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Microeconomics for Competitiveness

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Aerospace Cluster in Queretaro, Mexico



EXECUTIVE SUMMARY

Mexico is one of the longest democratic political systems in Latin America. It has one of the highest gross domestic product per capita but also suffers from chronic low productivity. Queretaro, a state in the central region, shares a similar competitiveness profile as Mexico. But it benefits from a much safer environment, low perceived corruption, and a growing specialized education. The state hosts a high-performing manufacturing industry spurred by an active local government, abundant natural resources (oil, metals, minerals) and skilled labor force.

The aerospace cluster is a promising cluster for Mexico with more than 200 firms in 18 states. Queretaro hosts one of the most advanced clusters in the country. Aerospace exports have been growing, particularly for assembly operations. The cluster has a strong position in the engines sub-cluster and is developing its aerospace and defense sub-cluster. However, it faces fierce competition from domestic clusters. Baja California, Sonora, Chihuahua and Nuevo Leon clusters are closer to the U.S. border and hold a comparative cost advantage. To compensate for this, Queretaro's current value proposition is offering heavy subsidies to large firms; providing a comprehensive set of training programs at the country's first Aeronautic University (UNAQ); and keeping labor costs under control.

These measures only lower production costs but do not make the cluster competitive. To scale up its productivity, we recommend the following policies: (i) aggressively brand the state as a talent hub to attract skilled labor force at higher levels; (ii) condition subsidies on the development of local suppliers; (iii) set a consistent national demand and supply strategy to leverage the purchasing power of the government with the production capacity of firms; (iv) cut the process, time, and prices of contract enactment; (v) expand airport capacity and reach to reduce transportation costs; (vi) complement the production capability of nearby states; and (vii) include a design and development program in the UNAQ's curriculum of UNAQ tap into the growing market of composite products.

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1. Mexico's Competitiveness

1.1 Country Profile

The United Mexican States ("Mexico") is a large country located in North America, south of the United States and bordered by the Caribbean and the Gulf of Mexico to the east and the Pacific Ocean to the west. Mexico's land area is 1,964,375 square kilometers and has a coastline of 9,330 km. With a population of over 120 million, Mexico is the third most populous country in the Western Hemisphere and the most populous Spanish-speaking country. Mexico's population is young, with a median age of 27.3 years, and highly urbanized, with 78 percent of the total population (CIA, 2014).

The Spanish Empire colonized and ruled Mexico for 300 years; Mexico gained its independence in 1821, and founded the Republic of Mexico in 1824. Following independence, Mexico experienced almost a century of political chaos, marred by the power struggles of historical figures such as Benitez, Diaz, Villa, and Zapata. Political stability was regained in 1929, with the creation of a party structure. The Partido Revolucionario Institucional ("PRI"), a center-left party, controlled politics for seven decades, until 2000, returning to power in 2012.

Today, Mexico continues to be constituted as a federated republic. It has 31 states and 1 federal district, Mexico City, its capital. President Enrique Peña Nieto assumed the presidency on December 1, 2012, and is both the chief of state and head of government. Peña Nieto was elected by popular vote and will serve a single-six year term.

1.2 Mexico's Economic Performance

Mexico has the fourteenth largest economy in the world with gross domestic product ("GDP") in Purchasing Power Parity ("PPP") terms of \$1.25 trillion (WEF, 2014). Since the 1980s, Mexico has pursued economic liberalization policies and ratified numerous trade agreements, including the North

American Free Trade Agreement (“NAFTA”). Mexico is a member of the OECD and considered an upper-middle income country by the World Bank.

Over the past three decades, Mexico’s economy has risen steadily (at annual average of 2.4%) and has been able to diversify its export earnings away from oil. NAFTA played an important role; between 1990 and 2013, the manufacturing sector of Mexico’s economy grew from 7.6% to 17.0% due to an increasing integration of its manufacturing sector into the production and distribution chains of the US companies. Inward foreign direct investments (“FDI”) also increased as a byproduct, which helped to modernize the Mexican manufacturing base. As a percentage of all Mexican exports, manufactured goods increased from 52.97% in 1990 to over 83% in 2013, with the US as their primary destination (UN Comtrade).

Mexico has the second largest economy in Latin America. However, its GDP growth is losing pace vis-à-vis countries in the region (see figure on the right). Further, Mexico’s economic growth is disappointingly low



Source: Authors' own elaboration using WDI data

considering the policy position and manufacturing success. Although Mexico has one of the highest per capita incomes (\$9,750) among Latin American countries, Mexico performs subpar on prosperity indices (i.e., GDP per capita and annual growth rate in GDP per capita). Stagnant productivity, weak public spending, and high levels of inequality help explain Mexico’s poor economic growth and prosperity performance.

In terms of productivity, Mexico has made progress in the last decade. However, Mexico's labor force participation rate (as a percentage of the total population older than 15 years) is also below average for the region (Mexico: 61% compared to 67% for Latin America) and even further when compared the OECD average (OECD, 2014). It also has high labor costs compared to other developing economies and its workers have among the highest annual hours actually worked per worker in OECD countries. Combined with low investments (as a percentage of GDP) in research and development, technology licensing, and patenting, Mexico has been unable to improve its productivity to maximize economic performance potential.

In terms of inequality, Mexico's inequality level has declined by international parameters. Between 2000 and 2010, 17% of the population joined the middle class and Mexico's Gini Index decreased more than other important Latin American countries like Argentina and Brazil. Yet, in Mexico there is almost a 27-fold difference between the average incomes of the top and bottom deciles, and the average annual income of the top 1 percent is 47-times higher than that of the poorest 10 percent (OECD, 2014).

1.3 Mexico's Competitiveness Analysis

1.3.1 Endowments

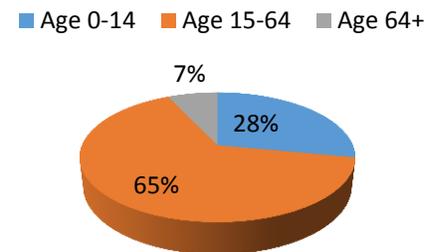
Using the Microeconomics of Competitiveness ("MOC") framework to assess Mexico's competitiveness, we begin with the country's endowments and see Mexico's strategic location to the United States is an important competitive advantage. This proximity offers Mexico a uniquely privileged access to America's large market. Consequently, Mexico benefits from American business outsourcing efforts and both direct and indirect foreign investment.

Mexico is the fourteenth largest country in the world in terms of land area with direct access to both the Pacific Ocean and the Caribbean Sea and Gulf of Mexico. Mexico also has abundant, rich

natural resources. Mexico’s petroleum and natural gas reserves are significant; Mexico also pumps out about 3.46 million barrels of crude oil each day. Unfortunately, Mexico’s petroleum and natural gas output also causes a fiscal reliance on these commodities, which is evident in years where commodity prices fall. Mexico is also strong in minerals and metals. In particular, Mexico is considered a global powerhouse in silver production and is very well regarded for its gold mines and for strong outputs in metals such as copper, lead, and zinc.

Mexico’s population and demographic breakdown are strong endowments. With a population that exceeds 120 million, Mexico has a huge internal market. Also, the median age is 27.3 (see figure on the right), which reflects a growing labor force that is also highly urbanized. Figures show that over 78 percent of Mexicans live in urban areas.

Mexican population distribution (By age group and percentage)



