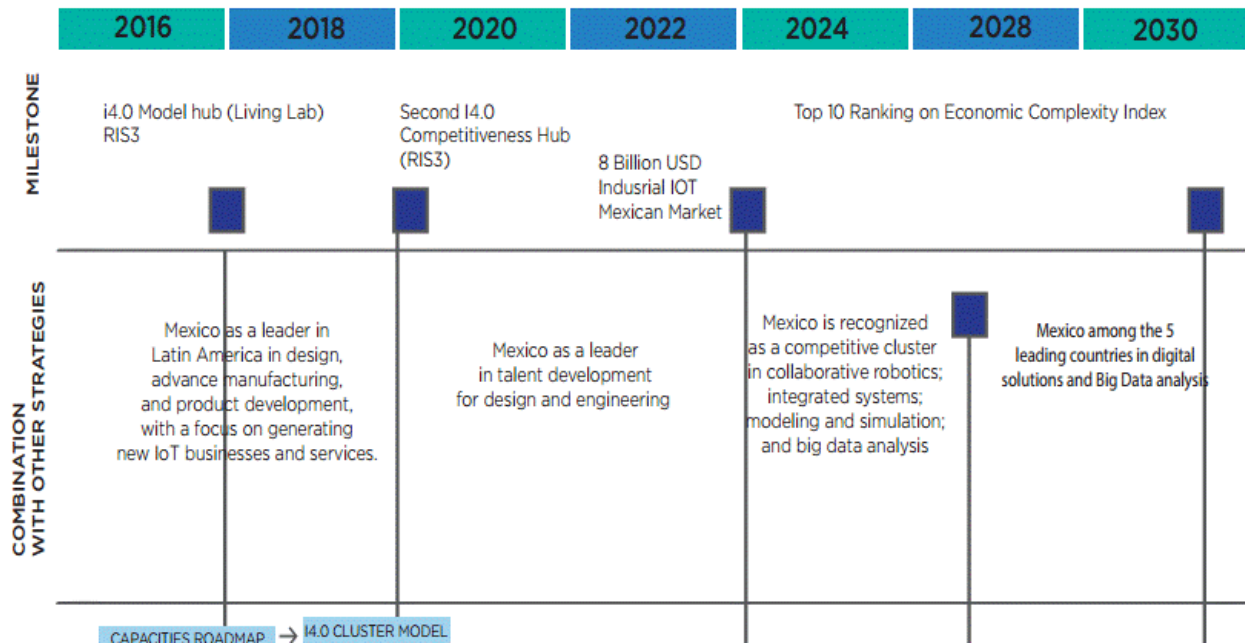
The Sectoral Planning (Planeación Sectorial) is a policy theme designed to develop a competitive internal market, promote strategic sectors and increase the commitment to free trade, capital mobility and integration of productive chains (Secretaría de Economía (2016), p.15). This consists of four programs categories across 28 sectors, namely: a) innovation, b) human capital development, c) supplier development, and d) regionalization. These initiatives are targeted largely towards the automotive, aerospace and electronics sectors, due to their strategic value to the Mexican economy (Secretaría de Economía (b), n.d., p.10).

4.2.2 Industry 4.0 Roadmap

Support to MSMEs in the manufacturing sector is considered essential due to the inadvertent development of a “two-speed” economy in Mexico, a dichotomy between highly productive and technologically advanced firms and low productivity traditional firms on the other. Advanced and efficient MNCs are approaching fourth generation production models, while MSMEs in Mexico are stuck in the first or second generation. The Ministry of Economy asserts that cost competitiveness of Mexican manufacturing should be leveraged by focusing on innovation capabilities, the development of Mexican brands (local champions), the supply chain and productivity rather than relying on cheap labor costs (Secretaría de Economía (2016), p.12).

The Ministry of Economy has indicated a shift in the manufacturing national strategy from the Mexican federal government. The Ministry of Economy refers to this strategy as “Industry 4.0,” a shift towards a digitalized and automated production model (Secretaría de Economía n.d. (d), p.68). For its “Industry 4.0” initiative, ProMexico has defined a number of strategic milestones to be achieved in the future, including the establishment of laboratories, a US\$8 billion Internet of Things industry and reaching the top 10 of the Economic Complexity Index (Secretaría de Economía n.d. (d), p.87).

Figure 11: Industry 4.0 Roadmap



Source Secretaría de Economía 2016a

This top section of the Industry 4.0 roadmap shows specific milestones as well as their intended connections with other strategies to increase Mexico’s competitiveness as a manufacturer, namely the development of design and engineering talent, competitiveness in advanced manufacturing techniques such as collaborative robotics and integrated systems and leadership in Big Data analysis.

4.2.3 Aerospace Roadmap

ProMexico defines the aerospace industry general strategy as the development of a national ecosystem of high added value and its competitive integration into international aerospace and defense networks (ProMexico 2015c, p.25). The aerospace industry in Mexico has adopted an innovation based roadmap that is developed through the collaboration of industry, academia and government (the “triple-helix”) to establish it as the economy’s flagship industry, attracting more productive investment, promoting technology and knowledge transfer, and affecting the creation of better jobs, opportunities and strategic partnerships (ProMexico 2015c, p.19). Strategic milestones in this roadmap are to establish Mexico as an aeronautical services hub by 2015, manufacture an aircraft in Mexico with high national content by 2016 and by 2019, to establish Mexico as a complete aerospace manufacturing platform that addresses the entire lifecycle of an aircraft (ProMexico 2015c, p.19). Other milestones include doubling the percentage of Mexican firms in the industry, elevating Mexico to the 10th largest aerospace manufacturer, exporting US\$12 billion in aerospace products by 2020 and raising local firm integration in aerospace manufacturing to 50% (MexicoNOW 2016 and ProMexico 2015d, p.48).

4.3 Initiatives implemented to develop MSMEs

Each initiative for developing MSMEs is determined in accordance with the above national strategies. There are five major themes for targeted programs: financing, skills development, R&D/technical support, business facilitation and trade promotion.

4.3.1 Financing support efforts

Financing schemes are designed to increase MSMEs' competitiveness and encourage their integration into larger supply chains, as they face many barriers to entry that stem from a lack of access to capital. Federal government financing is provided primarily through the Ministry of Economy, Bancomext and INADEM, among other agencies. The following mechanisms reduce the barriers to access credit and involve highly targeted grants/incentives for specific projects, activities and services.

4.3.1.1 SME Fund

The most comprehensive scheme is called the SME Fund (Fondo PYME), administered by the Ministry of Economy which provides grants/incentives for productive projects, industrial infrastructure, feasibility studies, training and consultancy services to increase MSME competitiveness and encourage their integration into larger supply chains (World Bank (2010), p.83). Funds provided rose from US\$41 million to US\$205 million between 2001 and 2006. In 2004-2012, total funds provided were US\$1,390 million to 5,436 projects, which led to the creation of 395,674 new jobs and the conservation of 5,330,170 jobs (Fondo PYME). The World Bank also found Ministry of Economy financing support programs such as the SME Fund to have had the greatest positive impact on value-added, employment and exports between 2001 and 2006 (The World Bank (c), p.28). Any federal source of credit will help MSMEs given the lack of private funding, and the targeted nature of the SME Fund resources directs them towards activities that allow them to increase their capabilities and grow their businesses.

