



Microeconomics of Competitiveness

Professor Michael E. Porter; Professor Hirotaka Takeuchi

JYOT BAWA

IKER CILLERO ETXEBESTE

MICHAEL KONIALIAN

JONATHAN NAHARRO MARTIN

HUGO RUIZ-TABOADA

## Aerospace Cluster in the Toulouse Region



## Table of Contents

<b>Executive Summary .....</b>	<b>1</b>
<b>France Country Profile .....</b>	<b>3</b>
<b>Competitiveness Overview.....</b>	<b>3</b>
<b>Country Diamond.....</b>	<b>5</b>
Factor Conditions.....	5
Context for Strategy and Rivalry .....	6
Related and Supporting Industries.....	9
Demand Conditions.....	9
<b>Aerospace Cluster in the Toulouse Region.....</b>	<b>10</b>
<b>The Region of Toulouse .....</b>	<b>11</b>
<b>A Big Aerospace Cluster.....</b>	<b>11</b>
<b>Location and Government as Catalysts .....</b>	<b>12</b>
<b>Strong in Final Integration .....</b>	<b>13</b>
<b>A Cluster Built Around OEMs.....</b>	<b>15</b>
<b>Positive Performance, but Low Profitability .....</b>	<b>16</b>
<b>Competitive Cluster Diamond, but Some Inefficiencies.....</b>	<b>18</b>
Factor Conditions are Very Good .....	19
Context for Strategy and Rivalry is Suboptimal .....	20
Related and Supporting Industries are Good .....	22
Demand Conditions are Good, but Customers are Increasingly Distant from Toulouse	23
<b>Recommendations.....</b>	<b>24</b>
<b>Country Level Recommendations.....</b>	<b>24</b>
Recommendation 1: Privatize State Owned Enterprises .....	24
Recommendation 2: Overhaul Patent Legislation .....	25
Recommendation 3: Reduce Escalating Unit Labor Costs and Labor Market Rigidity ..	25
Recommendation 4: Rebalance Tax Code.....	26
<b>Cluster Level Recommendations.....</b>	<b>26</b>
Recommendation 1: Limit Outsourcing.....	26
Recommendation 2: Negotiate a WTO Settlement with Boeing, and Limit Government Subsidies.....	27
Recommendation 3: Strengthen Links between European Clusters, and Consolidate Some in the Longer Run.....	28
<b>Disclosures and Disclaimers.....</b>	<b>30</b>
<b>References.....</b>	<b>30</b>

## Executive Summary

The aerospace cluster based in the French city of Toulouse and spanning the regions of Midi-Pyrénées and Aquitaine is one of the most competitive clusters internationally and the shining star of French exports both in its growth and share. The French government catalyzed the development of the cluster by establishing the headquarters of the Airbus project there—the anchor around which the cluster evolved. The government further supported the cluster through the development in Toulouse of world class educational and research institutions in aerospace and related engineering fields and later a government sponsored institution for collaboration (IFC) that seeks to enhance the cluster capabilities through bolstering R&D collaboration and by establishing ties with other aerospace clusters in Europe.

On a country level, France provides stable fiscal, monetary, and social policies, which has benefitted the very capital intensive aerospace industry. France also has significant political clout in the European Union and internationally, a workforce that is highly productive and educated, and investment levels in infrastructure and R&D that are comparable to other developed countries. However, France has issues that will negatively impact the competitiveness of the aerospace cluster if not addressed. It faces strong structural power of unions, ballooning labor costs that well outpace output gains, stubbornly high structural unemployment, a negative net inflow of FDI, an interventionist government, burdensome tax policy, and use of market distorting subsidies.

But, as the most successful French cluster by export performance, the unique competitiveness of aerospace in Toulouse is largely explained by its cluster diamond. Factor Conditions are strong, especially the infrastructure and workforce skills. The large presence of

Related and Supporting Industries, whose collaboration is enhanced by a solid IFC, also contributes to the competitiveness, though they are overly dependent on a few local original equipment manufacturers (OEMs). A potential issue in the future is the increasing level of outsourcing which could weaken the core capabilities of the cluster. The Context for Strategy and Rivalry benefits from the presence of Airbus and other world-class OEMs to drive investment and attract suppliers to the cluster. However, their large size limits rivalry, while subsidies further distort competition. The dispersed supply chain which resulted from EU politics also reduces rivalry within each European cluster, and introduces inefficiencies. Demand Conditions benefit from sophisticated customers and a robust global growth rate for commercial aircraft orders, though only a quarter comes from European customers.

Going forward, stakeholders should focus on several areas to strengthen the Toulouse aerospace cluster's competitiveness. First, outsourcing should be limited to non-core production and used wisely to reduce costs or conclude an offset agreement to enter a market. Second, Airbus should negotiate a WTO settlement with Boeing to define clear rules about government support. The government should then reduce subsidies drastically to both foster Airbus' competitiveness as a public company who needs to optimize its capital allocation, and to reduce barriers to entry to any new potential competitor. Third, the IFC should leverage the new European Aerospace Cluster Partnership to collaborate with other clusters on education, research, or recruiting initiatives. In the longer term, geographic consolidation of some European clusters is recommended to reduce inefficiencies in communication or logistics for instance. However, strong opposition is expected from the individual countries as they value aerospace' spillover effects on the high-tech and military sectors, as well as the jobs it creates.

## France Country Profile

### Competitiveness Overview

France is a stable, democratic country with developed institutions and moderate economic growth over the past 30 years. France's membership in the European Union complicates its prospects for continued growth as it both benefits from integration and inherits liabilities of other eurozone countries in crisis. In the past decade, the number of jobs in industry or manufacturing experienced a 2% CAGR decline to only 20% of the gross value add and employment in the economy while the service and public administration sectors have experienced 1-2% growth in employment. European countries represent 60% of France's \$512 billion in exports however exports to developing countries such as China and Russia have been growing at a faster pace (Porter, 2010).

The French labor market benefits from a productive workforce but is characterized by poor labor utilization and high labor costs. Labor productivity growth was strong at 8% over the past decade and output per employee is one of the highest in the world at almost \$90,000. However, France has low workforce participation of less than 42% of the population and high structural unemployment, averaging 8.8% over the past decade (World Bank Databank, Groningen Growth and Development Centre). The output gap is exacerbated by the low number of hours worked per French employee, even relative to other European nations (U.S. Bureau of Labor Statistics). Furthermore, French labor costs have risen almost 90% in the past decade, considerably outpacing output, in contrast to the United States where labor productivity has grown faster than its costs (U.S. Bureau of Labor Statistics). This has put a high burden on French firms and has contributed to the anemic French export growth over this time.

France has prime endowments including a strategic geographic location as a bridge between Northern Europe and countries along the Mediterranean. It has access to both the Mediterranean Sea, providing access to the Middle East and South Asia through the Suez Canal, and the Atlantic Ocean, which permits a direct route to the United States. France's topography is a mix of flatlands with some mountain ranges along its borders. Rivers in its coastal flatlands permit the transport of large aerospace subassemblies via barge from ports along the coast. The flat terrain throughout most of the country facilitates the cost effective building of industrial plants and the mountains of the Pyrenees and Alps are useful for training pilots.