1.3.2 Macroeconomic Competitiveness

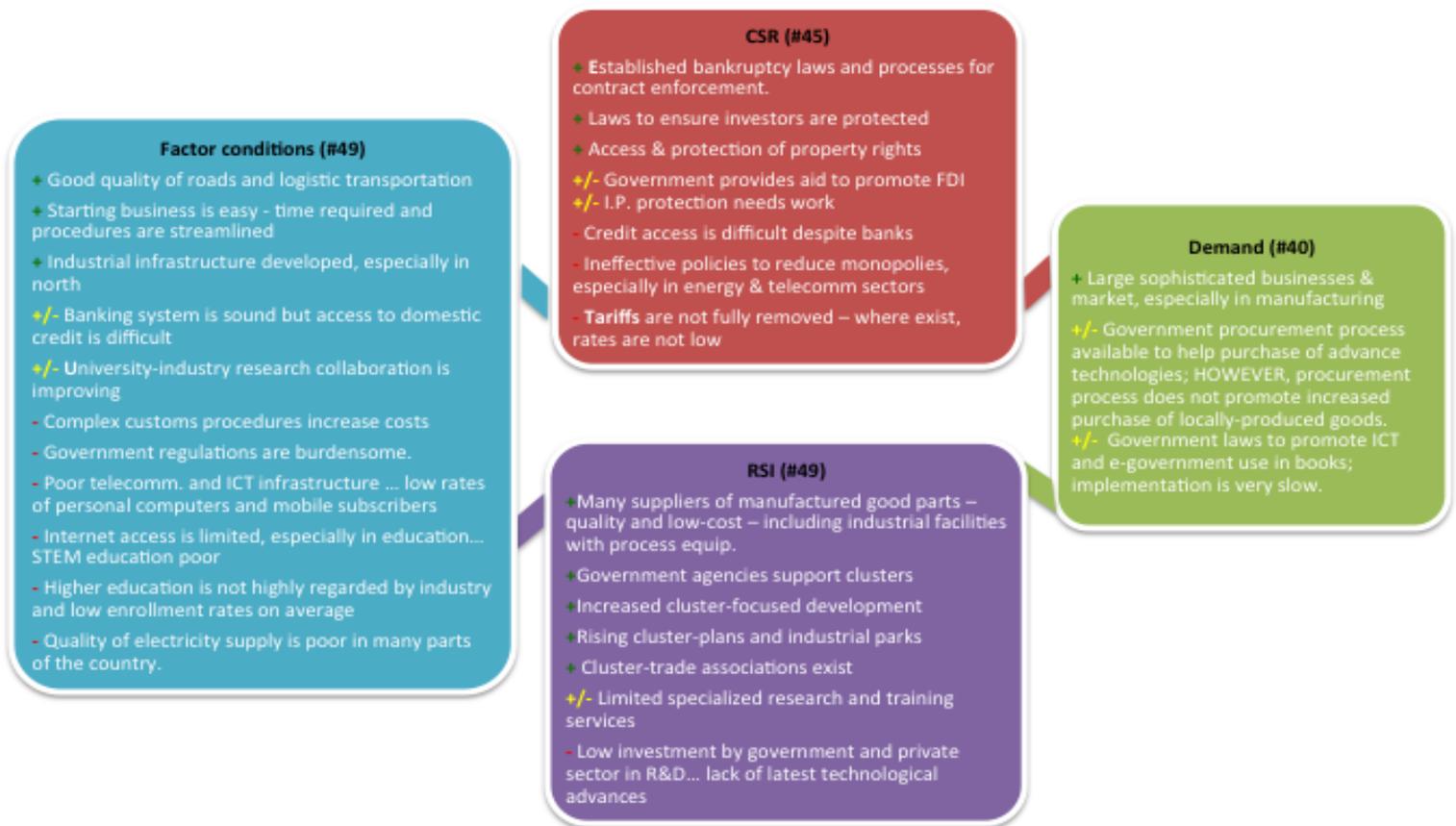
Mexico has managed to establish prudent fiscal and monetary conditions, which have helped keep good levels of confidence in the economy and spur economic activity since 2008. Mexico’s narrow current-account deficit and adequate reserves cushion helped mitigate effects of global currency volatility; the peso depreciated but not as much as other currencies (EIU, 2014). Mexico’s fiscal stance is also disciplined. Inflation is kept within the 2 to 4 percent range, although it did temporarily spiked up in early 2004 to an average of 4.4 percent, a result of fiscal reforms to motivate economic activity (INEGI, 2015). Real interest rates have also declined since the adoption of inflation-targeting policies and a free-floating exchange rate in the early 2000s (EIU, 2014). Mexico’s Central Bank should be able to concentrate monetary policy on supporting growth.

Unfortunately, Mexico faces salient challenges to human development and political institutions. Mexico is a “high human development” country per the UNDP, but its basic education system is a bottom-performer in all three PISA areas. Its levels of inequality hold back further development. And, despite a stable democracy, public trust has eroded by rising perceptions of corruption, especially within law-enforcement institutions and the judiciary. Mexico ranks 103 out of 175 countries for corruption (Corruption Perception Index, 2013). Mexico has not been able to reduce poverty or inequality, which has helped to increase organized crime. Since 2007, homicides rates have sharply risen in Mexico. Drug-trafficking and other organized crime are the primary reasons and among the most pressing issues to businesses and thus competitiveness.

1.3.3 Microeconomic Competitiveness

For microeconomic competitiveness, Mexico’s strengths are in the demand conditions and in its related and supporting industries; challenges are on factor conditions primarily.

Strengths: Mexico’s large, growing internal market helps although buyer sophistication may be low. There are numerous sophisticated businesses, both domestic and international, in the manufacturing sector. And, government procurement processes for advance technologies can help increase; however, they do not promote locally-produce goods. NAFTA helped build domestic suppliers, such as the *maquilas*, which produce quality, low-cost components for domestic and foreign firms. Mexico’s government has positively approached cluster-development at all jurisdictional levels to further promote this competitiveness.



Challenges: Poor education and low R&D investment limit specialized services to develop. As such, industry does not consider Mexico’s tertiary education to be of “quality” (WEF, 2014). Moreover, the telecommunication and ICT infrastructure is poor. Mexico’s burdensome and ineffective regulations hurt firm rivalry by protecting certain monopolies. Resulting poor services from limited competition in energy and telecom hurt businesses. Finally, difficult credit access of SMEs promulgate a large informal economy.

2. Queretaro’s Competitiveness

2.1 State Profile

Queretaro is located in the north-central region of Mexico. It is one of the smallest states of the country, occupying an area of 11,699km². It has a population of approximately 1.9 million people, half

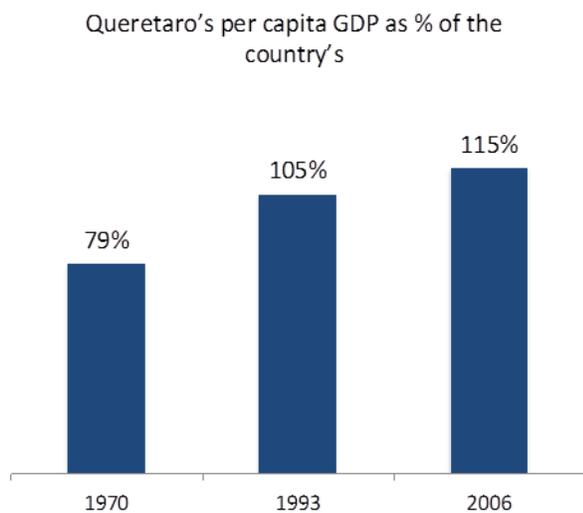
of which concentrated at the capital – Santiago de Queretaro. The majority of citizens is catholic – 96%.

In terms of political system, the governor is the head of state, being elected for 6-year terms. The state is divided into 18 municipalities – each one presenting its own government unit. The state has low fiscal autonomy (in line with Mexico’s centralization), as federal transfers accounted for 86% of revenues in 2010 (Indice de Competitividad Estatal, 2014).

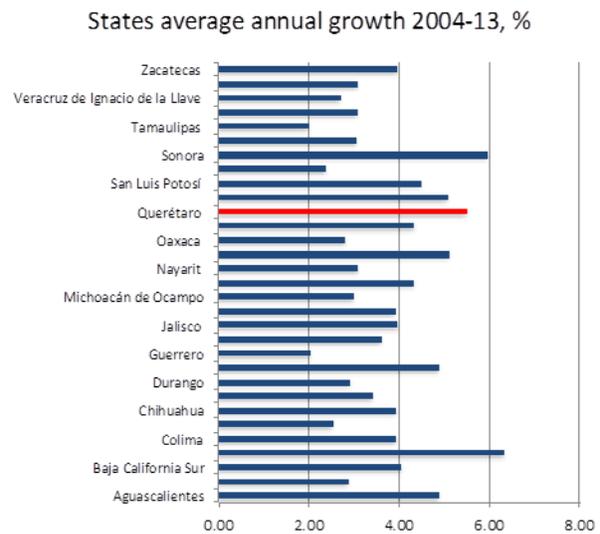
The state presents comparatively high living standards and a diverse economy – sources of immigration. These points will be further explored in this report.