4.3.1.2 The National Credit Guarantee System

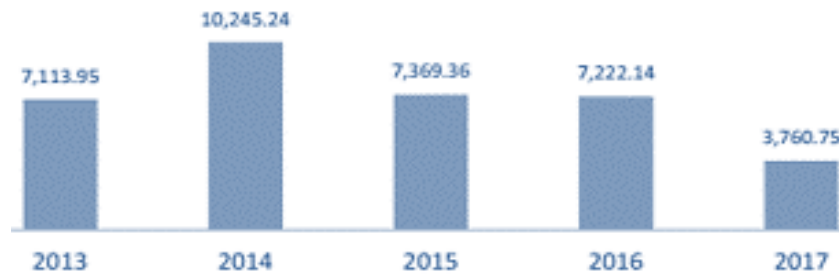
The National Credit Guarantee System was identified by the OECD as the most effective MSME financing scheme. This program leverages federal funds in collaboration with banks and state governments to reduce a prominent barrier to MSME access to credit by providing government guarantees in lieu of collateral for loans. It also incorporates a novel public auction system where banks bid on guarantees based on the volume of loans and projected rate of interest. This results in a drastic increase in the availability of credit for MSMEs, the removal of financial burdens in accessing credit, loans at interest rates lower than commercial rates and allows MSMEs to build credit for larger commercial loans in the future.

4.3.1.3 The National Fund of the Entrepreneur

Started in 2013 by INADEM, The National Fund of the Entrepreneur (FNE) provides financial grants for particular projects that encourage the creation, development, productivity, and competitiveness for MSMEs (INADEM n.d.). The 2015 Index of Performance of Federal Programs (INDEP) ranked FNE as the best performing program, with nearly perfect scores in coverage, achievement of goals and quality of design (El Empresario 2015). However, FNE dropped to rank 23 in the 2016 INDEP, largely due to declines in coverage and budget (Gestión Social y Cooperación n.d., p.21).

Since 2013, FNE has received 162,000 requests for support and provided over 400,000 total projects with about US\$2,200 million appropriated (INADEM 2016, p.97). FNE's budget from 2013 to 2017 (in Mexican pesos) is shown in the chart below. Aside from being a credit source, the competitive nature of the FNE grant process encourages MSMEs to engage in more ambitious and innovative projects, hopefully increasing their potential to integrate into GVCs.

Figure 12: FNE Budget: 2013-2017 (Mex\$ millions)



Source: INADEM, 2016

4.3.1.4 PROSOFT

The Ministry of Economy Program for the Development of the Software Industry (PROSOFT) is another innovation targeted fund for MSME support, with the specific goal to increase adoption and usage of advanced IT targeting the automotive, aerospace, electronics, IT and metal-mechanics sectors, among others. PROSOFT was recognized in the 2016 INDEP as the 11th best-performing program out of 157, in terms of achievement of goals, quality of design and coverage. The 2016 budget was US\$44,526,130.79, however the 2017 budget was slashed by 75% (Gestión Social y Cooperación n.d., p.21). The specific goals of this program are enhancement of human capital specialized in IT and innovation in strategic sectors, support for investigation and technology development in strategic sectors, creation of an IT innovation infrastructure and the generation of IT knowledge and expertise through studies and exhibitions (Secretaría de Economía (d) n.d.).

4.3.1.5 Program for Industrial Productivity and Competitiveness

The Program for Industrial Productivity and Competitiveness (PPCI), run by the Subsecretary of Industry and Commerce (part of the Ministry of Economy), is an initiative to integrate Mexican companies into value chains and to improve their productivity through industrial projects to promote economic growth and development. A more specific objective of the effort is to contribute to the availability of highly skilled human capital through specialized capacity building and certification in various productive processes and to provide equipment for training centers (Secretaría de Economía n.d. (b), p.4). PPCI coordinates various efforts to support the aerospace, automotive, and electronics industries. Efforts to bolster the domestic market include a scheme to provide credit to individuals to purchase domestically produced vehicles (Secretaría de Economía 2016, p.93).

This program is also seeking to generate industrial public policy that favors the development of GVCs, the improvement of productivity and the strengthening of regionalization. Initiatives are also meant to focus on certain sectors with specific methodologies to promote the differentiation of products, sectoral promotion strategies and design centers (Secretaría de Economía (b), p.4). Support is provided in the form of grants/incentives for proposed projects that meet the qualifications defined by the Ministry, with up to 75% of funds being provided (upper limit of \$500,000 per project) for projects determined to be important for economic growth in strategic sectors (Secretaría de Economía (2016), p.22).

4.3.1.6 State government financing

State governments participate in partnerships with federal agencies to administer funds and allocate their own resources towards MSME development and manufacturing support. The state government of Baja California collaborates with the Mexican Council for Science & Technology (CONACyT) to administer a local Mixed Funds program, which combines financing from the three tiers of government

to promote scientific and technological development in industry in general (CONACyT n.d.). Other measures such as tax breaks for public services (e.g. sewage services in Baja California) and special loans to MSMEs are available, reducing their burden to access credit and cover operating expenses. Nuevo Leon provides a program called Fondo de Apoyo para la Creación y Consolidación del Empleo Productivo (FOCRECE⁸) which provides microfinancing (up to US\$7,500) to MSMEs with low interest rates (SME Toolkit n.d.) (Baja California Trade and Investment n.d.).

Chihuahua administers a similar program called Program of Promotion of Productive Activities (FAP) with funds up to \$20,000 available as well as the Microenterprise Development program, which is a network of 3,600 creditors, including funds from the State of Chihuahua Inter-American Development Bank (DEMIC n.d.). Additionally, Queretaro administers the Employment Promotion Trust (FIPROE) to foster development, consolidation, viability, productivity, competitiveness, productive investment and sustainability of MSMEs. This program provided around \$700,000 in funds to 1,632 beneficiaries between 2010 and 2013 (Sistema Nacional de Programas de Combate a la Pobreza n.d.).

4.3.2 Skills development support efforts

Meeting the requirements of MNCs to enter their supply chains is not only costly, but also requires mastery of industry standards, as well as technological and business skills. In order to climb the value-added ladder, Mexican MSMEs must acquire these capabilities or be relegated to labor intensive, low value-added activities. Collaboration is essential, as MSMEs must be aware of what is required of them by MNCs, academia must produce qualified human capital, and government must optimize access, awareness, and funding for programs. The federal government supports skills development in MSME manufacturers through a mixture of targeted grants/incentives, provision of services and facilities and fostering collaboration with OEMs, with the goal of introducing MSMEs to sophisticated technology, providing opportunities for certification and increasing productivity.

4.3.2.1 The National System of Business Incubators

Led by the Ministry of Economy, the National System of Business Incubators (SNIE) funds projects in 3 types of business incubators: traditional, intermediate technology, and advanced technology, targeted at MSMEs and entrepreneurs (Mexico Mission to the EU (2006), p.1). These incubators help new firms learn essential administrative skills to run their business, provide access to essential technology in various sectors and reduce the time-burden on MSME owners and employees to explore market opportunities, access to finance and new technologies. Traditional incubators provide knowledge on well-known material and immaterial requirements. Intermediate-technology incubators assist firms with knowledge inputs from specialized institutions, large firms and innovation networks. The high-technology incubators focus on areas such as IT, biotechnology and microelectronics (OECD 2013, p. 50).

These are essential services, given significant apathy by MSMEs towards growth and accessing new technologies, as well as very low awareness and utilization of support programs. Between 2004 and 2006, US\$34.4 million was invested and the SNIE network currently consists of 308 institutions (Mexico Mission to the EU (2006), p.1).