France's macroeconomic competitiveness is largely in line with other developed countries and measures 20th on the Global Competitiveness Index Ranking in 2012 (Global Competitiveness Index). France has strong institutions, robust contract enforcement, and low corruption. It has enjoyed very low inflation of less than 2% on average over the past two decades and currently has the lowest interest rates in its history. The euro currency has appreciated 50% against the dollar since the year 2000, which has made Airbus exports more expensive to international customers relative to Boeing. France also has had persistent fiscal deficits over the past twenty years, with the highest at 7.6% of GDP in 2009 though it has since improved to its historical average of approximately 4% of GDP. Its total public debt stands at 80% of GDP, which is in line with other Western European countries. -reaching effect on members due to their interconnectedness. The bailout policies and "cross-border balance sheet exposure" (European Commission, 2012) show increase international concerns about fiscal sustainability and therefore an increase in risk premiums and yields. The effect of rising cost of capital only exacerbates debt and deficit issues that France must eventually address along with its peers.

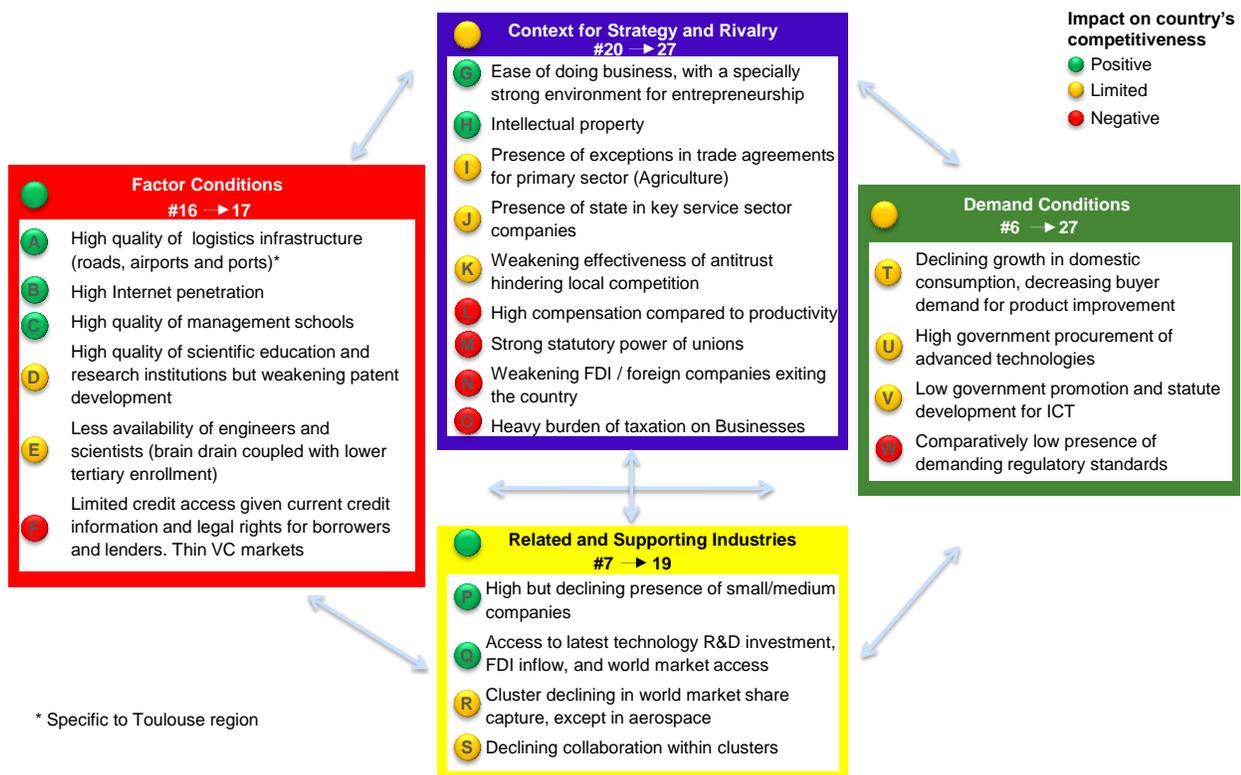
## Country Diamond

By examining the country diamond (see Figure 1), we find that France has mostly positive factor conditions and related and supporting industries to its export clusters but that it has significant problems in the context for strategy and rivalry and demand conditions.

### Factor Conditions

The strong factor conditions on a country level provide the lifeblood for the technologically advanced aerospace cluster. For instance, France has high quality scientific education and research institutions with a large number of trained scientists and engineers. However, relative to other Western developed economies France has a low rate of tertiary enrollment, and science and engineering students comprise only a quarter of tertiary degrees (World Bank Indicators).

Figure 1 France Country Diamond



Research and development expenditure per capita is above the OECD average but it has not translated to patent development, which per capita is lower than other advanced economies (U.S. Patent and Trademark Office).

France has average quality credit systems and its companies face low self-financing capacity with only moderate access to venture capital. France ranked only 53rd in the world in an OECD assessment of ease of getting credit, owing to its burdensome regulations and large degree of state involvement in the finance sector. Furthermore, French corporations have a harder time financing their investments through profits, as measured by the ratio of gross savings to gross fixed capital formation, than peer countries. The state of venture capital is more advanced than other Western European countries but its ratio of venture capital funds to GDP, at 0.05%, is only half of that of the United States, its largest aerospace competitor (OECD, 2009).

*Context for Strategy and Rivalry*

France ranks 34<sup>th</sup> in the World

Banks Doing Business indicators, with very strong contract enforcement and ease of trading across borders but considerable difficulty in registering property and paying taxes. As part of the European Union, France’s tariffs have declined in the last decade from a mean of 3% to 2%, lower than the United States’

**Figure 2 Government ownership in the Top 10 Companies in France**

**Public Companies are the Leading Companies in Sectors such as Energy, Transportation, Aerospace, and Automobiles**  
 Top 10 Public Companies in France

State Companies	Sector	Revenues (€ bn)	Public Ownership	Market Cap (€ bn)
GDF Suez	Energy	90,7	38%	38.1
EDF	Utilities	65,3	85%	29.8
EADS	Aerospace & Defense	49,1	15%	31.1
France Telecom	Telecom	45,3	14%	20.5
Renault	Automobile	42,6	16%	13.5
SNCF	Transportation Rail	32,6	100%	Private
Air France - KLM	Transportation Air	24,4	16%	2.1
Groupe La Poste	Logistics	21,3	100%	Private
Safran	Aerospace & Defense	11,7	27%	14.6
Areva	Atomic Energy equipment	8,9	83%	4.2

mean of 3% (EIU, 2012). One of the largest problems with French CSR is the large degree of government ownership in the private sector (See Figure 2). Of France's 10 largest corporations, the government has a stake of at least 14% in each company, with a controlling stake in four, for an aggregate equity ownership of over €70 billion (CIQ, 2013). EADS, the parent of commercial aerospace giant Airbus headquartered in Toulouse, is 15% owned by the French government with additional shares owned by Germany, the United Kingdom, and Spain.

The French government's influence in the competitive landscape is exemplified by the array of large subsidies that exist in various sectors, particularly agriculture and aerospace. The most egregious use of subsidies by France and E.U. government bodies has been in the agriculture sector under the Common Agriculture Policy (CAP). The European Union subsidies for Airbus, particularly under the Launch Aid policy, have had significant market distorting effects.