2.2 Queretaro’s Economic Performance

Queretaro has not only “caught up” with the country in terms of prosperity (GDP/capita), but also been an outstanding state in terms of economic growth (See Figure below)

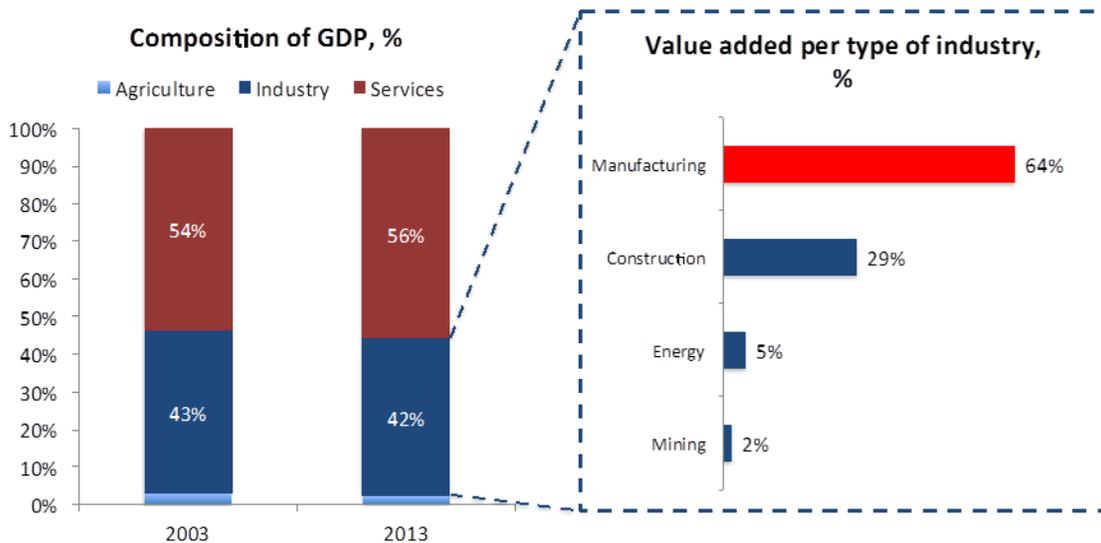


Source: Weis, Rosenblatt, 2010. World Bank Working Paper



Source: Analysis based on INEGI data

In terms of economic composition, the industry plays an important role, having the manufacture segment as the most important driver (see figure below)



Source: Analysis based on INEGI data

2.3 Queretaro’s Competitiveness Analysis

2.3.1 Endowments

Location: the state’s localization in the central region of the country gives it good access to Mexico City. At the same time, it places the state at a “middle ground” position to reach both coasts, and to connect north and south of the country. **Minerals:** Queretaro has a variety of methalic and non-methalic products, including silver, cooper, and opals.

Size: Being a small state might bring disadvantages, such as limited market size. In the case of Aerospace, this fact does not influence significantly, as even large Mexican states have to export their production. On the other hand, being small means it is more manageable in terms of public policy.

Forest land: Queretaro’s area contains species with comercial value, including oak, pine, and cedar. Besides the potential to become raw material, it can be directly comercialized.

Archaeology : The state has important archaeological sites – four of them opened to the public.

2.3.2 Macroeconomic Competitiveness

Queretaro has performed comparatively well in terms of its public debt. The state’s direct debt has stayed below 4% on the last three years of measurement, while its debt as % of guaranteed revenue is one of the best comparing to other Mexican states. In 2012, Standard & Poors upgraded Queretaro’s classification from BBB- to mxAA+ (See Figures below)

The state has also good educational performance (when compared inside Mexico). While the country faces huge challenges in terms of rule of law, Queretaro is seen as a relatively safe place. Moreover, it has the lowest perception of corruption among the Mexican states (See Figure below)

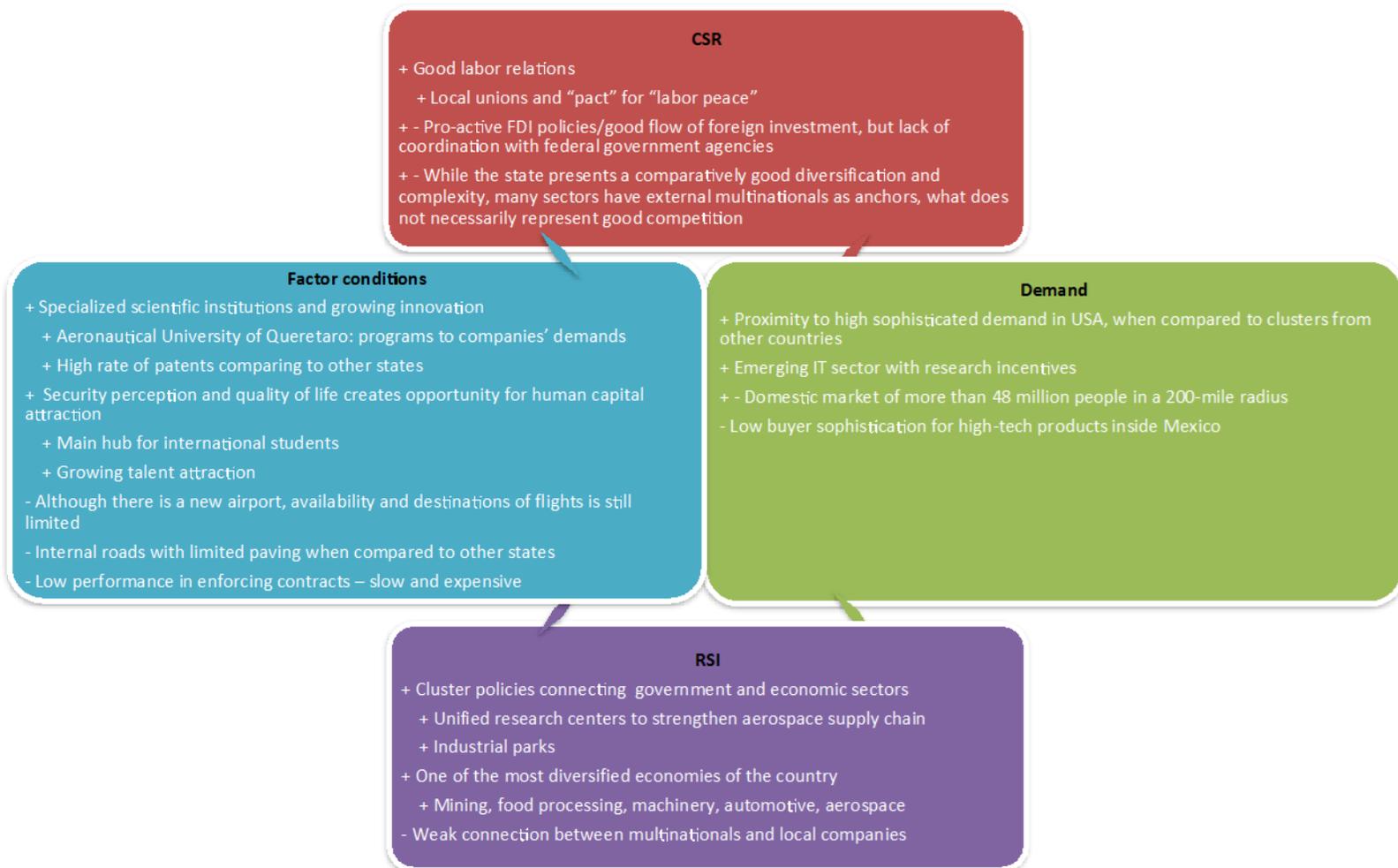
	+ Strengths	- Weaknesses
Human development	<ul style="list-style-type: none"> • Good Human Development Index (0.76) when comparing to Mexico and other states • Good K-12 math performance within Mexico (4th in 2012) 	<ul style="list-style-type: none"> • Low quality of basic education when compared to OECD countries
Political Institutions	<ul style="list-style-type: none"> • Lowest perception of corruption in government acts among Mexican states 	<ul style="list-style-type: none"> • Low availability of public information by the government • Low quality of e-gov
Rule of Law	<ul style="list-style-type: none"> • Relatively safe place, with one of lowest insecurity perceptions in Mexico 	<ul style="list-style-type: none"> • Low performance in contracts’ enforcement – relatively slow and expensive

2.3.3 Microeconomic Competitiveness

Potential hub for innovation

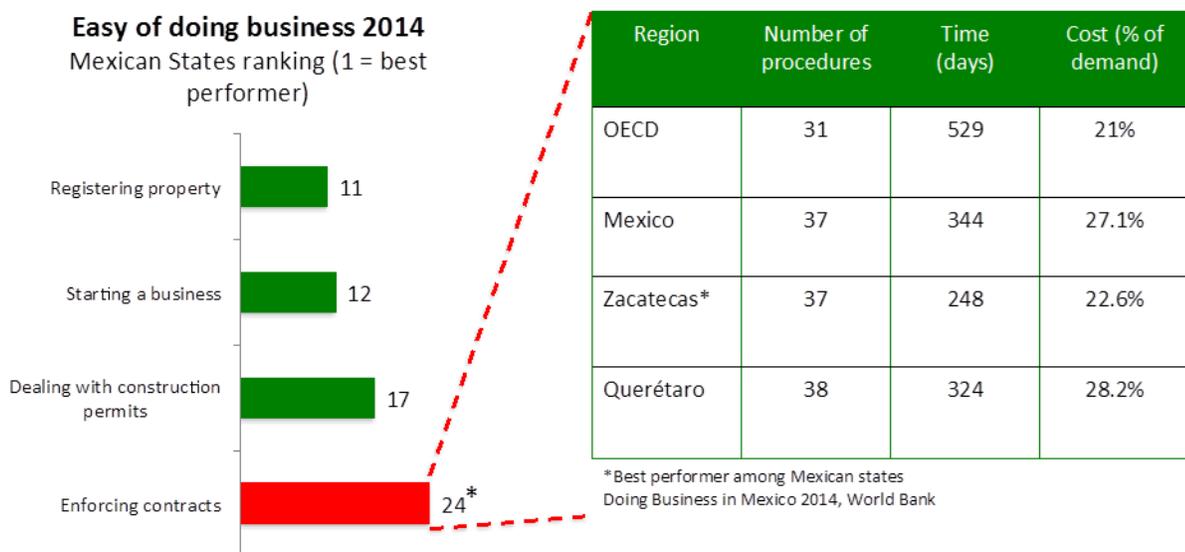
Queretaro offers one of the strongest innovation environments in Mexico, ahead of the main competitor states in terms of aerospace clusters, such as Nuevo Leon, Baja California, and Sonora. In

terms of number of patents, Queretaro is the second best performing state out of 32 states (Indice de Competitividad Estatal, 2014). It has also one of the strongest Scientific and Research Institutions, including the aeronautic sector (Aeronautical University of Queretaro and its connected research centers). This is one of the sources of human capital attractiveness. Queretaro is also the second best state in talent attraction, and the main pool for international students. While part of the story can be explained by the research & innovation environment, the other part is related to the living standards of the state. Queretaro is seen as relatively safe place at an overall violent country. This is enhanced by the good comparative basic education and by the proximity to Mexico City and other Central areas.