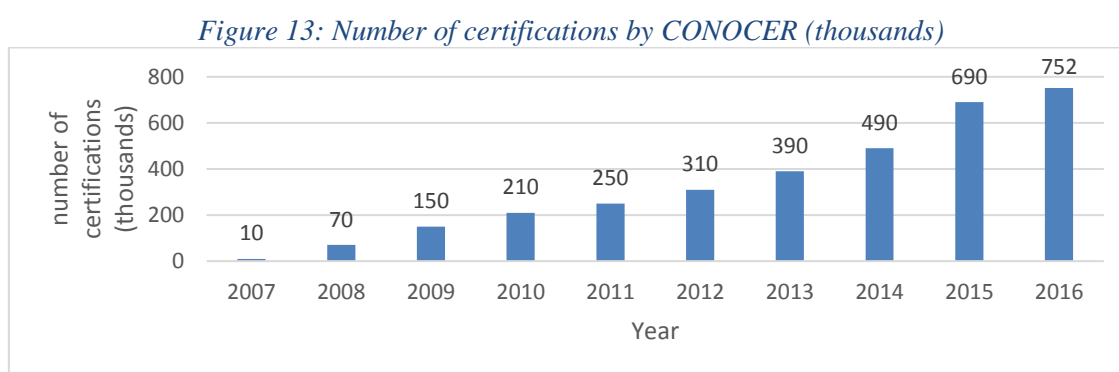
⁸ In English: Support Fund for the Creation and Consolidation of Productive Employment

4.3.2.2 Productivity Support Program

The Productivity Support Program (PAP) is a human capital-focused program provided by the Secretariat of Labor and Social Welfare. The program provides grants/incentives to training and technical assistance to SMEs to enhance their productivity and welfare of workers. Between 2001 and 2006, it trained about 1.6 million workers and benefited more than 226,000 firms (World Bank (2010) p.88).

4.3.2.3 CONOCER

The Labor Qualification Certification Council (CONOCER) is a Ministry of Education (SEP) program that aims to evaluate and certify the knowledge, abilities and skills of workers so as to establish the guidelines and define technical rules related to labor skills. It has increased the number of certified workers from 10 to 752 between 2007 and 2016 as the chart below shows (Secretaría de Educación Pública n.d.).



Source: CONOCER

4.3.2.4 Sector-specific national skills development programs

Sector-specific skills development programs provide additional support tailored to each industry's needs. The Center for Training and Certification in Design and Engineering Software (CATIA), managed and funded by the Mexico-European Union Competitiveness and Innovation Program (PROCEI), provides training and certification on CATIA and SolidWorks design and engineering software, providing services with high-technology content targeted to the aerospace sector (ProMexico 2015c, p.27). The Alianzas Estratégicas y Redes de Innovación para la Competitividad⁹ (AERIS), operated by CONACyT, seeks to build relationships and innovation networks between companies and academic institutions to establish Mexico as a viable option for R&D in the automotive industry and further develop Mexican engineers (ProMexico 2015b, p.69).

4.3.2.5 State government efforts

State skills development efforts focus on providing technical support to MSMEs. The State Council of Science, Innovation and Technology in Baja California administers the Innovapyme, an exclusively MSME-targeted program focusing on technology development with economic and knowledge supports. The program provides up to 50% of total project costs with a maximum of US\$1,000,000 (Tijuana Economic Development Council n.d.). Queretaro administers the Competitiveness Program for SMEs through the Ministry of Sustainable Development (SEDESU). Examples of measures include a consulting program for MSMEs to enhance their competitiveness, development of a web platform for

⁹ In English: Strategic Alliances and Innovation Networks for Competitiveness

MSMEs, execution of an industrial census for the strengthening the internal market and supply chains, training support, implementation of a business acceleration model, and support for certification in ISO 9001:2008 (Secretaría de Desarrollo Sustentable n.d.).

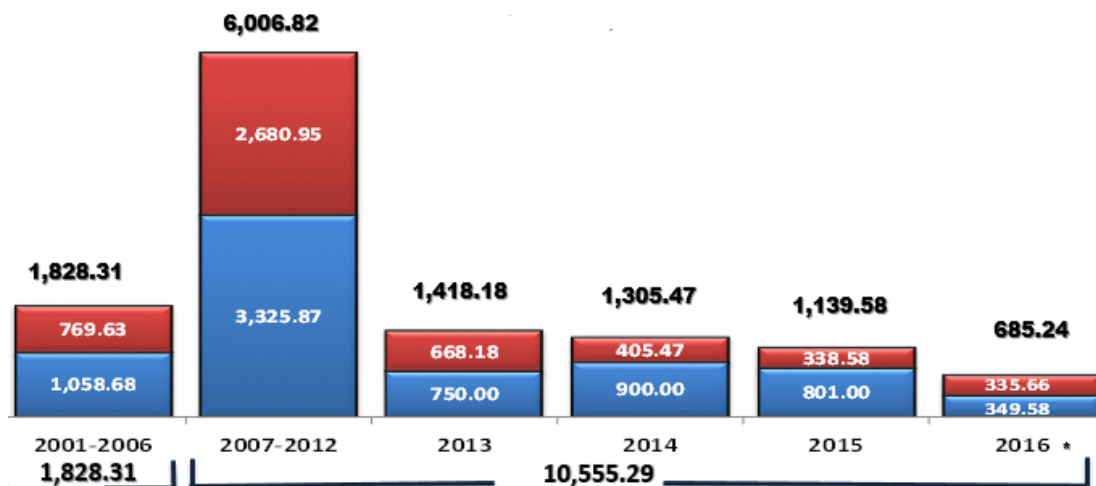
4.3.3 R&D support efforts

The federal government also runs a network of advanced research centers and laboratories focused on manufacturing which are accessible to both MSMEs and MNCs so as to support robust R&D activities and experimentation with advanced technologies. This allows MSMEs to access equipment, knowledge and resources that allow them to develop their capacity to use new technologies, productive models and materials to increase their competitiveness in increasingly sophisticated value chains (ProMexico 2015c, p.14). MSMEs would otherwise have little access to such advanced technologies and collaboration opportunities with each other and MNCs, and would face intensifying competition from foreign suppliers with more resources to explore the newest and most efficient production models.

4.3.3.1 Mixed Funds

Mixed Funds program (Fondos Mixtos) supports advanced manufacturing by funding applied research, technological development, reinforcement of infrastructure and creation and consolidation of research groups and networks and comprehensive projects (World Bank (2010) p.87). The program is administered by CONACyT, which supports scientific and technological development with resources from the three tiers of government. Since its inception, the program has provided ~US\$750 million to 5,832 separate projects (CONACyT n.d.). The appropriations for Mixed Funds are shown in the chart below. These resources allow MSMEs to increase their knowledge of advanced technologies that may be necessary to participate in the value chains of sophisticated industries such as aerospace, which they would normally have little opportunity to access on their own.

Figure 14: Appropriations for Mixed Funds Program: 2001-2016 (Mex\$ millions)



Source: CONACyT, 2016

4.3.3.2 PROCEI

Additionally, the Strengthening Technical Support to Enhance the Competitiveness of SMBs in Mexico's Aerospace Sector Supply Chain program, administered by PROCEI, also enables OEMs to collaborate with MSMEs in research and development of new materials and models to serve industry.

OEMs can evaluate potential suppliers and MSMEs can work towards certifications, and there is currently a proposal to incorporate equipment to analyze the quality of materials and components provided by MSMEs. The program chose 20 out of 51 metalworking MSMEs to advance towards AS9100 certification (ProMexico 2015c, p.26). This program helps resolve the “chicken and egg” conundrum of certification for MSME products and processes, as OEMs are able to select MSMEs they deem as appropriate to elevate rather than importing supplies/suppliers.

4.3.3.3 R&D centers

Representative examples of the numerous R&D centers established to support manufacturing and MSMEs follow below:

- The Center for Engineering and Industrial Development (CIDESI) provides technological and research services in flexible manufacturing, intelligent manufacturing, as well as high mix and low volume manufacturing for the automotive and aerospace industries (Secretaría de Economía (d), p.78).
- The Future Internet National Laboratory (LANIF) allows MSMEs to experiment with new internet technologies such as the Internet of Things (IoT), Big Data and Cloud Computing (Secretaría de Economía (d), p.78).
- The Advanced Technology Center (CIATEQ) is primarily focused on aerospace, in which OEMs collaborate with MSMEs in research and development of new materials and models to serve the medium to long-term needs of the aerospace industry (ProMexico 2015c, p.26).
- The Advanced Materials Center (CIMAV) conducts chemical analysis, materials testing and magnetism research critical for materials and composites development. (ProMexico 2015c, p.28).