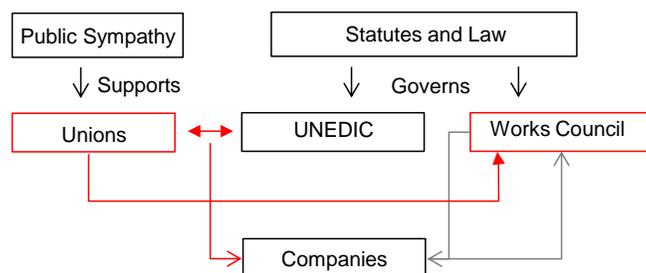
The overall result has been a decrease in rivalry within these sectors, as seen in the limited number of companies in each. France is the main market commodity producer for the European Union and is the main recipient of EU direct payments in agriculture (Boulanger, 2011). Although reforms have been set in motion since the 1990s, France's subsidy distortions have led to a consolidation of players in the agriculture market. Only 16.5% of subsidy recipients receive half of all direct payments (Boulanger, 2011). Historic distribution policy gives higher support for higher volume production, and we see the average size of farms increasing from 350 to 460 hectares and the number of farm entities decreasing from 45 to 24 thousand (Boulanger, 2011).

The same decrease in rivalry can be observed in the aerospace industry in France given the European Union's heavy subsidies to Airbus. The cumulative value of the subsidies from the EU

over the 40 years of Airbus’ existence approaches \$200B in today’s dollars (Thompson, 2010). The most serious use of subsidies, as cited by the U.S. complaint to the W.T.O., is Launch Aid, a low cost or no cost loan of \$5B that has been given by the EU to support Airbus’ A330 (Thompson, 2010 ). The fact that there has been a decline in the number of world aerospace firms over the last decades (McDonnell Douglas and Lockheed Martin exited the commercial aerospace market after observing such EU subsidies) has led to Airbus becoming the sole anchor for the aerospace cluster in Toulouse (Thompson, 2010).

Unions in France wield considerable influence and the labor is plagued by inflexibility and state interference. France has a very low union density of only 7.6%, the lowest of its peer group (EIU, 2013). However, unions are able to influence wages and business practices at a level incommensurate with their small numbers due to the entrenched structural power of unions and broad support by the French public. By statute, companies with over 50 employees must have a “works council,” which must be consulted on big management decisions, not only those based on working conditions or remuneration (See Figure

**Figure 3 Role of Unions in France**



3). Companies are required to finance these councils and their staff with a budget of roughly 2% of the overall pay. The five largest unions have a blocking coalition over who may stand for election to the works councils and hence are able to insert pro-labor representatives. An independent body, UNEDIC, fixes the rate and duration of benefits in direct negotiation with the unions and administers unemployment benefits. Furthermore, France has one of the most stringent regulations on employment protection in the world, in stark contrast to the United

States, making corporations less inclined to hire new employees and fuels France's high structural unemployment rate (OECD Database, 2012).

Businesses in France also face a very high tax burden relative to peer countries. The total tax rate faced by French companies is 66% of corporate profits and the tax revenue collected by the government is 44.2% of GDP, almost double that of the United States (World Bank Database, 2012). Twenty-five percent of total tax receipts in France are social contributions for public pensions, healthcare, and unemployment, again twice the rate collected in the United States. The shift of taxes from personal and corporate income, as in the United States, to social contributions distorts the business environment in France since companies carry a larger tax burden relative to individuals, disincentivizing corporate investment.

### *Related and Supporting Industries*

France has a well diversified economy with dozens of mature clusters that have well established supply chains and distribution channels. There is considerable collaboration among French clusters, though it has been declining. There is a large presence of small and medium enterprises (SMEs), though the prevalence of them in the economy is declining as France's growth stalls. There is strong access to new technologies, large inflows of FDI, and robust access to global markets. However, with the exception of the aerospace and medical devices clusters, all major French clusters are losing world export market share as emerging economies grow faster than developed countries (Global Competitiveness Index).

### *Demand Conditions*

France's demand conditions are moderate but facing headwinds. France's annual consumption growth has declined rapidly from an average rate of over 2% before the onset of the

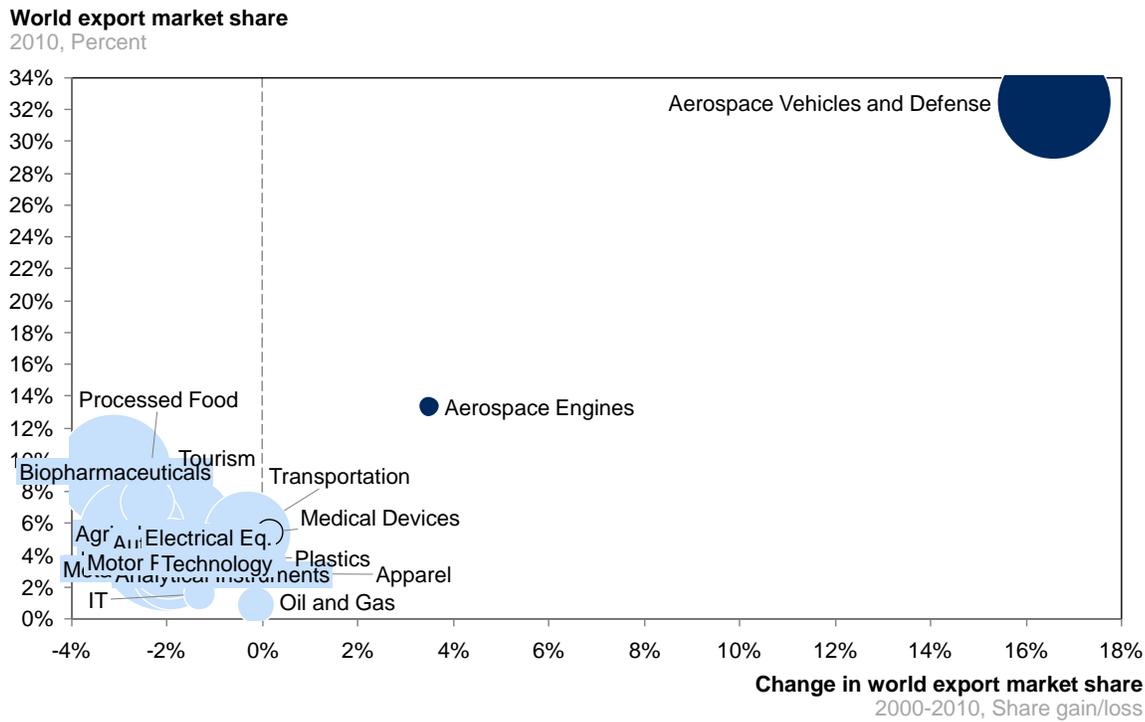
financial crisis in 2007 to below 1% in the years since. Savings growth rates, in contrast, have remained steady and have returned to its pre-crisis levels of 1% of gross disposable income. France benefits from high government procurement of advanced technologies and reasonably sophisticated demand for goods. However, it has a comparatively low presence of demanding regulatory standards, which drive innovation in product performance (Global Competitiveness Index).

Overall, the business environment and macroeconomic conditions have contributed to France seeing a decline in world market share of most of its clusters. The macroeconomic issues in increasing labor costs (that outpace increases in output) and persisting public debt crowd-out business environment improvements such as meaningful R&D investment and financing for smaller, emerging firms. Such a system has made room for low cost, export oriented to steal share in most sectors.

## **Aerospace Cluster in the Toulouse Region**

Aerospace is by far the best performing export cluster in France. While the vast majority of clusters in France are losing world export market share, aerospace vehicles and defense gained 17% additional world export share in the last 10 years to capture over 32% of the world export market in 2010. Aerospace engines similarly gained close to 4% in world export share to capture 13% of the export market (Porter, 2010). (See Figure 4)

Figure 4 France Export Portfolio By Cluster



### The Region of Toulouse

The Toulouse region has a population of 6 million people, accounting for 10% of the total population of France. Its economy represents 8.5% of France total GDP, of which 52% is based on wholesale and retail, and 12% on industrial sectors. Its average GDP per capita of €26,000 is aligned with the French national average excluding the Île-de-France region outlier (GDP per capita of €51,000). Also, the region’s unemployment of 10.2% has been slightly higher than the national average (Insee, 2012). In summary, from a macroeconomics perspective, the Toulouse region mirrors well the overall French regional situation.

