OFFSET AGREEMENTS IN AEROSPACE

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ABSTRACT

The aerospace industry is one of the most politicized high technology markets, as well as one of the most globalized and global industries in the world. Demand for aircraft in emerging markets and countries, such as China, India or Russia, is surging and is connected with the offshoring plans of original equipment manufacturers. One of the main reasons behind the offshoring process of aircraft manufacturers, such as Airbus or Boeing, is to fulfill offsets requirements from governments around the world. Offsets clauses are also one of the most overlooked reasons and processes in the literature in spite of its relevance and importance in the aerospace industry. The purpose of this study is to gain insight into the offset-process in the aerospace industry.

The study follows a desk research approach (Verschuren and Doorewaard, 2005) and focuses on issues such as: what are the reasons for outsourcing and/or offshoring in the aerospace manufacturing industry? What are the risks of outsourcing and/or offshoring in the aerospace manufacturing industry? The study also contains a description of the aerospace industry to understand specific characteristics that apply to this industry as well as examples of offsetting.

It is concluded that due to its relevance in the economy and its specific characteristics, such as customers geographically dispersed, few prime contractors and similar product needs, the commercial aerospace industry is prone to outsource and offshore a major part of its work. However, after the study of the risks and reasons, it is concluded that even though cost reduction is the most cited and repeated reason for outsourcing and offshoring, the risks associated with these processes have caused many companies to re-think their location decisions as the cost savings did not offset the risks. However, and despite controversies over the approach, the aerospace industry tends to be seen by governments of economically developed as well as industrializing countries as a key industry and this is an important motive for offset requirements.

Key words: Offset, aviation, international business, outsourcing, offshore, technological development

INTRODUCTION

The aerospace industry is one of the most globalized and global industries in the world (Wipro Council for Industry Research, 2008; Mocenco, 2015). For instance China, India and Russia are expected to

purchase more than 3,500 planes over the next two decades (Bédier, Vancauwenberghe & van Sintern, 2008; PWC, 2016a). Table 1 provides an overview of the forecasted deliveries from the four largest commercial aircraft manufacturers from 2017 until 2036 for the seven regions in the world. This shows the global nature of aircraft sales. For Embraer these numbers are based on 90+ seat jet aircraft (Embraer, 2017) while for Bombardier it is the 60-150 seat segment (Bombardier, 2017), both Airbus (Airbus, 2017a) and Boeing (Boeing, 2017a) only produce large jet aircraft. Table 1 illustrates the large amount of aircraft that the manufacturers expect to deliver in the next 20 years. These (expected) aircraft sales represent large amounts of money. For instance, Airbus expects to deliver $5.1 trillion worth of commercial aircraft while Boeing estimates its deliveries to be worth $ 6.1 trillion.

Table 1: Market Forecasts 2017-2035 large four aircraft manufacturers

Company	North America	Latin America	Europe	Asia Pacific	Middle East	Africa	CIS	World
Airbus	5,620	2,666	6,820	14,276	2,526	1,055	1,203	34,166
Boeing	8,640	3,010	7,530	16,050	3,350	1,220	1,230	41,030
Bombardier	3,400	1,050	2,200	4,200	450	550	700	12,550
Embraer	5,300	2,370	5,250	9,070	2,110	530	1,190	25,820

Given the high stakes involved, it is not surprising that the aerospace industry is a highly politicized high technology market. This includes presidential involvement in the sale of aircraft such as for example in 1993 when after direct intervention by President Clinton, Saudi Arabia planned to buy $6 billion worth of new passenger jets from McDonnell Douglas Corp. and Boeing Co. (Peltz and Broder, 1993). Another example is that French president Hollande cancelled a trip to Poland after disagreements arose over sales of Airbus products and related offset deals (Vinocur, 2016). Because of the financial stakes, and especially in situations with economically developing nations, other aspects may be brought into the purchase of commercial aircraft. For example, in 2016 Vietnamese airlines agreed to purchase 40 Airbus jets for $6.5 billion while at the time of the announcement the leaders of France and Vietnam pledged a stronger economic and defense partnership for example announcing their cooperation in defense by letting each other's navy vessels make port calls and sharing intelligence on maritime defense and satellites (Tomiyama, 2016).