Some state governments also have research center and laboratory projects to support advanced manufacturing, usually focused on a certain cluster. For example, the Sonora Institute for Aerospace and Advanced Manufacturing provides a series of programs to support the aerospace industry, such as conventional and CNC machining, sheet metal, structural assembly, composites and tooling (The Offshore Group (2012)). Chihuahua has an advanced metalworking and prototyping station called FabLab (fabrication laboratory), which is intended to provide MSMEs with a cost-effective means to further design and develop their own products in the aerospace, automotive and electronics industries. This project was funded jointly by PROCEI and the Economic Development Agency of Chihuahua (DESEC) and managed by ProMexico (Global Business Reports (2016), p.66).

4.3.4 Business facilitation support efforts

Business facilitation programs leverage the efforts of the federal government and MNCs to inventory the capacity of manufacturing MSMEs in Mexico, evaluate their potential to integrate into MNCs’ supply chains and create mechanisms that promote the collaboration between MNCs and MSMEs. This allows MNCs to make well-informed business decisions on where to locate plants and who to select as suppliers, while MSMEs get opportunities to participate in supply chains and engage in higher value-added activities.

4.3.4.1 National initiatives

ProMéxico developed a methodology and program to pursue these objectives called the Model for Alliances with Transnational Companies (ACT) and National Supplier Development Program, which

seeks to integrate the MSMEs into the supply chains of MNCs by identifying the intermediate goods that MNCs import, identifying qualified certified domestic suppliers and assessing whether the current installed capacity is sufficient to meet those requirements (ProMexico (2013), p.44). This initiative expands MSMEs' horizons by providing a clear picture of what they could potentially supply within the GVCs of strategic industries in Mexico while demonstrating their capabilities to MNCs. For example, in the aerospace industry, MNCs will not consider a supplier that lacks certain certifications like AS9100 and NADCAP, and ACT/the Supplier Development Program helps them identify qualified suppliers with a list of AS9100/NADCAP certified companies.

The National Assessment of Advanced Manufacturing works to identify gaps in supply chain, acquisitions and supplier development and further supports supplier development initiatives (ProMexico 2015c, p.39). The INADEM ProAuto project is a particularly successful initiative targeted at the auto industry. This union of educational, governmental and banking institutions seeks to connect MSMEs with MNCs and support them with credits up to \$2.67 million and opportunities in automotive supply chains. 4,000 MSMEs were supported in 2015, with the goal to double the figure in 2016 (ProMexico 2015b, p.13) (Mexico Automotive Review n.d.). This program helps directly address the resource gap faced by MSMEs in upgrading to meet the standards to become suppliers of manufacturing MNCs.

4.3.4.2 State initiatives

Baja California also operates its own Supplier Outreach and Supplier Development program, providing services to MNCs to find qualified suppliers and training MSMEs to meet the requirements to participate in these supply chains (Tijuana Economic Development Council n.d.). Additionally, the state launched its own business facilitation effort to promote exports and partnerships over the border with California, with a formal agreement signed and initial funding of US\$225,000 allocated in 2008. It conducts market assessment among other efforts (CaliBaja n.d.).

4.3.5 Trade promotion support efforts

Trade promotion efforts by the federal government largely focus on removing barriers to importing inputs used in the manufacturing sector. These trade promotion efforts such as suspension of tariffs and export tax credits largely benefit MNCs seeking to take advantage of Mexico's manufacturing advantages and access to markets, but indirectly create opportunities for MSMEs to work with these MNCs and export indirectly through their supply chains. The scheme that allows manufacturers to import inputs on a duty/tariff free basis is a special type of special economic zone (SEZ) referred to as the *maquiladora* system. This system was designed to encourage FDI in manufacturing and encourage exports. It has been largely successful, with Mexican exports to the U.S. and Canada increasing by over 600% between 1994 and 2015 with the explosion in *maquiladora* investments following NAFTA (Mexico Representation 2015).

IMMEX simplifies the requirements and procedures for the *maquiladora* programs and allows manufacturers in Mexico with structured trade plans to temporarily import inputs of goods and services without paying VAT, if these inputs are used in the manufacture of exports (ProMexico 2016b, p.84). There are 5,000 firms registered under IMMEX, employing 2.3 million (ProMexico 2016c, p.23). Large trade promotion policies such as these attract foreign MNCs that create the demand for supporting industries.

A more targeted trade promotion effort is the Sectoral Promotion Programs (PROSEC), which allows firms in specific priority sectors to import duty-free certain intermediate goods used for manufacturing products approved by the Ministry of Economy (Secretaría de Economía (c)). This program is designed to encourage diversification of supply sources (ProMexico 2016b, p.84). Inputs identified by the

Ministry as essential can move more freely into the economy, and gaps in the supply chain can be more easily addressed with cheap imports, benefitting both MNCs and MSMEs that use these goods.

Taking the example of the automotive industry, these efforts focus on reducing barriers to imported inputs, strengthening the domestic market and developing Tier 2 and 3 supplier capacity. Between September 2015 and June 2016, 321 solicitations for the importation of inputs were approved through PROSEC with a value of US\$3,352 million (Secretaría de Economía (2016), p.91).

A scheme for exempting imported inputs was implemented for the electronics industry through PROSEC, enabling the industry to save of US\$62.1 million by avoiding import duties (Secretaría de Economía (2016), p.94). Suspension of import duties for the aerospace industry is done in collaboration with the Ministry of Communications and Transportation, who determines which goods can be exempted (Secretaría de Economía (2016), p.93).

5. RECOMMENDATIONS FOR GOVERNMENT POLICIES TO ENHANCE SUPPORTING INDUSTRIES

This study finds that the Mexican government is interested and active in supporting MSME integration in GVCs due to their large contribution to national GDP and employment. Manufacturing growth is steady in the aerospace, automotive and electronics sectors, and MSMEs participate in all.

Still, there is potential to expand and enhance the integration of Mexican MSMEs in GVCs. MSMEs remain primarily involved in low value-added, labor intensive activities, despite continued heavy FDI in MNC manufacturing operations in Mexico. There are opportunities to improve this situation by addressing MSME limitations in production skills, certifications, capacity, and access to capital.

Current government innovation support programs for MSMEs involve collaboration between federal and state governments, academic institutions, and industry stakeholders; typically taking the form of financing, skills development, R&D/technical support, business facilitation, and trade promotion. With greater coordination and simplification, these programs can make faster progress toward development of supporting industry capabilities and comprehensive integration of MSMEs at all levels. This section presents related findings that may be useful for other APEC economies.

5.1 Best practice findings

This section presents an overview of government efforts in Mexico that literature and interviewees have identified as most useful for facilitating growth of supporting industry and integration of MSMEs into GVCs.

Mexico's high level of collaboration between government, industry, and academia on development of programs to promote manufacturing and supporting industry has resulted in a hospitable environment that attracts MNC manufacturers and provides development and business opportunities for MSMEs. Programs such as ACT can serve as a model.

A diverse range of manufacturing sectors broadens the range of supporting industry capabilities, and improvements in one sector can benefit others. At the same time, programs to promote supporting industry should reflect that the needs of MSMEs vary across sectors, and tailor assistance accordingly.

Continuous gains in productivity are critical to sustaining manufacturing cost competitiveness, especially as Mexico strives to help supporting industry MSME suppliers to move up the value chain towards higher value-added activities.

Based on these key observations, Table 11 below summarizes Mexico's experience in terms of key MSME GVC integration challenges faced, government responses, and best practices that may be applicable in many APEC economies. More detailed reviews of these issues are provided in the following sections.