### A Big Aerospace Cluster

The aerospace cluster surrounding the city of Toulouse in southwest France comprises 80% of French aerospace exports and over 9% of all French exports, for a total of approximately €39 billion – 15 times larger than the Bordeaux wine exports, the second largest cluster in the

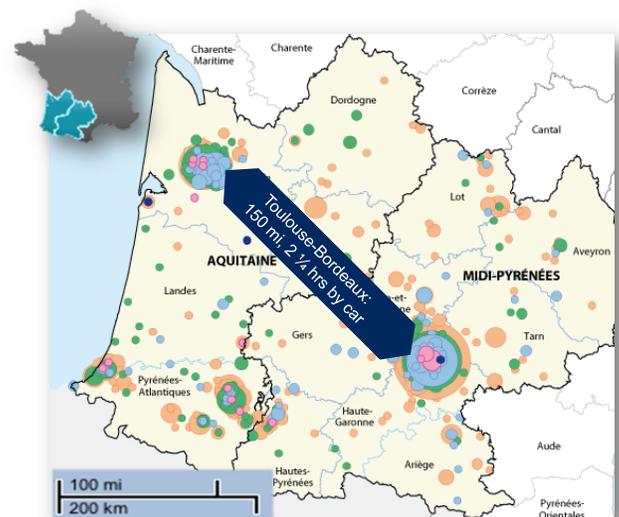
region (Ministère de l'Économie et des Finances, Ministère du Commerce Extérieur, 2013). Excluding trade within the EU, the Aerospace cluster exports €23 billion to the rest of the world and imports €7 billion. The trade figures within the EU show a neutral position with exports and imports netting off (€16 billion exports vs. €15 billion imports) (IHS Global insight, 2011).

Spanning the regions of Midi-Pyrénées and Aquitaine, this cluster is home to 1,500 companies and 100,000 workers. (See Figure 5) It hosts a dozen world class original equipment manufacturers (OEMs), including the headquarters of commercial aerospace giant Airbus, and a number of others in commercial and military aircraft, satellites, and missiles.<sup>i</sup> OEMs are much fewer in number than contractors, but have 39% of workers in the cluster (Insee, 2012).

## Location and Government as Catalysts

The Toulouse region evolved into a leading cluster catalyzed by a favorable location and deliberate government policies in its favor. It started with a government order for 1,000 reconnaissance aircraft during World War I to Latécoère, a heavy industry company in Toulouse. The city was chosen because it was the most distant one from the German front, and a major industrial area. It also had ideal atmospheric conditions, and the Pyrenees Mountains as a geographic reference point for training pilots (Duperrex, 2011).

**Figure 5 Cluster Footprint**



<sup>i</sup> Notable OEMs include Airbus, Dassault, ATR, Astrium, Thales Alenia Space, Turbomeca, and Snecma

The French government's participation in the Concorde Project and consortium for the A300 aircraft in the 1960s helped develop the integration, testing, and research capabilities of the Toulouse region. The government also embarked on a progressive administrative decentralization policy in 1965 and moved several Parisian schools and research labs to Toulouse to reinforce centers of competitiveness outside the capital. Ultimately, the action that strengthened the Toulouse region as a leading aerospace cluster was the foundation of Airbus Industrie in 1970 as a consortium between the governments of France, Germany, and the United Kingdom with the headquarters in Toulouse (Jalabert and Zuliani, 2009).

After developing its capabilities in the last decades, the cluster worked on solidifying its know-how as the new millennium started. In 2000, Western European governments consolidated their holdings into the European Aeronautic Defence and Space Company (EADS)—a pan-European corporation— and Airbus was transformed into a corporate subsidiary of EADS the following year. Finally, the French government created the Aerospace Valley institution for collaboration (IFC) in 2005 as part of its new national cluster policy (Aerospace Valley, 2013).

### **Strong in Final Integration**

The Toulouse cluster competes in several parts of the value chain for aircraft and spacecraft. (See Figure 6) OEMs are responsible for the systems engineering of the varied assemblies and components throughout the design and fabrication process, though the value chain is international with different systems constructed in different cities, primarily in Europe, for both economic and political reasons.

Figure 6 Aerospace Value Chain



The value chain begins with marketing and sales, which are centralized with the OEMs and provide signals to forecast demand and invest in production capacity. The development cycles for new aircraft and satellites are very long, often up to ten years, and based on numerous design iterations. Applied research and development for each stage is conducted by OEMs and contractors both in Toulouse and across the world.

The next steps in the chain are the manufacturing of engineered parts, and the subsystems assembly. A small number of Tier I suppliers, often less than ten, control the design and production of parts throughout the chain. Contracts are designed to include direct risk sharing among players along the value chain to ensure high quality and timely delivery. The following step is the formation of parts and subsystems into larger systems, such as the landing gear or segments of the fuselage. Each of the systems is modular, which allows them to be designed independently based on certain interface parameters ensuring compatibility.

The Toulouse cluster is most prominent in final integration, which is the largest value added step. As the one responsible for final integration and testing of modules, the OEM must tightly manage the systems development throughout the chain to ensure that all modules are interfaced properly and delivered on time in order to not hold up an aircraft or spacecraft. Toulouse is home to most of Airbus’ final assembly lines which take place in mammoth hangars.

Once an aircraft has been fully integrated and painted it is then delivered to the customer at the Toulouse Blagnac airport where it is accepted and flown to the airline's base of operations. After this point, there is a number of after-market services including maintenance, repair, overhaul (MRO), and training services for airlines. These activities are conducted in and around airports in Toulouse and around the world.

### **A Cluster Built Around OEMs**

The Toulouse aerospace cluster is built around Airbus and other OEMs that form the node in a dense web of interaction among public sector and private sector entities. The contractors and other suppliers along the different segments of the value chain are visualized on the left hand of Figure 7. For instance, navigation, communications, and control systems electronics subassemblies are combined into an avionics assembly before being sent to Airbus or another OEM. Most of the modular systems and subassemblies (e.g., engines, avionics, wings) are not manufactured within the cluster. Nevertheless, these parts are all integrated in the different final assembly lines in Toulouse.<sup>ii</sup>

Government agencies also play a strong role in the regulation and promotion of the aerospace cluster. The Regional Council has competencies in economic development fields - in particular, it fosters innovation by financing the IFC, and by helping SMEs to access talent and to implement appropriate financing instruments. Nationally, the Ministries of Industry and Education are respectively enforcing the context of industrial policy, such as the number of hours worked per employee, and investing in technical skill building. The European Union also plays an important role both in moderating competition and in regulating aircraft safety, noise, and

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<sup>ii</sup> See analogy with corks produced in Portugal for the California Wine Cluster (Porter, 1998)

environmental requirements. In addition, the European Space Agency is a large value buyer of satellites from Astrium, based in Toulouse.

Government funded agencies play a major role in education, research, and coordination. Toulouse is home to several prominent universities, known as *Grandes Écoles*, including the French Civil Aviation University (ENAC<sup>iii</sup>) and Higher Institute of Aeronautics and Space (ISAE<sup>iv</sup>), which both train hundreds of engineers and conduct advanced research on subjects related to aerospace. There are also several leading research centers based in the cluster, including the French Aerospace Lab (ONERA<sup>v</sup>) and the Toulouse branch of the National Centre for Scientific Research (CNRS<sup>vi</sup>). Further, the Aerospace Valley IFC established by the government is charged with coordinating scientific research, promoting the cluster, and building ties with related clusters.