Problem in contract enforcement

Although Queretaro’s business environment performance is in line with the one of other Mexican states, it has a specific challenge in enforcing contracts – they follow more bureaucratic procedures, take longer, and costs more than the majority of other states (See Figure).



Source: Doing Business in Mexico 2014, World Bank

Diversified Economy x missing linkages

Queretaro has one of the most diversified economies of the country. It’s industrialization began substantially at the 40s. Given their mineral endowments, mining was one of the first sectors to flourish. At the same time, textiles, agro industries, and food & beverages were established at the state. Some relevant companies representing this first move were Singer, Tetrapak, and Kellogs. Between the 60s and the 80s, the mining opened space for metal mechanics, which were also accompanied by Chemicals and home appliances. Companies like General Electrics and PPG represented this second wave.

Finally, the 90s introduced a further industrialization step toward more complex segments. Taking advantage of the metal mechanics sector, the automotive and aerospace took place in Queretaro. At the same time, electric & electronic companies “evolved” from the home appliances segment. Some of the strong companies from this period include IBM, Scania, Eaton, Michelin, and Bombardier.

This industrialization process led to a relatively diversified economy (for Mexican standards), what is a positive sign towards economic prosperity. During this process, the establishment of multinationals represented an important step, as they became anchors for different segments – textiles, food processing, electric, car, and aerospace, for instance.

Although this process brought undelieble positive results, two points of attention should be made. First, as many multinationals became anchors, they did not necessarily faced competition inside the state. This is not a problem per se, as usually such competition occurs with firms in other states and even other countries. Second, as many multinationals moved to the state, there is initially a distance between them and local companies. In some cases, these links are made, but in others the missing links between multinationals and local suppliers persist, as those prefer to buy inputs from outside. One of this examples can be found at the aerospace cluster, what will be further explores at this report.

Other challenges: internal infrastructure

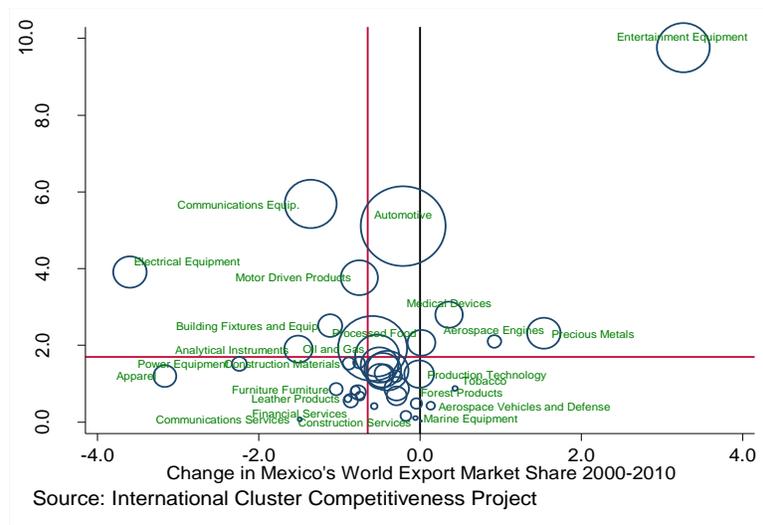
As remaining issues, it's relevant to point out internal infrastructure challenges. Queretaro's has one of the lowest rates of paved roads among Mexican states, factor that is followed by a large rate of accidents (Indice de Competitividad Estatal 2014).

Even more relevant, the state doesn't perform well in terms of air traffic. Although Queretaro recently built a new airport, the availability of flights seems to be limited, as well as destinations. This might represent a relevant barrier to export lighter products.

3. The Aerospace Industry in Mexico

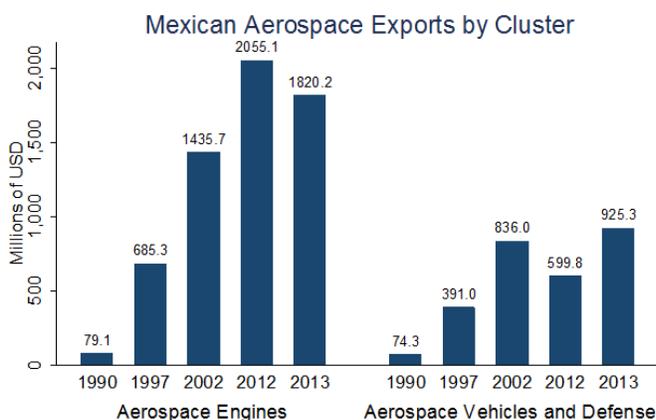
3.1 Country Cluster Profile

Even though Mexico is overall losing world market share on the majority of the clusters, clusters related to aerospace such as Aerospace Engines and Aerospace Vehicles and Defense are all growing. This means that the aerospace industry in Mexico is likely to become more important in the years to come.



3.2 Mexico's Aerospace Exports

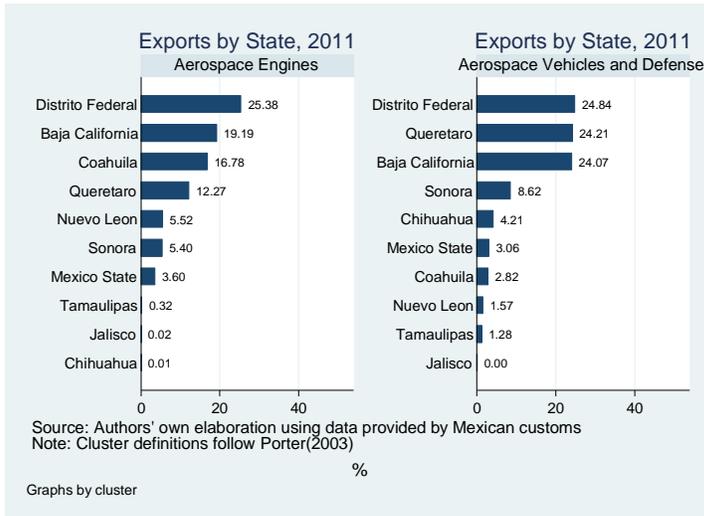
3.2.1 Exports by sub-cluster



Aerospace exports have been growing over time, although as a percentage of total Mexico's exports both clusters combined represent less than 1%. Disaggregating by sub clusters (not shown), engines is the

Source: Authors' own calculations using UN-Comtrade
 Note: Cluster definitions are based on Porter (2003)

most important category, while defense is almost negligible.



3.2.2 Exports by state

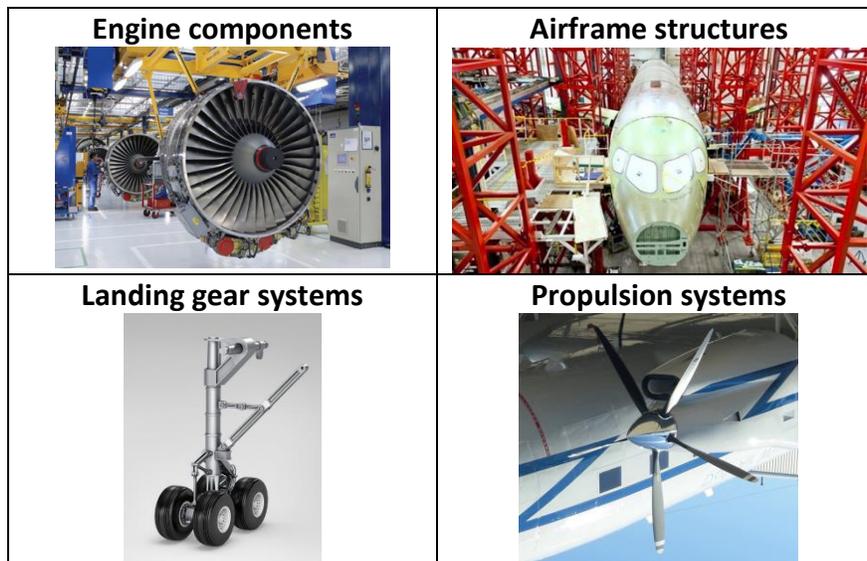
Despite representing 2% in total country exports, Queretaro represents nearly 15% of Mexico's total Aerospace exports. It is the fourth most important exporter of Engines and the second most important exporter of Vehicles.