Table 11: Overview of key challenges to MSME integration in GVCs and related best practices

Challenge	Relevant program	Best practices
<p>Access to credit: high cost to access, low supply, MSME business practices limit access (INEGI 2016a)</p>	<p>SME Fund/National Fund of the Entrepreneur: grants/incentives for productive projects, industrial infrastructure, feasibility studies, training and consultancy services to increase MSME competitiveness and encourage their integration into larger supply chains. World Bank (2010), p.83) (The World Bank (c), p.28) (INADEM n.d.).</p> <p>National Credit Guarantee System: provides government guarantee in lieu of collateral for loans, incorporates novel public auction system where banks bid on guarantees (OECD 2008, p.97).</p>	<p>Competition for funds to productive projects encourages innovation and competitiveness. Providing credit guarantees removes a large barrier to credit access for MSMEs, provides interest lower than market rate, and allows building of credit history (INEGI 2016a)(OECD 2008, p.97).</p>
<p>Human capital/innovation deficiencies: lower educational achievement in MSME workforce, lack of training provided by MSMEs (INEGI 2016a),low participation in R&D, poor access to advanced technology</p>	<p>CONOCER: evaluates and certifies the knowledge, abilities and skills of workers so as to establish guidelines and define technical rules related to labor skills. Has developed a total of 844 competency standards for numerous sectors and has issued a total of 3,603,000 certificates (Secretaría de Educación Pública, n.d.).</p> <p>Productivity Support Program (PAP): Provides grants/incentives for training and technical assistance to MSMEs to enhance their productivity and welfare of workers. (The World Bank 2010, p.87).</p> <p>National System of Business Incubators (SNIE): business incubator program providing services to MSMEs, such as feasibility studies of market opportunities, administrative services, offices, skilled labor and information about access to finance and new technology (Mexico Mission to the EU (2006), p.1).</p> <p>Mixed Funds: provides resources focused on advanced manufacturing through applied research, technological development, reinforcement of Infrastructure and creation and consolidation of research groups and networks and comprehensive projects (World Bank (2010) p.87).</p> <p>The Strengthening Technical Support to Enhance the Competitiveness of SMBs: platform for OEM/MSME collaboration in R&D of new materials and models in aerospace industry. Chose group of MSMEs to advance towards basic aerospace certification (ProMexico 2015c, p.26).</p> <p>CONACyT facilities (CIDESI, CIATEQ, LANIF, CIMAV): laboratories that allow MSMEs to experiment with various technologies and can serve as MNC/MSME collaboration platform (ProMexico 2015c).</p>	<p>Addresses deficiencies in skills in MSME workforce caused by educational system/lack of MSME training (INEGI 2016a), provides tool MNCs can use to verify quality of MSME workforce. Also assists MSMEs with access to information on market opportunities, business administration skills, collaboration on research projects, and sophisticated services/ technology/certification required to participate in GVCs.</p>

Challenge	Relevant program	Best practices
<p>Poor integration between MNC/MSME: lack of connection between MNCs and MSMEs, few local certified suppliers, necessity to analyze cost structure of entire value chain of particular industries (World Economic Forum 2015, p.7, 14).</p>	<p>ACT Model: assesses demand of MNCs, simultaneously assesses capabilities of MSMEs and seeks to form linkages. Over 150 companies have improved productive processes and implemented quality tools as a result of assistance under ACT 2013-2015, business between MSMEs and MNCs was valued at \$13 billion dollars and 487 clients either joined or remained in the supply chain, 37% of these had ties to at least two MNCs (ProMexico 2016c, p.7)</p> <p>ProAuto: union of educational, governmental and banking institutions that seeks to connect MSMEs with foreign companies and support them with credits up to \$2.67 million (ProMexico 2015b, p.13)</p>	<p>Links buyers and sellers, assesses cost structure(s) of value chains, conducts market study to identify supply gaps and includes plan to develop supplier bases. These efforts improve the capacity of MSMEs to meet requirements of MNCs.</p>
<p>Regulatory burdens: difficult/confusing compliance, slow response of public institutions, lack of digitalization, difficult to access government support programs (World Economic Forum 2015, p.8).</p>	<p>“Ventanilla Única” is a one-stop online portal providing trade tools and information on regulatory procedures and government programs for MSMEs. (gob.mx n.d.) (Gobierno de la República de Mexico n.d.).</p>	<p>Compiles relevant information on government and their regulatory procedures in one place, digitizes procedures, promotes consistency, and reduces redundancy.</p>

Source: Washington Core

5.1.1 Financing

Government funding for MSMEs in supporting industries is seemingly best delivered through targeted programs that allocate funds for innovative projects and sophisticated technology and services for which firms must compete, ensuring that key resources go towards high-impact projects. Additionally, those that reduce the barriers associated with accessing credit are also effective. Programs that require MSMEs to spend grants/incentives on high technology services or propose innovative projects to receive funds ensure that government resources are allocated efficiently to innovative, value-added projects.

The SME Fund, which provides funds to firms to promote MSME linkages to MNC value chains and services such as feasibility studies and consultancy, is a good example of a program that encourages efficient projects. Similarly, PROSEC targets resources effectively due to its focus on certain sectors and requirements to receive exemption of import duties, which encourages the diversification of supply sources and eliminating gaps in the supply chain. PROSEC was found to have positive impacts on value added, sales, export, and employment (The World Bank 2010b, p.31). The CONACyT programs provides funds to firms based on merit and quality through competitive applications targeted towards projects focused on scientific and technological innovation in manufacturing processes, encouraging MSMEs to experiment with higher value-added processes and innovate.

The National Credit Guarantee System is another effective financing scheme. This system replaces collateral that MSMEs would otherwise need with a government guarantee, and includes an innovative public auction system where financial institutions bid for guarantees and receive them based on the volume of loans and rate of interest they project. This results in loans for MSMEs that would otherwise not be available at rates below regular commercial loans. It also allows MSMEs to build credit and increase their long-term access to commercial loans. This program effectively addresses one of the

largest barriers to MSME integration into global value chains, access to credit, and simultaneously reduces the financial burden to access credit itself (OECD 2013, p.97).

5.1.2 Skills development - Certification support

Certifications help to provide evidence of the quality and capabilities of Mexican manufacturing MSMEs, which in turn helps economic development by enabling the substitution of higher value added domestically-produced components in the manufacturing value chain and attracting investment interest from OEM and Tier 1 companies looking for new suppliers. The most effective skills development initiatives involve collaboration between MNCs, MSMEs, and government/academia, which gives MSMEs access to industry-relevant advice and skills while creating the potential for future collaboration.

Multiple literature sources and interviewees noted that the complexity and expense of acquiring certifications presents a significant hurdle to MSME participation in MNC value chains. Particularly in high product mix industries like aerospace, the certification requirements that must be fulfilled to be considered as a supplier by MNCs can be challenging. In the aerospace industry, OEMs have their own sets of certifications for parts and processes which MSMEs must comply with to become their suppliers. Given this, government certification efforts that facilitate collaboration between OEMs and MSMEs are the most effective, as MSMEs learn directly from the most experienced and powerful members of the value chain while they receive business facilitation opportunities.

Consequently, the federal and state governments as well as regional industry associations have been active in supporting a variety of certification support schemes. PROCEI's program on Strengthening Technical Support to Enhance the Competitiveness of SMBs in Mexico's Aerospace Sector Supply Chain is an example of a program that not only assists MSMEs to get certifications, but also provides them the opportunity to be evaluated by OEMs. This program led to the AS9100 certification of 17 metalworking MSMEs, allowing them to participate as suppliers for the aerospace industry.

5.1.3 Business facilitation – Supplier matching and market forecasting

Even with the proper certifications, interviewees noted that it is still a challenge for MSMEs to build business relationships with MNCs. The efforts of the Mexican government and industry associations to bridge this divide are critical to expanding MSME involvement in GVCs. Notable among these efforts is ProMexico's ACT Model and Supplier Development Programs. By consulting closely with MNCs about their current and future supplier requirements, and MSMEs about the certification status, ACT is able to help match up both parties' interests to foster mutually beneficial connections to integrate more MSMEs in value chains. This methodology is effective because it seeks linkages between MNCs and MSMEs by assessing what each party is looking for in the other: the future demand for components and processes of the MNC, and the capabilities, quality and certifications of the MSME.