### **Positive Performance, but Low Profitability**

Toulouse is the largest cluster competing on commercial aircraft in the world, and it has performed very well in the last decade. Its fundamentals display favorable trends in the last years. The number of OEMs and suppliers' employees grew by 5% per year, the number of R&D projects labeled by the IFC increased annually by 40%, and the suppliers' revenue raised by 9% each year, though the share of exports in their revenue plateaued at around one third (Insee, 2011). As a result of the cluster good performance, France more than doubled its world export share in aerospace between 2000 and 2010, and became the largest aerospace exporter in the world (Porter, 2010). Tailwinds in the global demand for aircraft are expected to continue in the

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<sup>iii</sup> *École Nationale de l'Aviation Civile* in French

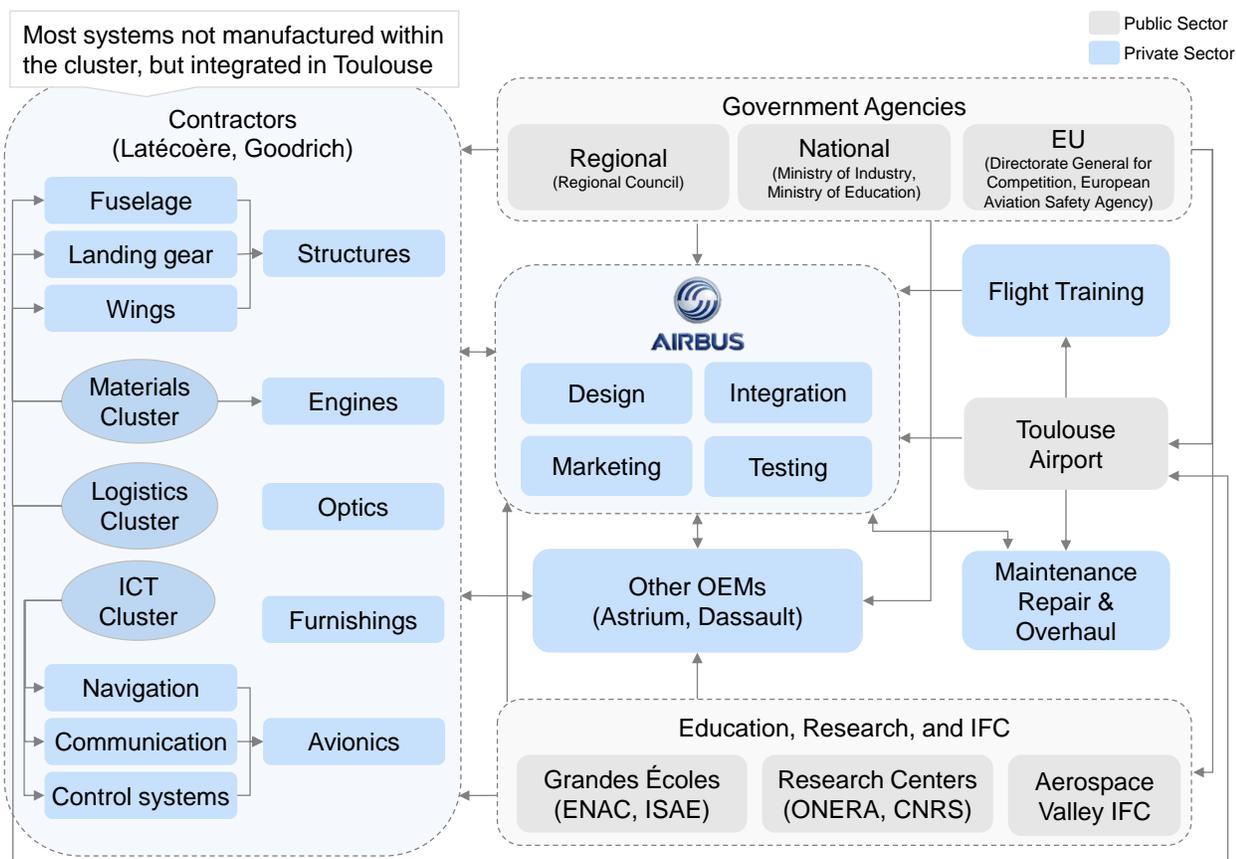
<sup>iv</sup> *Institut Supérieur de l'Aéronautique et de l'Espace* in French

<sup>v</sup> *Office National d'Études et de Recherches Aérospatiales* in French

<sup>vi</sup> *Centre National de la Recherche Scientifique* in French

coming decade as broad swaths of emerging economies join the middle class, which will provide Airbus and its ecosystem of contractors a growing revenue base.

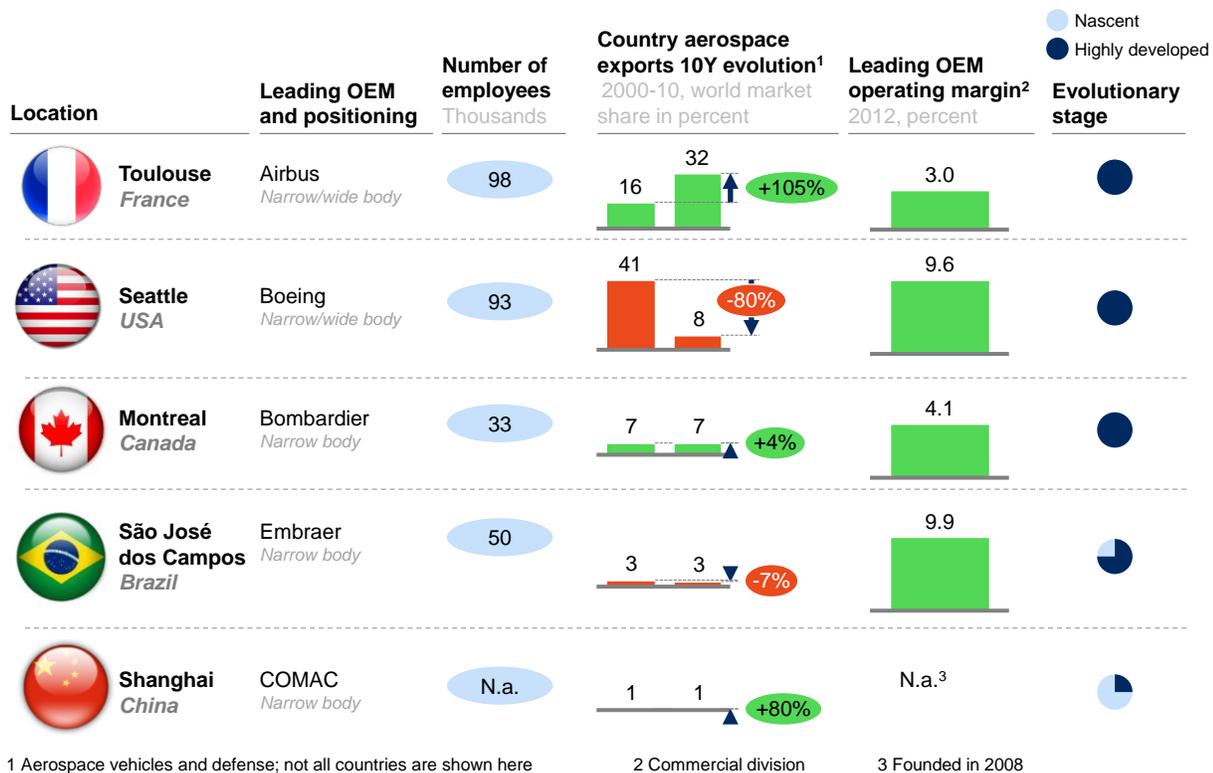
Figure 7 Toulouse Aerospace Cluster Map



However, Airbus’ profitability has been lower than for any other peer (Hoover’s, 2012; Company investors relations, 2012). There are several reasons. First, Airbus has been selling aircraft at razor-thin margins to grow its market share (Airbus, 2012). Second, it was hit by a strong Euro relative to the US Dollar. Indeed, Airbus’ expenses are in Euros, whereas its revenues are in US Dollars, the currency used for all aircraft sales. As the US Dollar depreciated against the Euro over the last years, the Euro-denominated revenues declined relative to the expenses. Third, the A380 program has experienced considerable delays and has not broken even yet.