4. The Aerospace Cluster in Queretaro

4.1 Cluster Products

Queretaro's manufacturing capabilities are overall composed by propulsion systems, airframe structures, subassemblies and subsystems, engine components and landing gear systems (see below).

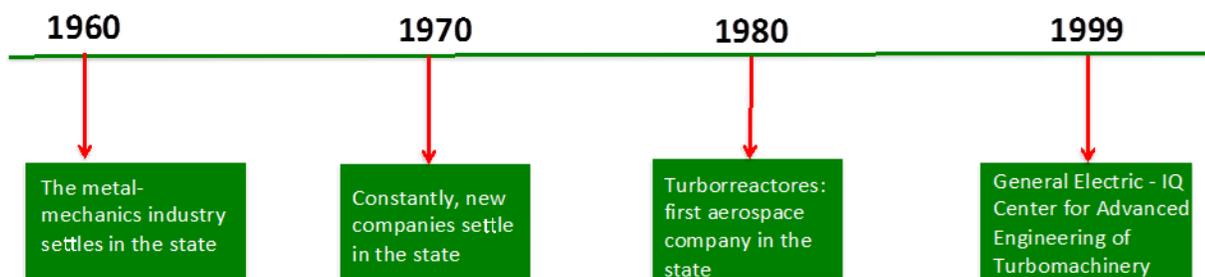
Its long term vision is to become a hub for complex machining processes and MRO.



4.2 History of the Cluster

The history of the cluster of Queretaro can be divided in two phases: the pre-cluster policy and the post-cluster policy. The first phase dates back to the 1960s when the metal-mechanics industry settles in the state. This industry rapidly modified the economic profile of Queretaro and its sociodemographics characteristics. In a period of less than 10 years, industrial development bolstered in the late 1970s with new companies.

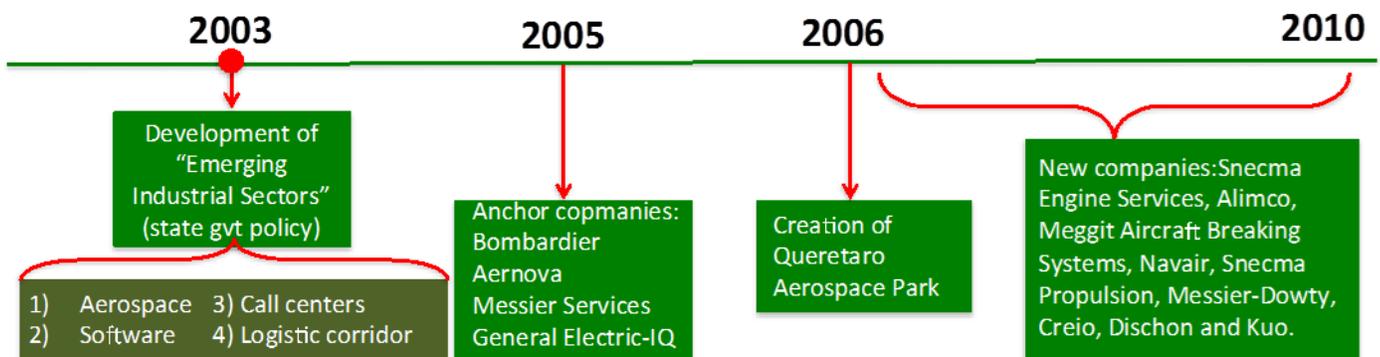
The first aerospace company was “Turborreactores”, a Mexican company specialized in turbine manufacturing, which settled in Queretaro in 1980. Later, in 1999, General Electric-IQ started designing turbines and components. Nonetheless, by this time there was not specific government policy to develop the aerospace industry in Queretaro.



The second phase started with the state government administration 2003-2009, which had the objective to develop what they called the “Emerging Industrial Sectors”. These sectors were aerospace, software, call centers and logistics. With this view, the aerospace industry became a policy priority in the Queretaro’s development plan 2004-2009. The first thing that the state government did in 2004 was to substitute the old airport, which was only used for domestic flights, to start operating the International Airport of Queretaro.

Later, in 2005, the state government attracted Bombardier Aerospace as an anchor company. Like this one, some other companies also settled in the state such as Aernnova, Messier Services, Snecma Americas, Messier Dowty and Snecma Propulsion. In 2006 the state government invested 200 USD million to develop the Aerospace Complex, which included the creation of the Aerospace Industrial Park of Queretaro.

In 2007 the government of Queretaro also created the National Aeronautics University, which had access to the Aerospace Industrial Park of Queretaro and the International Airport of Queretaro. From 2005 to 2010 was the most fecund period in the local aeronautics industry in Queretaro, with the start of operations of multiple companies such as Bombardier Aerospace, Aernnova, Snecma Engine Services, A.E. Petsche Co., Messier Services Americas, Elimco, Meggitt Aircraft Breaking Systems, Navair, Snecma Propulsion, Messier-Dowty, Crio, Dishon and Kuo Aerospace.



The public policies designed by the state government of Queretaro to develop and maintain the aerospace cluster could be summarized in the following fields:

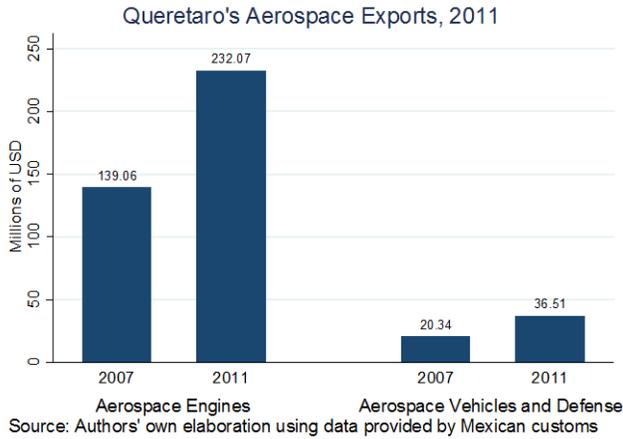
Foreign direct investment: aerospace companies get VAT returns in 5 days; there is also no import tax for these companies. **Logistic platform:** the state invests resources to generate infrastructure, such as the investement in the previously mentioned Aerospace Industrial Park. It also supports

economically to aerospace companies to settle in the state. The economic support can be through acquisition of machines and technologies. **Technological innovation and development:** both the state and national government have funding programs for research and development for the aerospace industry. **Support to local companies:** with state and federal funds, the government offers to SMEs 70% of the costs for certification programs to be suppliers of multinational companies. **Education focused on competencies:** the state government created the National Aeronautics University, which is fully government-funded, and is the training center for different levels, from technical to post-graduate. The government also has the program “Becate” (get a scholarship), which offers training scholarships for the aeronautic sector, including professional training abroad.

This educational policy is the main subsidy in the cluster policy, because it practically offers multinational companies the possibility to train their employees for very low costs or even for free.