This type of resource allows MSMEs to plan purchases of equipment and decisions on product mix, and helps to inform decisions on plant locations while possibly allowing them to avoid the cost of importing inputs. Having such a resource is important as Mexican MSMEs often lack dedicated staff that can undertake complex studies, and the ACT Model can provide them not only with a detailed projection of the products that OEMs will be demanding in the future, but also can facilitate links between compatible MSME suppliers and OEMs. The program also supports efforts to equip MSMEs with the appropriate technology, skills, knowledge and finance to participate in GVCs.

The OECD lists supplier development initiatives as a policy best practice for MSME support, due to its ability to increase the ability of Mexican MSMEs to indirectly export through value chains, form relationships between MNCs and MSMEs, increasing MSME efficiency, skills and management and eventually allowing them not only to supply MNCs but hopefully expand to new markets on their own

initiative. Supplier Development Programs have spread to at least 20 different cities, and during 2010, 80 large MNCs developed relationships with 5,674 MSME suppliers (OECD 2013, p.120).

For the aerospace sector, FEMIA's current efforts to create a supplier capabilities profile database will strongly complement ACT's efforts by providing MNCs with an easily referenced guide to supplier capabilities.

5.2 Areas for improvement

Mexico has engaged in a variety of proactive efforts to facilitate development of supporting industries and expand opportunities for MSMEs, but there remain opportunities to optimize on these efforts as indicated below.

5.2.1 Accessibility and coordination of government support programs

Government programs are only effective in supporting MSMEs when the beneficiaries are aware of programs and have the capacity to participate in them without significant administrative burdens. Findings indicate that this is an area where Mexico is working to improve. As of 2010 there were 151 Mexican government programs that support MSMEs in some manner, and the 2014 National Survey on Productivity and Competitiveness of Micro, Small and Medium Enterprises (ENAPROCE), found that awareness of support programs was low, and further that "excessive government paperwork and high taxes" was cited as the most significant concern impeding growth among both small- (24.4%) and medium-sized (23.9%) firms. Additionally, the process by which programs are phased in and out makes the support infrastructure confusing and difficult for MSMEs to assess what support exists and how to access it. An industry representative agreed that the bureaucratic procedures required to apply for the support programs can be cumbersome to the point that they dissuade MSME participation.

Another interviewee indicated that, for the aerospace industry, there is a mismatch between financing mechanisms and the industry's needs. Mechanisms are tailored towards a high volume, low mix industry with a production cycle expected to yield returns within ~2 years. However, aerospace requires financing instruments that address the low volume, high mix production cycle. In education, structural issues have led to poor graduation rates, limiting the number of qualified professionals. Industry members have frequently commented on their desire to improve connections between academia and industry, in order to create programs that can produce technicians that are better suited to meet industry requirements.

By creating the INADEM agency and the Ventanilla Única information portal, Mexico is making progress toward better coordination and visibility of its many support efforts, which should lead to greater uptake by MSMEs.

5.2.2 Program evaluation

There is a need for more thorough and regular impact evaluations of MSME support programs in Mexico, so that policymakers can more efficiently make comparisons between programs and optimize allocation of scarce government support resources. The evaluations that exist are largely qualitative and measure factors such as beneficiary satisfaction. Information on program budgets, activities and beneficiaries are difficult to access and indicate a necessity to consolidate information on MSME support as consequence of the absence of a comprehensive structure directing government resources (The World Bank 2010, p.27). More robust follow-up mechanisms are needed for participants and evaluations to move beyond analyzing program activities to assessing program outcomes as well.

6. APPENDIX

6.1 Government programs

Table 12: National program/initiative profiles

Program category ¹⁰	Organization that administers the program	Program name	Program target	Program description	Program results to date
5	Ministry of the Economy	<i>Maquiladora system</i>	Manufacturing MNCs	SEZs that allow manufacturers to import of inputs/ equipment on duty/tariff free basis, no local partner rules-> Encourage FDI + trade w/ U.S. Benefits MNCs, indirectly domestic MSMEs due to opportunities in supply chain.	Mexican exports to the U.S. and Canada increasing by over 600% between 1994 and 2015 with the explosion in maquiladora investments following NAFTA (Mecham, 2013).
5	Ministry of the Economy	IMMEX	Manufacturing MNCs	Simplifies the requirements and procedures for the <i>maquila</i> programs allow for manufacturers in Mexico to import inputs of goods and services without paying VAT, if these inputs are used in the manufacture of exports (ProMexico 2016b, p.84).	5,000 firm registered under IMMEX employing 2.3 million (ProMexico 2016c, p.23)

¹⁰ Program categories

1. Financing
2. Skills development and certification
3. R&D/technical Support
4. Business facilitation
5. Trade promotion

Program category ¹⁰	Organization that administers the program	Program name	Program target	Program description	Program results to date
5	Ministry of the Economy	DrawBack	Manufacturing MNCs	Refund or reduction of customs duties assessed importation of goods which are subsequently exported, came into effect 2001. Prime beneficiaries are MNC manufacturers (U.S. Customs and Border Protection, 2017).	Results unclear.
4	Ministry of the Economy	the Sectorial Promotion Programs (PROSEC)	Manufacturing MNCs	Tax breaks for specific sectors to import manufacturing inputs. Benefits MNCs, indirectly MSMEs due to competitiveness of sector (Secretaría de Economía, n.d. (c)).	3,981 firms have applied and been authorize for PROSEC between 2000 and 2015, applying to 4,817 separate plants (Secretaría de Economía (d) n.d.).
4	INADEM	INADEM Cooperation Agreement w/ U.S. Dept. of Commerce	Manufacturing MNCs	Goal is to link manufacturing clusters in U.S./Mexico using cluster mapping; finds investment opportunities and joint assets. Benefits MSMEs and MNCs, as MNCs can seek suppliers and MSMEs gain exposure. Map is completed and available (U.S. Economic Development Administration, 2016).	Map is completed and available following visit of Mexican pres. To U.S. in 2016, plans for North American cluster mapping tool made.

Program category ¹⁰	Organization that administers the program	Program name	Program target	Program description	Program results to date
1	Ministry of the Economy	SME Fund (Fondo PYME)	Manufacturing MSMEs	Grants/incentives for productive projects, industrial infrastructure, feasibility studies, training and consultancy services. Beneficiaries are MSMEs. Founded 2001	Funds provided rose from US\$41 million to US\$205 million 2001-2006. Between 2004 and 2012, funds were provided to 5,436 projects, which led to the creation of 395,674 jobs and the conservation of 5,330,170 jobs (Fondo PYME, n.d.).
1	Bancomext	Crediexporta	MSMEs	Financing scheme primarily targeted at MSMEs: (i) working capital, (ii) investment projects; (iii) buyer loans; (iv) guarantees (v) credit letters (Club Planeta, n.d.).	In 2010, 47 firms were participating in Crediexporta.
1	INADEM	National Fund of the Entrepreneur (Fondo Nacional del Emprendedor- FNE)	MSMEs	Financial grants for particular projects that encourage the creation, development, productivity, and competitiveness for MSMEs (INADEM, n.d.).	Since 2013, FNE has received 162,000 requests for support and supported over 400,000 total projects with US\$1,756 million appropriated (INADEM 2016, p.97).
1	Bancomext	Crédito PYME	MSMEs	Specialized credit for importing and exporting Mexican MSMEs, including low interest rates, long term credit, access to specialized foreign products and services in foreign and domestic currency (BANCOMEXT, n.d.).	As of 2015, 3,983 MSMEs had received financial support from Bancomext totaling over US\$9 billion, accounting for 88% of all firms assisted by Bancomext (Bancomext 2016, p.43).