Going forward, emerging aerospace clusters in Canada, Brazil, and China will increasingly threaten Toulouse’s leadership. Indeed, Bombardier, Embraer, and COMAC respectively are competing in the narrow body aircraft market. Though their exports are currently limited, the expected growth of their domestic demand could fuel their sales, and push them to go upmarket into more profitable wide body aircraft, threatening the Airbus/Boeing worldwide duopoly. (See Figure 8)

**Figure 8 Comparison Main Clusters Hosting a Commercial Aircraft Leader**



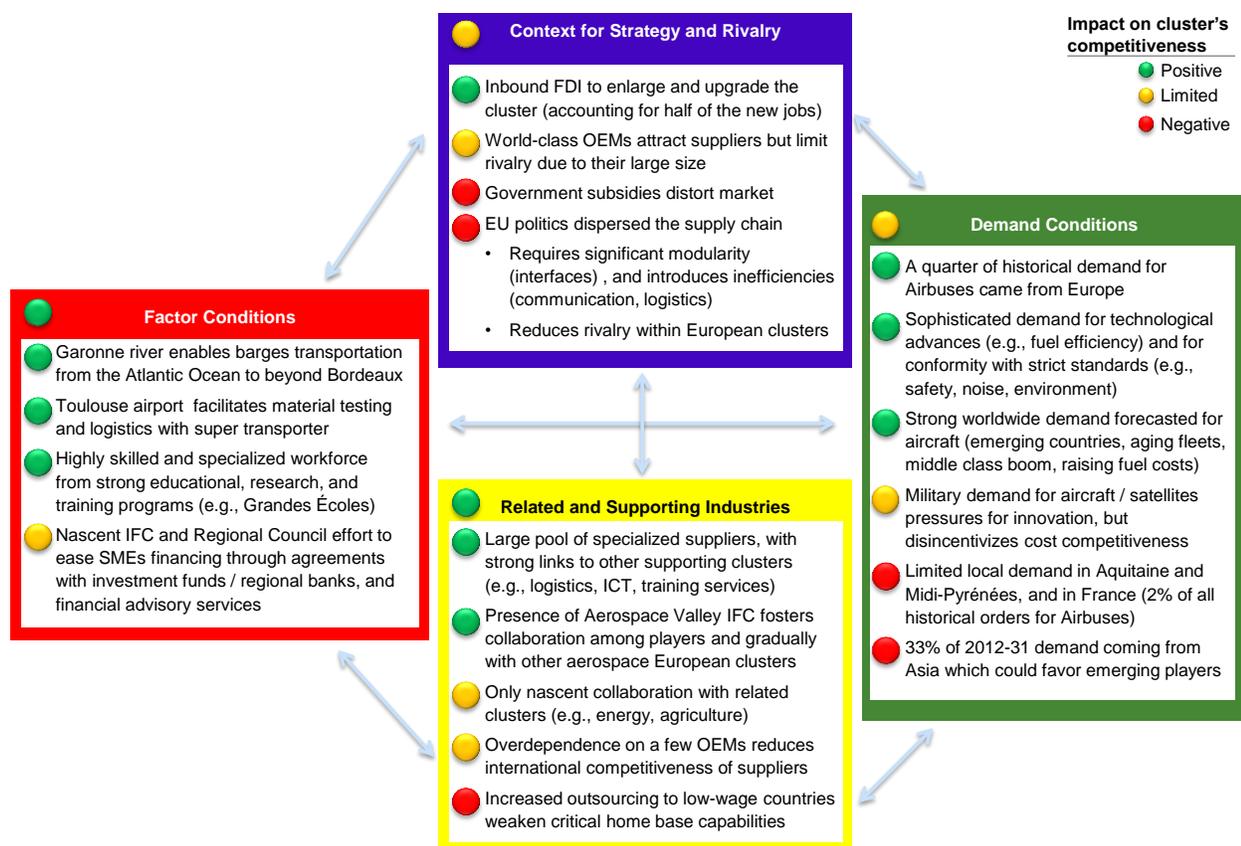
### Competitive Cluster Diamond, but Some Inefficiencies

The diamond of the Toulouse aerospace cluster illustrates a contrast between the ailing competitiveness of France as a whole and the robust competitiveness of cluster. However, despite its strengths, there are problems in each of the diamond quadrants that hamstring the ongoing development of the cluster.

*Factor Conditions are Very Good*

Location was a major catalyst for the cluster development at the beginning of the twentieth century. Its importance has decreased, but the Garonne River remains a valuable asset to transport components by barge from the Atlantic Ocean to beyond Bordeaux. Infrastructures are also favorable. In particular, the large Toulouse airport is used for material testing and logistics with the super transporter Beluga.

**Figure 9 Toulouse Aerospace Cluster Diamond**



Another major strength is the existence of world-class industry-specific education, research, and training programs. There is then a highly educated workforce who has graduated from the two aforementioned *Grandes Écoles* ENAC and ISAE, from the University of Toulouse's dedicated program to aerospace engineering, or from several specialized management programs

tailored for the aerospace industry, including an Aerospace MBA. In addition, there are 80 specialized public research centers, including the mentioned powerhouses ONERA and CNRS that produce ongoing research in the aerospace industry. Nearly 500 PhDs are also annually awarded in basic and applied science, while the cluster offers nearly 600 training courses in aerospace. Finally, Toulouse is home to Airbus' main worldwide training center for pilots, flight attendants, maintenance staff, and engineers (Aerospace Valley, 2013).

The only key factor condition to improve is SMEs access to financing. In that sense, the Regional Council and the Aerospace Valley IFC started concluding agreements with investment funds and regional banks, as well as providing financial advisory services.

#### *Context for Strategy and Rivalry is Suboptimal*

The presence of large world-class OEMs is positive to attract contractors and suppliers to base in the cluster. It also boosts investment to expand and upgrade the clusters capabilities. In 2011, inbound FDI is credited with creating half of the new ~4,500 jobs in the Toulouse aerospace cluster. As a result, the region of Midi-Pyrénées received the third largest amount of FDI in France, following Île-de-France (Paris) and Rhône-Alpes (Lyon) (AFII, 2012).

However, large OEMs are also a liability. Their size creates large barriers to entry for potential competitors, and limits rivalry. In fact, the issue is endemic to this capital-intensive industry, and explains the duopoly between Boeing and Airbus in commercial aircraft.