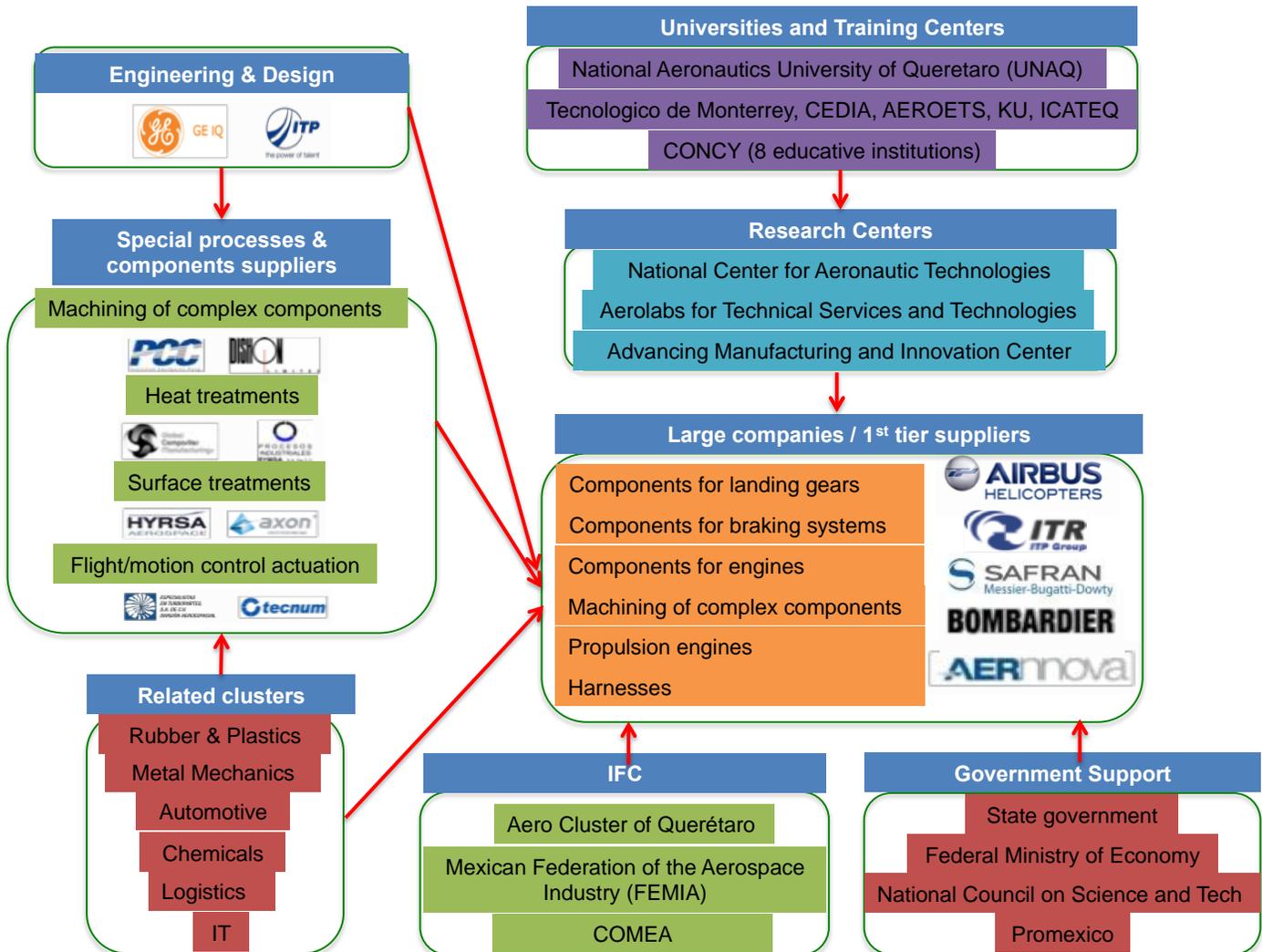
4.3 Cluster Performance

According to state governor Jose Calzada, the aerospace sector in Queretaro is growing at annual rate of 15% compared to 10% nationwide. This is reflected in a number of metrics; while in 2005 there were only 2 companies established in the cluster (General Electric and Turborreactores), by 2013 this number had grown to 34 (Salinas, 2014). In parallel, Queretaro’s cluster is the cluster which receives the largest amount of FDI at the national level according to FDI magazine. In terms of employment, the aerospace industry in the state is employing over 4800 people, and from 2010 to 2012 the employment growth rate was 255% (Secretaria de DIllo. Sustentable, 2010). The employment growth rate is mostly propelled by the arrival of new companies and less so by the growth of incumbents since only three of the firms in the cluster have over 500 employees.



Queretaro's aerospace exports have been dramatically growing over the past years; between 2007 and 2008 Aerospace Engines' exports grew at a compound annual growth rate (CAGR) of 13.7% and Aerospace Vehicles exports grew at a CAGR of 15.7%. This is way above the national trend of 3.7% and 0.9%, respectively.

4.4 Cluster Map



4.5 Domestic Competition

Querétaro faces fierce competition from rival clusters. In general, the most relevant clusters (Sonora, Chihuahua, Nuevo Leon and Baja California) are closer to the U.S. than Queretaro, forcing the latter to diversify its export destinations to both U.S. and Europe. More specifically, among the areas where the clusters compete, three of them stand out: **value chain focus, training, and manufacturing inputs.**

- In **value chain**, Querétaro focuses more on complex machining and maintenance, repair and operations (MRO) but competes with the work of Nuevo Leon on advanced manufacturing and MRO (EY, 2014).
- Competition is also present in **training** provided to workers. While Querétaro funded the first aeronautic university where 2/3 of Bombardier labor force studied, Nuevo Leon does not lag far behind with technical schools offering customized training to firms (EY, 2014).
- In terms of **manufacturing inputs**, Bombardier in Querétaro employs composites to produce 85% of its manufacturing parts while Nuevo Leon mainly uses metal components. Composites are gaining market share compared to metal components given their lighter weight and anti-corrosion property which benefits fuel-efficient and environmentally-conscious manufacturers (EY, 2014).

Queretaro (Complex machining, MRO*)	Nuevo Leon (Advanced manufacturing & MRO*)	Baja California (KPO® leader for fuselage systems and power plants)	Sonora (Manufacture of turbine and engine components)
+ Only aeronautic university (from basic training to graduate degrees)	+ Technical schools offer customized programs and respected research centers with large R&D in aerospace	+ Integrated into Pacific aerospace corridor connected to Seattle hub	+ Integrated into Pacific aerospace corridor connected to Seattle hub
+ Pro-active policy to attract aerospace FDI	+ Presence of metallurgic industry producing cheap aerospace inputs	+ Large concentration of complementary firms in value chain	+ Precision machining technology to reduce product costs
+ 85% of Bombardier's production employed composites	+ Strong supply network due to manufacturing experience across various	+ Focus on composite components gaining market due to weight, resistance	+ Large airport infrastructure to reduce transport costs
- Furthest from U.S.	- Low government support	- Too much dependence on U.S. market	- Too much dependence on U.S. market
- Losing Canada market	- Metal components losing market due to weight	- High reliance on outsourcing	-
- University focused on manufacturing, not design			-

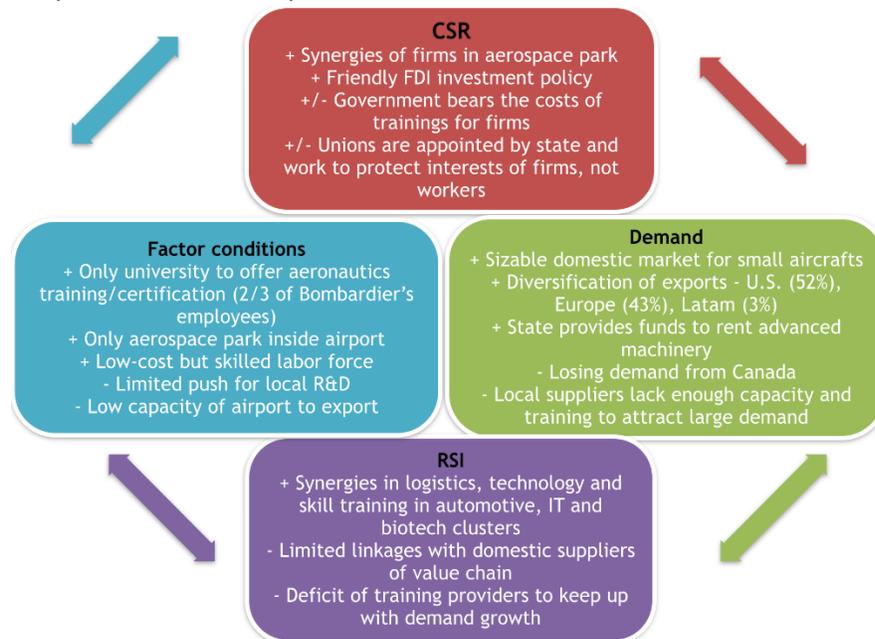
4.6 International Competition

Mexico	Brazil	Canada
+ Low costs and skilled workforce	+ Embraer: 3 rd largest aircraft manufacturer	+ Bombardier: 4 th largest aircraft manufacturer
+ Sizeable domestic market for small jets, helicopters	+ Aerospace cluster in one city (Sao Jose dos Campos)	+ 20% of industry activity dedicated to R&D
+ Similar time zone to U.S.	+ Design and innovation as DNA	+ Concentrated in eastern Canada (60%)
- Manufacturing, not yet design	- Too few airports and old Air Traffic Management	- Debt is more than twice market value
- Little coordinated production process	- Shortage of qualified professionals	- Shares have slumped 40% in a year
- Not R&D-driven, no product integration	- Outdated tax system	- Have yet to enter large jet market

Mexico as a country also faces intense competition from more advanced clusters in the region. In Brazil the cluster is based only in one city and in two cities in Canada whereas there are up to 280 companies scattered in 18 states throughout Mexico (Monterrey Aerocluster, 2015). This level of agglomeration enables Brazil and Canada to exploit synergies more than Mexico's clusters which tend to offer differentiated services without cooperating among themselves. This level of cooperation is reflected in the planes that each city can manufacture and R&D investment.

The cluster in Brazil assembles Embraer planes while Montreal does the same for Bombardier. But Queretaro just discontinued the production of the only plane entirely assembled in Mexico, the Learjet 85. Also Brazil's cluster focuses much more on design and innovation while in Canada 20% of the industry activity is dedicated to R&D (Canada Industry, 2014). In Mexico, on the other hand, the industry focus is entirely on manufacturing without a product integration strategy across the country.