Program category ¹⁰	Organization that administers the program	Program name	Program target	Program description	Program results to date
2	Ministry of Economy	National System of Business Incubators (SNIE)	Manufacturing/high-technology MSMEs	Funds projects in 3 types of business incubators: traditional, intermediate technology, and advanced technology, targeted at MSMEs and entrepreneurs (Mexican Mission to the EU 2006, pp.1-2).	2004-2006: US\$34.4 million invested. Works through network of 308 incubators (Mexican Mission to the EU 2006, p.1).
2	The Secretariat of Labor and Social Welfare	Productivity Support Program (PAP, formerly CIMO-PAC)	MSMEs	Provides grants/incentives to training and technical assistance to SMEs to enhance their productivity and welfare of workers (The World Bank 2010, p.87).	2001 to 2006: trained about 1.6 million workers, benefiting more than 226,000 firms.
2	CONACyT	Mixed Funds (Fondos Mixtos)	Manufacturing sector, Not specifically MSME focused.	Measures established in 2002 to support scientific and technological with resources from the three tiers of government. Not specifically MSME targeted, has given most of funds to manufacturing projects.	35 funds (32 state, 3 municipal), since its inception has provided ~US\$600 million to 5,832 separate projects (CONACyT, n.d.).
2	PROCEI	Strengthening Technical Support to Enhance the Competitiveness of SMBs in Mexico's Aerospace Sector Supply Chain	MSMEs + MNCs	OEMs collaborate with MSMEs in research and development of new materials and models to serve industry. OEMs can evaluate potential suppliers and MSMEs can work towards certifications (ProMexico 2015c, p.26).	Has proposal to incorporate equipment to analyze quality of MSME parts/components, chose 20 out of 51 metalworking MSMEs to advance towards AS9100 certification, 17 of which received the certification (CONACyT (a) n.d.).

Program category ¹⁰	Organization that administers the program	Program name	Program target	Program description	Program results to date
3	CONACyT	The Center for Engineering and Industrial Development (CIDESI)	All manufacturers	Provides technological and research services in flexible manufacturing, intelligent manufacturing, high mix and low volume manufacturing for the automotive and aerospace industries (Secretaría de Economía 2016, p.78).	Results unclear.
3	CONACyT	The Future Internet National Laboratory (LANIF)	All manufacturers	Allows MSMEs to experiment with new internet technologies such as the Internet of Things (IoT), Big Data and Cloud Computing (Secretaría de Economía 2016, p.78).	Results unclear.
3	CONACyT	Advanced Materials Center (CIMAV)	All manufacturers	Advanced materials laboratory that conducts chemical analysis, materials testing and magnetism research critical for materials and composites development (Secretaría de Economía 2016, p.78).	Developed a software application that supports commercial aircraft harnesses for Safran Labinal, doubling their production in Chihuahua (Secretaría de Economía 2016, p.78). 511 projects between 2011 and 2015 (CIMAV n.d., p.2). Federal government allocated US\$13.5 million in 2015 (CIMAV n.d., p.12).

Program category ¹⁰	Organization that administers the program	Program name	Program target	Program description	Program results to date
3	CONACyT	Advanced Technology Center (CIATEQ)	All manufacturers	Laboratory, primarily focused on aerospace, in which OEMs collaborate with MSMEs in research and development of new materials and models to serve the medium to long-term needs of the aerospace industry (Secretaría de Economía 2016, p.78).	Results unclear.
2	PROCEI	Center for Training and Certification in Design and Engineering Software (CATIA)	All manufacturers	Provides training and certification center to offer clinics on CATIA and SolidWorks design and engineering software, providing services with high-technology content targeted to the aerospace sector (ProMexico 2015c, p.27).	Since Jan. 2014, three instructors have certified 30 engineers in their area of interest
2	CONACyT	AERIS	Not explicitly MSME targeted.	Seeks to build relationships and innovation networks between peer companies and academic institutions to promote the development and application of new products and contribute to the development of Mexican engineers. Not explicitly MSME targeted (ProMexico 2016b, p.69).	Results unclear.

Program category ¹⁰	Organization that administers the program	Program name	Program target	Program description	Program results to date
2	Ministry of Education (SEP)	Labor Qualification Certification Council (CONOCER)	Not explicitly MSME targeted.	CONOCER promotes workers' development through the evaluation and certification of their knowledge, abilities and skills, with the goal of promoting skills certification to establish general guidelines and define technical rules related to labor skills (CONOCER, n.d.).	From 2007 to 2016, CONOCER increased the number of certifications given from 10 to 752.
2	Federal Environmental Protection Attorney	National Environmental Audit Program (PNAA)	'SME-related'	Voluntary certification program promotes environmental audits to acquire knowledge about how their operations generate pollution and environmental risks, and how they could comply with environmental regulations, apply best-practices and use raw materials and energy more efficiently (The World Bank 2010, p.88).	Between 2000 and 2006, PNAA initiated 4,147 audits, signed 2,285 action plans, initiated 7,390 investments, and granted 1,773 "clean industry" certificates

Program category ¹⁰	Organization that administers the program	Program name	Program target	Program description	Program results to date
5	ProMexico, Bancomext, Ministry of Economy, INADEM	ProAuto	MSMEs	Union of educational, governmental and banking institutions that seeks to connect MSMEs with foreign companies and support them with credits under \$2.67 million. The program also provides information to MSMEs on where to locate businesses and opportunities in the supply chain (ProMexico 2016b, p.13 and Mexico Automotive Review, n.d.).	4,000 MSMEs were elevated in 2015, with the goal to double the figure in 2016. (ProMexico 2016b, p.13) Between 2014 and 2016, a total of US\$45 million was provided to 142 MSMEs (BANCOMEXT 2016a)
5	ProMéxico	National Supplier Development Program	MNCs + MSMEs	Program designed to identify capabilities of domestic suppliers in the aerospace industry and compare that to what is demanded by OEMs and Tier 1 companies, with the goal of integrating MSMEs into their supply chains (ProMexico 2015c, p.39).	Results unclear.
5	ProMéxico	National Assessment of Advanced Manufacturing	MSMEs + MNCs	Planned assessment of advanced manufacturing in Mexico, with goal of identifying gaps in supply chain, acquisitions and supplier development. Largely benefits MNCs, but also exposes MSMEs to MNCs (ProMexico 2015c, p.39).	Results unclear.

Program category ¹⁰	Organization that administers the program	Program name	Program target	Program description	Program results to date
5	ProMéxico	ACT Model	MSMEs + MNCs	seeks to integrate the MSMEs into the supply chains of MNCs by identifying the products they import, searching for and assessing qualified certified domestic suppliers and identifying whether the current installed capacity is sufficient to meet those requirements (ProMexico 2013, p.44).	Results unclear.
2	ProMéxico; the Ministry of Education; FEMIA; Mexican Space Agency; Mexican Council of Aerospace Education	Comprehensive Strategic Program for Aerospace Education	Aerospace manufacturing	Government, industry and academia partnership to develop aerospace education programs that address industry needs and produce qualified engineers and technicians (ProMexico 2013, p.42).	Results unclear.
2	Directorate General of Civil Aviation (DGAC)	The Bilateral Aviation Safety Agreement (BASA)	Aerospace manufacturing, MNCs, MSMEs	Set of minimum standards regarding design and manufacturing processes that was essential to certifying local MSME aerospace suppliers in Mexico. It also covers maintenance of aerospace products, allowing firms focused on MRO or selling repaired components to become certified more easily (ProMexico 2013, p.27).	Results unclear.

Program category ¹⁰	Organization that administers the program	Program name	Program target	Program description	Program results to date
2	INADEM	Network of Entrepreneur Support (Red de Apoyo Emprendedor)	MSMEs.	Entrepreneurial support network that works through 606 locations, a call center and an internet portal to provide consultancy, training and connections with public and private programs for MSMEs (Secretaría de Economía 2016, p.22).	Has supported 940,000 entrepreneurs and 408,000 MSMEs.
4	ProMexico	RedExporta	MSMEs.	Program to establish export networks and consolidate existing export consortia/consolidators to improve competitive capacity of MSMEs and increasing their share of national exports- by encouraging exporting or increasing value-added (ProMexico 2016d, p.31).	Results unclear.