In addition, the government further distorts competition by having massively subsidized Airbus with \$18 billion of cumulated low-interest "program launch aid" which were in large part declared illegal under international trade law by the WTO (Devaney, 2012). These illicit subsidies appear higher than the \$7 billion found by the WTO to be given illegally to Boeing in the form of

R&D grants, tax abatement, and other subsidies (Lester, 2012). The negative impact of subsidies is twofold: they inhibit other domestic OEMs from challenging Airbus' regional monopoly in certain segments, and they potentially finance lossmaking investments (see Airbus' low margin), shielding the company from investor pressure to enact greater cost discipline.

Another issue is the geographically dispersed supply chain across Western Europe. Indeed, Airbus started as a consortium of aerospace manufacturers in 1970, which naturally split the supply chain for the A300 between France, Germany, and the UK. Four decades later, that design has persisted despite the manufacturers' merge that founded EADS in 2000. Indeed, each country defends its own aerospace industry which has usually large spillover effects on other sectors, including military, and creates a significant amount of jobs. Embodying that political struggle was EADS' dual management until 2007, with German and French co-CEOs (Rothman, 2012).

The dispersed supply chain has multiple implications. On the positive side, Airbus became skilled at designing and managing modular interfaces that yielded effective platform strategies, reduced time-to-market, and led to component expertise. Airbus' resulting ability in managing complex supply chains as levels of international outsourcing increase enables the company to produce planes at an estimated 10-20% cost savings to Boeing (Shih, Pierson, 2012). However, this modularity also creates communication issues. For instance, Germans produced kilometers of cables which were too short due to informatics incompatibilities with French (Clark, 2006). Additionally, the logistics cost increases due to the geographical distance between clusters. Finally, rivalry within each cluster lowers as potential competitors are located in distant clusters. (See Figure 10)

Fortunately, EADS CEO managed to get shareholders' approval in March 2013 to eliminate the veto that French and German governments had enjoyed over the company strategy since its inception (Clark, 2013), opening the opportunity to optimize the supply chain with less political interference

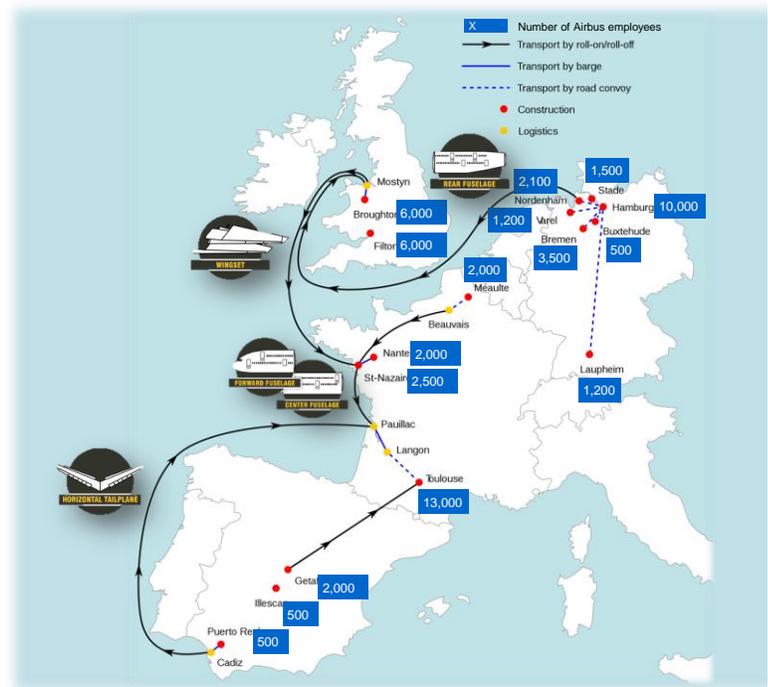
### *Related and Supporting Industries are Good*

The Toulouse cluster has a large pool of specialized contractors and suppliers, with strong links to other

supporting clusters such as logistics, ICT, and material. Additionally, the Aerospace Valley IFC has fostered an increasing number of R&D collaboration projects among its ~600 members, and is gradually building ties with other European IFCs. For instance, it agreed to exchange trainees and develop joint degrees studies with the Hamburg Aviation cluster (Butterworth-Hayes, 2010). In addition, it is part of the new European Aerospace Cluster Partnership. This large initiative currently gathers 39 IFCs from 13 countries, and aims at both promoting knowledge exchange between partners, and, ultimately, improving collaboration between clusters and companies to increase European competitiveness in aerospace (EACP, 2013). (See Figure 11)

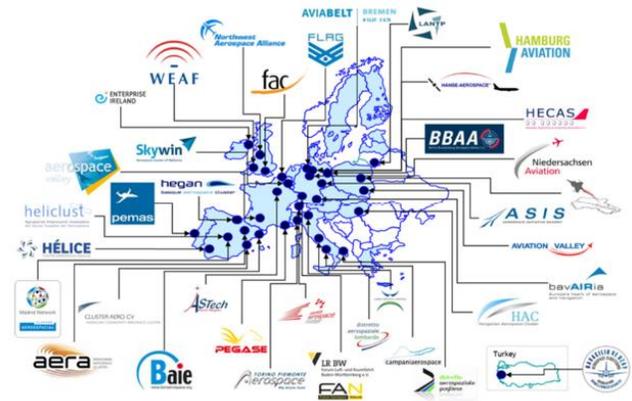
However, the contractors and suppliers' current overdependence on a few local OEMs is a threat to the ecosystem. Indeed, the lack of diversity in the customer base and sales footprint reduces supply's international competitiveness.

Figure 10 Airbus' Dispersed Supply Chain



Going forward, outsourcing could damage the whole cluster competitiveness as home base capabilities are lost. Indeed, the degree of outsourcing at Airbus has increased from an historical average of 25-35% to 50% with the latest A350 platform (Michaels, 2012), mainly driven by the need to reduce expenses and the asset base, and to access new markets through offset agreements where the foreign company agrees to source parts from local suppliers. The risk for traditional players is to lose core innovation capabilities, which are critical for the cluster continuous upgrade, as clusters in low-wage economies emerge. Indeed, these new clusters currently compete on manufacturing (e.g., Malaysia's aerospace cluster focuses on composite structures), but could go upmarket later. For instance, Chinese COMAC is already building a 168-seat-narrow-body to compete against the A320 and 737.

**Figure 11 FCs Part of the European Aerospace Cluster Partnership**



#### *Demand Conditions are Good, but Customers are Increasingly Distant from Toulouse*

Although local demand only represents 2% of all historical orders for Airbus aircraft, 25% of them came from Europe. Overall, air traffic experienced remarkable growth over the last forty years, and will further grow fuelled by strong demand in emerging economies (ICAO, 2012; Airbus Global Market Forecast 2012-2031, 2012). In fact, Asia-Pacific is estimated to comprise one third of future airframe demand (Airbus, 2013). This may favor emerging players whose

production assets are located close to the demand, for instance in China, and may force foreign players to further delocalize.

By nature, demand for aircraft is sophisticated, with pressure for technological advances in areas such as fuel efficiency and need for conformity with strict standards for safety, noise, and environment impact. For instance, an apparently simple modification such as adding a new wingtip to an aircraft requires 600 flight hours and 300 flights for certification at Airbus' flight test center in Toulouse (Airbus, 2012), while a flight test campaign for an entirely new platform usually extends beyond 18 months until airworthiness certification is granted. This has an important positive impact in Toulouse's economy. Last but not least, almost half of the cluster participants has a substantial amount of defense contracts, which drives technological innovation but disincentivizes cost containment due to the nature of 'cost plus' contracting.

## **Recommendations**

Recommendations on the country and cluster level are presented in order of importance.