4.7 Cluster's Competitiveness Analysis



The cluster competitiveness in Queretaro has some pros and cons but three main issues stand out. Two issues concern factor conditions and the other touches on related and supporting industries (RSI):

I. Limited linkages with domestic suppliers in value chain

Global patterns suggest that Original Equipment Manufacturers (OEMs) are moving towards vertically building their global supply chain networks (EY, 2014). But in the case of Querétaro more than 50% of the main aerospace firms have brought along their own foreign suppliers. And less than 40% of these firms plan to develop local suppliers (Salinas, 2014).

The lack of incentives to develop existing local suppliers can be explained by their auto origins and limited specialization. Local suppliers are mainly spin-offs of auto and metal mechanic firms that lack international aerospace certification (NADCAP, ISO 9001, BASA). Thus, it is easier for firms to relocate already certified companies rather than having to train and certify them.

Moreover, even when local suppliers are certified, they lack the specialization needed to attract enough demand to survive in the aerospace industry. While the auto industry is a high demand, low mix business, the aerospace industry is a low demand, high mix business. Hence to become a competitive supplier, companies need to become very specialized. And that it is not the case of spin-offs of auto companies in Queretaro who mainly seek to provide similar services provided to auto firms.

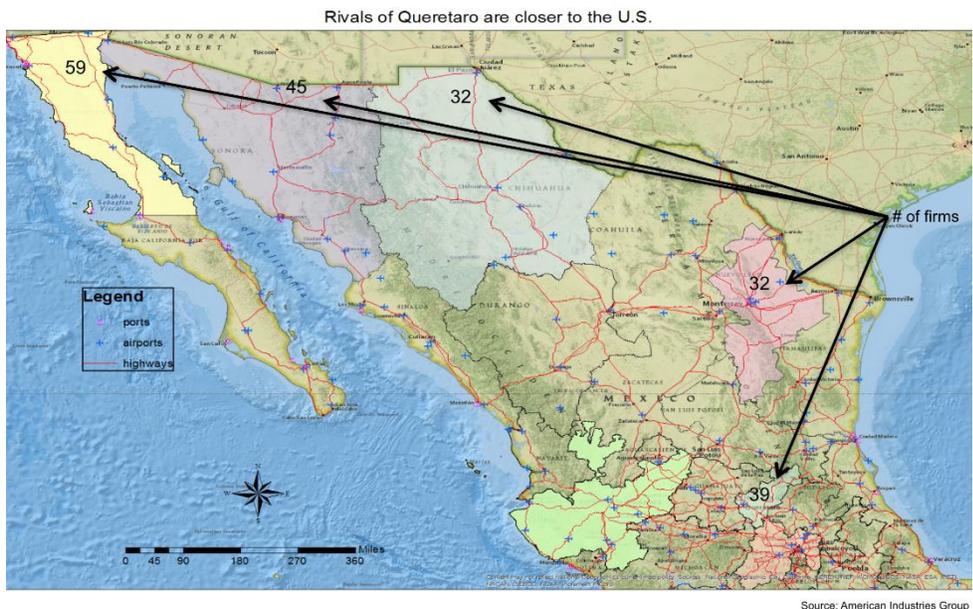
II. Limited Push for R&D: Lack of university curriculum on design

Recent movements in the aerospace industry show that OEMs are increasingly focusing on fuel-efficient and environment-friendly products to remain competitive (EY, 2014). This focus has led

OEMs to purchase composite products that are lighter and less polluting. In Querétaro, the development of composites is gaining popularity through the establishment of LABTAB - a lab that focuses on testing the level of duration of composite material, among other things.

However, Bombardier, which manufactures 85% of composite materials in Queretaro, recently discontinued a large part of this activity without having transferred its technology. Despite the global patterns, local testing knowledge and past demand from its anchor company, the *Universidad Aeronáutica en Queretaro* (UNAQ) still lacks a curriculum in the design and development of composite materials. Its program, from basic training to graduate level, focus entirely on manufacturing (EY, 2014).

III. Airport infrastructure is limited for needs

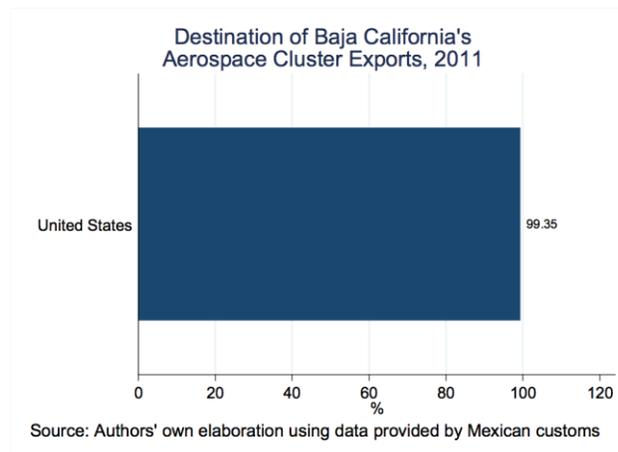
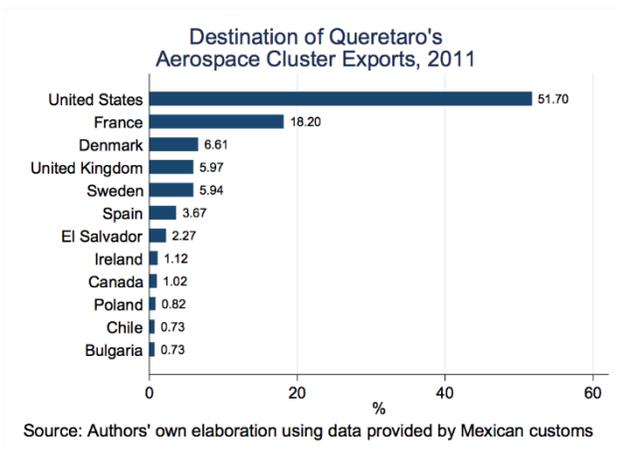


OEMs are outsourcing manufacturing in proximity of the U.S. to lower costs in lean times (EY, 2014). This pattern explains the development of Mexican clusters

(Baja California, Sonora, Chihuahua and Nuevo Leon) close to the U.S. border as shown in the map.

The large distance of Queretaro to the border poses a cost disadvantage for the state. A broad approximation suggests that while it costs U\$ 150 in tolls to ship a 9-axle truck from Queretaro to Reynosa-U.S. customs (917 km and 9 hours), it only costs U\$ 80 in toll from Chihuahua to Ciudad

Juarez-U.S. customs (351 km and 3.5 hours) (STC, 2015). Although this approximation only looks at tolls, it can be used a proxy given transport cost is a function of distance (fuel), time (wage and depreciation) and mode of transportation (fuel efficiency). Moreover, this cost disadvantage is reflected in the composition of Queretaro’s export destinations vis-á-vis bordering states. For instance, while 50% of exports from Queretaro go to the U.S. and 44% to Europe, Baja California’s exports entirely end up in the U.S. market. But distance is not the only disadvantage. The state airport has limited capacity to export large aeronautic parts. Only 2.44% of the exports exit through the state airport while 44% leave via airports in nearby Toluca and D.F and 47% do so through Reynosa.



4.8 Strategic vision, challenges and recommendations

4.8.1 Cluster's Current Value Proposition

Mexico has structured a value proposal which is mostly centered on manufacturing activities at comparably cheaper production costs. The manufacturing of aerospace components and structures represents the largest portion of activities performed by aerospace companies in the country with 76.56%, followed by maintenance, repair and operations with 11.33% and design and engineering with 5.86% (Salinas, 2014). Industry's production costs are 21% lower than in the United States, 11% lower than those of China and 3% lower than those of India (Salinas, 2014). These cheap production costs are achieved through a combination of cheap labor force, and significant government benefits like special infrastructure investments (building of aerospace parks), special tax breaks (no import tax for related inputs), among others.

Querétaro follows the national trend by offering the world its manufacturing capabilities combined with relatively cheaper production costs, however, unlike other Mexican states it offers three important advantages: a safe and developed industrial environment (specially through the automotive cluster) which is well connected with the capital of the country, second, a skilled labor force, trained locally through the first aerospace university as well as overseas. Third, a higher involvement of the state government allowing Querétaro to offer distinct opportunities for international companies: financial aid to purchase machinery, aid for local suppliers to get international certification, and important investments in infrastructure such as the aerospace park, the upgrading of the airport, among others.

The combination of skilled labor force and the state government's involvement (see above) has allowed Queretaro to become one of the leading states in receiving the most important aerospace projects in the country, even though it houses a lot less number of companies vis-a-vis other states

(like Baja California). For example, the state is home to Bombardier Aerospace, dedicated to the manufacture of executive and regional aircraft, and Airbus Helicopters (which are two of the most important aerospace OEMs worldwide). The State also houses eleven Tier 1 units (Salinas, 2014).