Table 13: State program/initiative profiles

Program category (1-6) ¹¹	State	Organization that administers the program	Program name	Program target	Industry	Program description	Program results to date
1	BJ	State government of Baja California	Law of competitiveness and economic development in Baja California	Companies in general	Manufacturing in general	Eligible companies will benefit the tax reduction and the preferential cost of water and sewage usage.	Establishment of guidelines for further regulations with two regulatory institutions.
4	BJ	Economic development organizations of counties from Baja California, Mexico and California, the U.S.	CaliBaja Mega-Region Initiative	Companies in general	Manufacturing in general	Began as bi-national efforts to promote a market as CaliBaja, it has evolved into a formal partnership of counties in CaliBaja area.	Assessment of the market, agreement signed, creation of asset maps, among other bi-national efforts
1	BJ	COCIT-BC	Fondos Mixtos (Mixed Fund)	Companies in general	Manufacturing in general	Joint fund by the state government of Baja California (whose representative body is COCITBC) and the federal government (through COCACYT) for technological and scientific development.	In 2014, 21.6 million peso was provided through the mixed fund (SIICYT n.d.).

¹¹ Program categories:

1. Financing
2. Skills development and certification
3. R&D/technical Support
4. Business facilitation
5. Trade promotion

Program category (1-6) ¹¹	State	Organization that administers the program	Program name	Program target	Industry	Program description	Program results to date
3	BJ	COCIT-BC	INNOVAPYME	MSMEs	Manufacturing in general	As one of the innovation stimulus program, INNOVAPYME exclusively focus on technology development in MSMEs, with economic and knowledge supports.	Results unclear.
5	BJ	SEDOCO	Advanced Manufacturing Meetings	MNCs and MSMEs	Manufacturing in general	A platform for original equipment manufacturers and small and medium-sized enterprises to interact.	300 companies represented by 15 economies attended. 4,000 one-to-one meetings were held (Advanced Manufacturing Meetings Baja California, n.d.).
1	NL	SEDEC (Secretariat of Economic Development of Nuevo Leon)	FOCRECE	MSMEs	Manufacturing in general	This program provides loans at preferential rates for MSMEs.	Created in 2010, it has realized 20,500 microloans with 49 million pesos until its fifth installment in 2012. In its fifth installment, 12 million pesos was invested to 3,500 microcredits (Ledesma, 2012).
2	CH	ICHMujer (Institute of Chihuahua of Women)	Program for women	Women	Manufacturing in general	Free workshops and financial support for women who want to work, especially single or divorced mothers.	Results unclear.
1	CH	State government of Chihuahua	FADES	MSMEs	Manufacturing in general	Support fund for social and productive development	Results unclear.
1	CH	State government of Chihuahua	FAP	MSMEs	Manufacturing in general	Loan for MSME development	Results unclear.

Program category (1-6) ¹¹	State	Organization that administers the program	Program name	Program target	Industry	Program description	Program results to date
1	CH	State government of Chihuahua	Programa de Mejora de Imagen y Propiedad Industrial (Image and Industrial Property Improvement Program)	MSMEs	Manufacturing in general	Support for last phase of the production process, including improvement of brand image and marketing into new markets with barcode, nutrition table, and other label printing.	Results unclear.
1	CH	Desarrollo a la Microempresa (Microenterprise Development)	DEMIC	MSMEs	Manufacturing in general	Financial support for MSMEs	3,600 creditors (Demic, n.d.)
1	QE	Fideicomiso Promotor del Empleo (FIPROE, Employment Promotion Trust)	FIPROE	MSMEs	Manufacturing in general	financial support to foster development, consolidation, viability, productivity, competitiveness and sustainability of MSMEs, as well as those that promote productive investment to generate more jobs in MSMEs.	# of beneficiaries 2013: 161 2012: 248 2011: 586 2010: 798 (Catálogo de Programas y Acciones Federales y Estatales para el Desarrollo Social, n.d.)
1	QE	State government of Queretaro	Investment	Companies in general	Aerospace	State government announced an investment in the Queretaro Aerospace Park for its urbanization.	Results unclear.
1	QE	Queretaro Institute of Molds and Tooling	Investment	MSMEs	Manufacturing (plastic sector)	Train companies to maintain molds, provide personnel, replace imports	Start in 2015 with 1200 square meters facility (Rosas, 2014).

Program category (1-6) ¹¹	State	Organization that administers the program	Program name	Program target	Industry	Program description	Program results to date
2	QE	Aerospace Cluster	Configuration of more MSMEs	MSMEs	Aerospace	Through a collaboration of more companies and a permanent training center, the Queretaro aerospace cluster aims to develop further with more inclusion of MSMEs in supply chain.	Results unclear.
1	QE	SEDESU (Secretariat of Sustainable Development)	Puedes	MSMEs	Manufacturing in general	Loan for MSMEs for their purchase of equipment or infrastructure	182 million pesos raised in 2016 (Código Informativo, 2016).
2	QE	SEDESU (Secretariat of Sustainable Development)	Competitiveness Program for SMEs	MSMEs	Manufacturing in general	Consulting program for MSMEs enhancing its competitiveness	Examples of programs include development of web platform, implementation of business acceleration model, and support for certification (Queretaro, n.d. (b)). 3.1 million pesos was spent on over 80 supports from January to September 2011 (López, 2011).

Program category (1-6) ¹¹	State	Organization that administers the program	Program name	Program target	Industry	Program description	Program results to date
3	NL	Secretariat of Economic Development of Nuevo Leon	Kaizen program (Automotive Supply Chain Strengthening program)	MSMEs	Automotive	With the aid of Japanese government through Japan International Cooperation Agency (JICA), the business improvement programs were implemented with technical support in the automotive suppliers.	technical assistance was provided to 10 companies to develop a continuous improvement in aspects such as production control, defect identification, and improvements in logistics, among others, to raise its quality level, reduce delivery times and costs (Escalante de León, 2015).
5	QE	SEDESU	PROEXPORT	MSMEs	Manufacturing in general	support programs for exporting companies in a coordinated manner with federal and international rules	Results unclear.
5	QE	SEDESU	DISEXPORT	MSMEs	Manufacturing in general	Support for developing image, packaging, labeling with the aid of graphic design students at Universidad del Valle de México.	300 brands have been made as of December 2015 (Alvarado, 2015).

6.2 Research methodology

The research team conducted literature research on MSME supply chain participation and assessments about supporting industry capabilities in Mexico for the aerospace, automotive, and electronics industries. Aerospace provides an example of a young and rapidly growing industry, while automotive and electronics are two of Mexico's largest and most successful manufacturing sectors. To complement the industry review, government policies and programs to strengthen and expand supporting industries in these manufacturing sectors were analyzed. Literature resources analyzed are listed in Section 7. Additionally, phone interviews were conducted with knowledgeable experts to hear observations on MSME participation in supporting industries, including pertinent government agencies and manufacturers' associations. A list of these interviewees follows in Table 14.

Table 14: Mexico interviewees

Type	Organization	Description
Federal government	INADEM - Instituto Nacional del Emprendedor (National Institute of Entrepreneurship)	Agency of the Ministry of Economy created in 2013 to implement and coordinate national policy on support for entrepreneurs and MSMEs.
State government	State of Baja California - Baja California Trade & Investment	Office responsible for planning strategies to attract investment and expand the supply chain.
Industry Association	Chihuahua Aerospace Cluster	The cluster works to strengthen aerospace manufacturing capabilities in Chihuahua through services such as technology training and certification support.
	INA - Industria Nacional de Autopartes, A.C. (Mexican Association of Automotive Parts Manufacturers)	INA represents and supports companies in the automotive parts sector.
	FEMIA - Federación Mexicana de la Industria Aeroespacial, A.C. (Mexican Federation of the Aerospace Industry)	FEMIA promotes the development of the Mexican aerospace industry at national and international levels.

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