### **Country Level Recommendations**

#### *Recommendation 1: Privatize State Owned Enterprises*

The large degree of government ownership in France's private sector is a profoundly negative force on the competitiveness of French enterprise. The government as equity owner reduces the pressure on businesses to employ assets to maximize long term profits, encourages bloated employment, and leads to unnecessary bureaucratic oversight and meddling in corporate affairs. The sale of government stakes in large French corporations, including Airbus parent EADS, would generate well over €70 billion in revenue to the government which could be used to reinvest into basic scientific research, pay down public debt, or used to reduce corporate tax rates. Eliminating French ownership of firms will also reduce the legitimacy of the French

government in meddling in the private affairs of corporations regarding mergers and acquisitions, employment, and corporate strategy.

### *Recommendation 2: Overhaul Patent Legislation*

France suffers a lower degree of patent development per capita than other developed peer countries despite a high level of investment in research and development. Part of this is attributed to the fact that in France, it is largely unclear who owns intellectual property rights for inventions created in state funded research institutions. A report by the EU Economic Policy Committee characterizes France's universities as "poorly organized to address the complex issues of patent rights." (qtd. in Siepmann, 2004)

France should introduce new legislation similar to the U.S. Bayh-Dole Act, which permits government funded agencies, such as universities and research centers, to retain intellectual property rights to inventions derived from the fruits of government-funded research. Retaining control of the patent with the institution instead of the government would incent patent creation by encouraging researchers to direct their work towards areas where new patents may be awarded. This would also kickstart entrepreneurship since researchers would then be able to convert the patented inventions into new businesses that would push more advanced technologies to existing clusters.

### *Recommendation 3: Reduce Escalating Unit Labor Costs and Labor Market Rigidity*

France faces the considerable weight of an expensive and inflexible labor market. France should first dismantle the convoluted and wasteful UNEDIC and works council system and allow unions to negotiate directly with management without government influence. This would not only save considerable expense, but ensure that the power of unions is no longer

disproportionate to their small prevalence in the French workforce. France should also eliminate laws constraining employers from firing employees since it disincentivizes companies from making hires except when absolutely necessary and employees from working to their full potential.

#### *Recommendation 4: Rebalance Tax Code*

French corporations face a very high tax rate that inhibits investment and hurts profitability. The French government should rebalance the tax code both to reduce the amount of tax collected (by reducing other public expenditure) and by shifting more of the tax burden to individuals instead of corporations, as in the United States. The government should considerably reduce the taxes on employers for social contributions and shift them to individuals. This would encourage more FDI into the country since corporate investments would yield a higher return. Furthermore, individuals are subject to a high VAT, a regressive tax, comprising 25% of total tax receipts as compared to 17% in the United States. This should be reduced while increasing the income tax, which only represents 17% of total tax receipts as compared to 37% in the United States, which would decrease prices in the economy and encourage consumption.

### **Cluster Level Recommendations**

In the following pages, we discuss in detail the most critical recommendations to increase the cluster's competitiveness.

#### *Recommendation 1: Limit Outsourcing*

Airbus and other OEMs in the Toulouse cluster should seek to limit the extent of outsourcing on their products in order to retain core research and development and manufacturing capabilities in-house. Otherwise, the long term viability of the cluster is at risk by the erosion of the competitive advantages in design and integration. Indeed, leadership in

innovation is critical to create revolutionary platforms such as the A380 jumbo jetliner, and compete effectively against the low-wage clusters that may go upmarket in the next decades.

On the opposite, outsourcing of peripheral and non-leading edge capabilities is recommended in four cases. First, an offset agreement to subcontract or coproduce locally is acceptable when it gives access to protectionist markets with large demand such as China, India, and Russia. Second, outsourcing is effective when it reduces production costs to continue competing successfully. In this case, sourcing from low-cost countries (LCC) such as Malaysia, Mexico, Romania, or Ukraine, is appropriate. Third, outsourcing can give access to human capital or specific raw material like titanium. Fourth, it can mitigate the effects of a strong Euro against the US Dollar. Thus, Airbus could send basic non-core production either to lower-wage overseas countries with currencies pegged to the US Dollar, or to the USA for a natural hedge (ECORYS, 2009). Outsourcing is then beneficial as far as there is no transfer of home base technology.

Given these guidelines, outsourcing half of the program as Airbus does with the latest A350 seems excessive. Outside-in, we would recommend returning to levels more in line with the 25-35% historical average.

#### *Recommendation 2: Negotiate a WTO Settlement with Boeing, and Limit Government Subsidies*

Government subsidies are distorting competition. Airbus should then first negotiate a lasting settlement with Boeing in the WTO and end a significant source of legal expense and management distraction. A negotiated agreement between the two duopoly players would create a strong opportunity to shape clear rules about government support to aerospace OEMs that would stop escalation of subsidies at Boeing and Airbus, and serve as a useful protection against inflated government subsidies in emerging clusters in the coming decades.

After, the government should dramatically reduce subsidies in the form of launch aid to Airbus. Indeed, subsidies raise new competitors' barriers to entry and can finance investments with negative net present value (NPV). This desincentivizes innovation, and incents to overinvest in capacity such that Airbus might face a severe contraction should the market slowdown. In addition, Airbus is a public company, and it is difficult to justify large redistributions of European citizens' taxes to shareholders – especially when conjuncture is low and requires social spending cuts.

Some experts may argue that the scale of financing is difficult to raise for aerospace in the private markets (Miles, 2012). But, Airbus has now an advanced product suite and a booming global market. In this context, it should be able to receive private financing at rates such that investments would have positive net present value (NPV) given the risks involved. In addition, the government could still step in, but lending at fair market price to bridge capital raises that are not fully subscribed by private investors. That private sector involvement would ensure fair market pricing. Finally, there are increasing opportunities to share risk across the value chain as players tend to consolidate for economies of scale, and acquire the critical mass to assume part of the risk – a trend already experienced in the USA.

### *Recommendation 3: Strengthen Links between European Clusters, and Consolidate Some in the Longer Run*

The production of the A380 alone is dispersed across over 20 cities in five Western European countries, causing inefficiencies and reducing rivalry within each European cluster.

In the short and medium term, the Aerospace Valley IFC should continue to foster collaboration with other European aerospace clusters at both the IFC and company level. In that sense, the new European Aerospace Cluster Partnership offers the right platform to access almost

40 other IFCs. Concrete areas to work on are: joint degrees with student exchange, cooperation between research institutions, common participation in R&D programs funded by the EU, or mechanisms to help SMEs to recruit talent across Europe. In addition, companies should systematically gather their transnational teams at the beginning of the each project and at regular intervals to later improve remote communication. Finally, Airbus should take full advantage of the recent removal of the veto that the French and German governments had over the company strategy, and start optimizing the supply chain according to pure economic criteria.

In the longer term, geographical consolidation of some clusters is recommended – especially as Airbus transforms its DNA from a consortium among governments to a public company with a fiduciary responsibility to shareholders. Advantages are multiple. It would result in cost synergies by eliminating duplicative overhead and capital equipment, and by reducing monitoring and rework costs. It would also save logistics costs, and reduce the likelihood of mistakes that delay or ground a platform through enhanced ease of communication and management. Finally, it would increase the density of competition among contractors within each cluster, leading to productivity and competitiveness gains throughout the supply chain.

However, there are political barriers to the geographical consolidation as countries value the economic and strategic importance of aerospace. Indeed, the industry tends to have significant spillover effects on other high tech sectors, as well as on military applications. In addition, it the industry is most of the time a large employer.

## Disclosures and Disclaimers

One of the authors, Iker Cillero Etxebeste, is a former employee of Airbus.

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