Even though Queretaro's labor force is in better position than other states, it is still unable to help move the cluster up the value chain towards significantly higher value added activities. The reasons behind are multiple: (i) university although prestigious fails to prepare students for more R&D, design or engineering type of jobs; (ii) there is very little demand for design or engineering jobs, since most of the R&D activities are done in the companies' HQs while local labor demand is focused on the attraction of certified technicians; (iii) there are very little linkages with local suppliers which may propel demand for more highly skilled local workers. Given this scenario, and notwithstanding the fact that Queretaro offers a more value-added proposal versus other states, the value proposition of the state to the world is still very much like the national trend which is mainly centered around offering manufacturing activities at significant lower costs.

4.8.2 Recommendations

Most of our recommendations are related to factor conditions. We believe Queretaro needs to consolidate the factors that can level the playing field to scale up in the value chain.

At national level

- 1. Promote the government purchase of locally-produced aircrafts.** Given the industry is a low-demand, high mix business, the government could leverage its purchasing power to spur local demand by guaranteeing the purchase of domestically produced jets and helicopters for its security fleet. So far the Mexican government purchases Brazilian and Russian aircrafts. Had

the government ensured the purchase of the Larjet 85 from Bombardier, it might not have discontinued its production.

At state level

- 2. Forge an alliance with other aerospace clusters within Mexico.** While most countries have one aerospace cluster (Brazil, France, Canada) or between 2 and 3 in the case of relevant players (USA), Mexico has over 5 agglomeration nationally identified as clusters. Furthermore, these clusters compete with each other for the attraction of foreign companies while collaborating very little. A clear example is that the product capabilities of Nuevo Leon and Queretaro complement each other greatly in the value chain. Yet little if no cooperation exists among the clusters despite being connected through the same eastern corridor and shipping exports via the same customs. The alliance could guarantee exchange of technology and shared input materials and transportation to reduce costs.
- 3. Launch a brand strategy to market the state as a main talent hub for innovation.** Queretaro's has a large potential to attract talent given its close location to Mexico City and education opportunities. It also outcompetes its rival clusters in the U.S. border in security issues. However, the government does not have a marketing strategy to attract talent neither from competing rivals nor from Mexico City. The campaign should target these locations specifically to reach out to the right engineers.
- 4. Improve contract enforcement in Queretaro.** Lack of contract enforcement affects negatively the business environment of the state, especially in an industry characterized for its low demand nature. The lack of enforcement means that if one contract falls through, it is hard for a company to compensate by jumping to another offer quickly. The government can reduce

this level of uncertainty by reducing procedures, cost and time to enforce contracts as well as penalize more severely those companies that do not abide by the contract rules.

- 5. Expand airport capacity, destinations and create a performance-based tax credit to attract cargo companies to the airport.** The state airport has not only limited cargo providers but the existing ones do not normally travel to the main destinations of Queretaro's exports. To attract these, the state first must expand its airport capacity. Then it should create a performance-based tax credit to attract cargo firms to avoid handing out subsidies further. This credit can then be phased out once companies start capturing the state export growth.

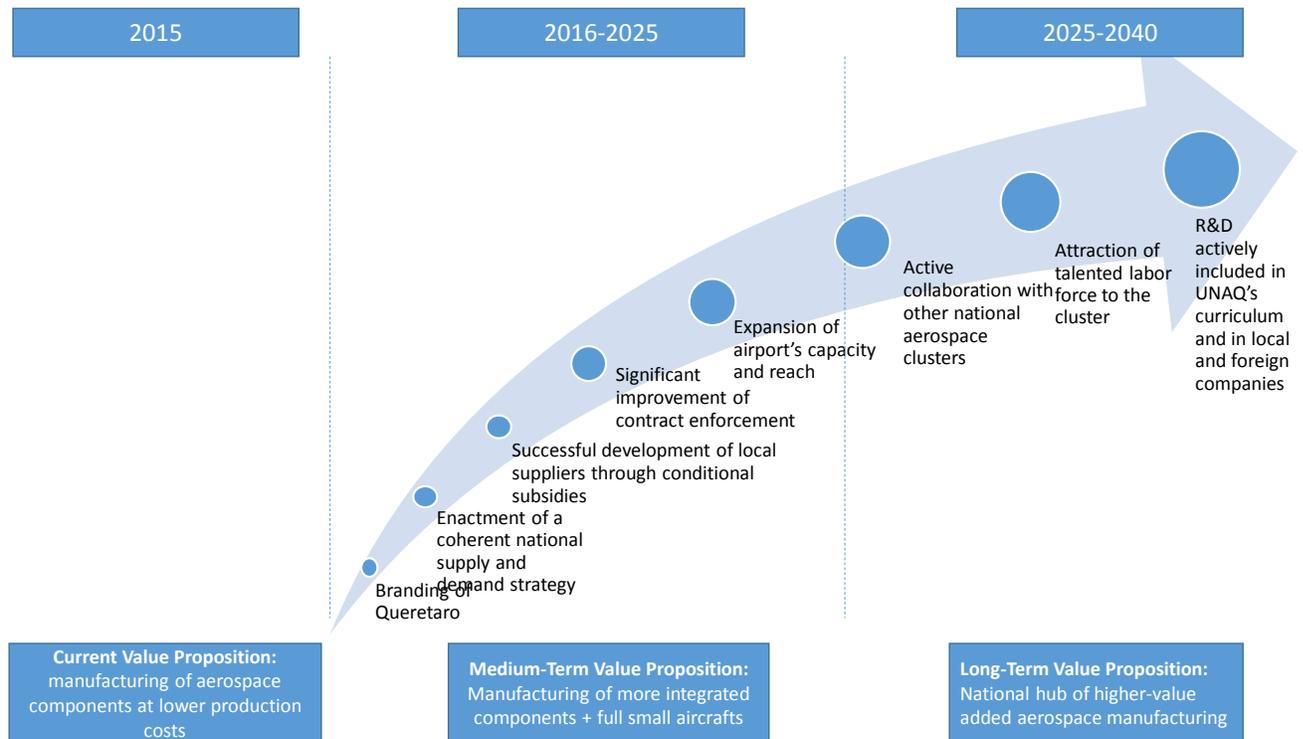
At cluster level

- 6. Include courses on design and development of composite materials in UNAQ's curriculum.** The university program so far focuses entirely on manufacturing despite a growing interest for composite development both internationally and domestically. The university can tap the expertise of Bombardier engineers to help craft the courses and attract experts from the other clusters through the talent campaign.
- 7. Condition FDI subsidies of state agencies on the development of local suppliers.** So far OEMs receive heavy subsidies without leaving in place any technology transfer or developing local capacity to support their operations. If they leave, little knowledge will be left behind. Therefore, helping the development of local suppliers in exchange of the subsidies can help the cluster improve their competitiveness in case OEMs leave the country in the future.

4.8.3 Cluster's Recommended Value Proposition

Queretaro aerospace cluster's current value proposition is centered on the manufacturing of components (mainly engine components) at lower production costs. This is not only reflective of the

overall national value proposition in aerospace but of the Mexican manufacturing industry in general. Unless important policies are introduced, the aerospace cluster in Queretaro risks emulating the “maquiladora” model in which the country’s main export is a service (cheaper labor or the facilitation of lower costs) instead of a product (a higher value added product from what it is imported).



The chart above depicts the desired outcomes (text box below the circles) which should be achieved upon implementation of the recommendations outlined in the previous section. Transforming the cluster into a cluster centered on higher-value added products with important spillovers to local industries is not an easy task since this would imply going against a national trend not only in aerospace but in manufacturing in general. Given this, we recommend achieving a more realistic intermediate goal before embarking in the long term goal of producing higher value added products. This intermediate value proposal should aim at manufacturing not just engines and some other random parts but rather at manufacturing interlinked structures that would better facilitate

knowledge spillovers and advancement within the value-chain. In the long run Queretaro should exploit its advantages of being home to excellent education institutions including the first and only aerospace university, its location and safety standards to become an innovation hub in the Mexican aerospace industry. By becoming a hub Queretaro has the unique opportunity of leading the transformation of the national aerospace industry (and probably other industries) away from the “maquiladora” model and into an industry that promotes locally seeded R&D and as well as the development of the local industry.

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6. Annex

6.1 Annex 1: Interviews

	Person interviewed	Position/Background/Relevance	Area of contribution in the project
Government	- Juan Carlos Duarte Zarza	Undersecretary of Economic Development of Queretaro	State economy Public policies
	- Manuel Sandoval Rios	Former Director of Prospective Analysis and Innovation at PROMEXICO	National policy State policy
Researchers/Professors	- Prof. Javier Salinas	Labor Studies Unit coordinator at the Autonomous University of Queretaro	State economy Public policies
	- Daniel Molina	Trade Specialist at ADB	National and State exports