In many instances, what governments are looking for as part of the expensive purchase of aircraft is to reduce the expense related to the cost of the purchase of aircraft while at the same time providing employment or improving the country's technological capabilities. This can be achieved through offset agreements. Offsets are defined by Johnson (1999) as "a practice in which a purchasing entity, usually a government, demands that a seller not only provides a service or product, but in addition helps the purchaser to obtain additional technology, business, or investment". Many original equipment manufacturers use practices such as outsourcing or offshoring part of their production. Main reasons for this include gaining proximity to markets, access to low cost production, and access to skills and knowledge (Ferdows, 1996; Vereecke and van Dierdonck, 2002). While offsets are not among the reasons typically considered for the spread of global production, at least in the aerospace industry, offset requirements can be viewed as an important reason why companies such as Airbus and Boeing end up dispersing their production through offshoring or outsourcing. The purpose of this research is to provide more insight into offsets in the aerospace industry.

This paper is set-up as follows. The next section discusses the commercial aerospace industry because the industry context has to be understood before offset can be meaningfully discussed. The section after that focuses on offsets. Finally, conclusions are drawn.

GLOBAL PRODUCTION IN THE COMMERCIAL AEROSPACE INDUSTRY

The aerospace industry is one of the most globalized industries in the world (WCIR, 2008; Mocenco, 2015). Customers are geographically dispersed, they have similar product needs and they are able to look globally for aircraft suppliers which can meet their needs (WCIR, 2008). Market forecasts done by PWC (2016a) and Deloitte (2017) show that in the near-term, as well as in the long-term, aviation will continue to grow faster than the overall economy because of its critical role in the global economic infrastructure. This growth is bolstered by economic growth in Asia, the Middle East, Eastern Europe and Latin America.

The commercial aerospace manufacturing industry can be characterized as an oligopoly. There are only a few prime contractors that manufacture aircraft, i.e. Airbus, Boeing, Bombardier, and Embraer, or engines, i.e. Pratt & Whitney, Rolls Royce, and GE. These prime contractors are supplied by large subcontractors each of which may use numerous small and medium sized firms who supply components and subsystems. A general categorization of the firms participating in the development of aircraft is provided by Mocenco (2015):

i. Original Equipment Manufacturers (OEMs) – these are the companies that assemble large aircraft components and provide final products to customers.

ii. First-tier suppliers – direct OEM suppliers that manufacture / assemble major sections, aircraft systems (including engines, avionics, aircraft interior, landing gear, etc.).

iii. Second level suppliers – key suppliers of tier I that deliver complex manufacturing products.

iv. Third level suppliers – firms that perform special components and specific process, e.g. raw materials, electronic components, etc.

In general, the aerospace value chain is characterized by engine manufacturers and systems suppliers firms which are in exclusive supplier contracts with aircraft manufacturers. In the past, these life contracts were not provided to component manufacturers as the prime contractors would want to retain the opportunity to reduce costs later (WCIR, 2008). However, with increasing globalization and supply chain capabilities, the system manufacturers are outsourcing and offshoring more and more of the sub-system value chain (WCIR, 2008; Mocenco, 2015). In 2008, it was estimated that almost 140 Billion USF of aerospace manufacturing was outsourced (WCIR, 2008).

Partially due to its relevance for domestic economies, local governments often play a prominent role in their domestic aerospace industries. The aerospace industry has a high status because it is an important source of high-wage employment, its dual-use technologies and production facilities, and its frequent requirements for government financial support (Mowery, 1999). The manufacturing of civilian aircraft is a long-term, high risk and multi-billion venture, and therefore, some conclude that the great achievements of the industry would have been unconceivable and unreachable without governments' support (Niosi & Zhegu, 2005). However, the government support is not only due to the inherent risks of the industry. Another key reason is that the military and civil aircraft sectors share a

large part of the same technology base, supply chain base and many skills and processes. There has been considerable knowledge spillovers flowing from the government financed defense sector to the civil sector, while the latter has been preserving the necessary industrial infrastructure to assure the viability of national defense goals. It is because of these interests that the government's interventions have been hindering the market-driven functioning of the civil aircraft sector (Niosi & Zhegu, 2005). These interventions have come generally in the form of subsidies that have, for example, led to trade wars between the two largest airplane producers, i.e. Airbus and Boeing. The European Union and United States have been filling complaints against each other with the World Trade Organization for more than 30 years (László, 2011).

Key trends in the global aerospace industry

The aerospace industry has substantially evolved since its inception a century ago. Forecasts show an optimistic future in terms of traffic growth; however, "increasing competition, cost pressure (rising energy costs, high commodity prices, etc.) and the impact of the global financial and economic crisis are some of the issues that aerospace industry is facing" (Mocenco, 2015). To cope with these challenges and the traffic growth, five key trends in the industry have been identified by WCIR (2008):

i. Globalization of aerospace manufacturing – the amount of outsourcing in the aerospace industry is about 80% of the airplane. Manufacturers and suppliers are using the advantages derived from the globalization of the aerospace supply chain (Mocenco, 2015).

ii. Global product development – product design is becoming a globally collaborative activity. Therefore, by shifting the design process closer to the potential markets and the production facilities, the time to market is reduced.

iii. Technical specialization – airplanes have gotten increasingly complex and it is not expected that a single company would have the technical expertise to meet the myriad requirements.

iv. Shift of Maintenance, Repair and Overhaul (MRO) base – the aftermarket services are being pushed back to the suppliers since the original equipment manufacturers (e.g. Airbus, Boeing, Rolls-Royce, and others) increasingly understand that this is not their core competence.

v. Offset conditions – governments are increasingly applying offset conditions on the procurement of aircraft and defense items from various suppliers.

Some of these key trends are highly interlinked. In particular, this study is interested in exploring the relationship between the globalization of aerospace manufacturing and the offset conditions that governments ask for from original equipment manufacturers. Before getting into that particular topic the practices of outsourcing and offshoring process in the aerospace manufacturing industry will first be analyzed.

Outsourcing and offshoring in the aerospace manufacturing industry

It is important to distinguish the concepts of outsourcing and offshoring in order to avoid confusion. Outsourcing is the process of transferring portions of work to outside suppliers rather than completing it internally while offshoring is the action of obtaining services or products from another country. Based on this, at least two distinct models can be described for offshoring: a) offshore in-sourcing, i.e. locating owned production activities in a foreign country, and b) offshore outsourcing, i.e. outsourcing manufacturing activities via foreign suppliers (Joubioux & Vanpoucke, 2016). What generally grabs

attention in the media is the process of offshoring while the employees of a company might be more worried about outsourcing than offshoring.

In recent years, on the one hand, offshoring has become more and more popular in the industry (Bédier, Vancauwenberghe, & van Sintern, 2008). On the other hand, more and more companies are experiencing that offshoring is far from being a panacea (Bengtsson 2008; Pisano and Shih, 2009; Platts and Song, 2010) and academic studies increasingly focus on the process of reshoring, i.e. bringing manufacturing back (Kinkel, 2012; Benstead, Stevenson and Hendry, 2017). In 2016, more than half of the American companies that chose to offshore some of their manufacturing activities were moving back (Joubloux & Vanpucke, 2016; PWC, 2016b). Two clear examples of the growing tendency of outsourcing and offshoring by major original equipment manufacturers of aircraft are the newest programs of Boeing, i.e. the 787 Dreamliner (figure 1), and Airbus, i.e. A350 XWB (figure 2).

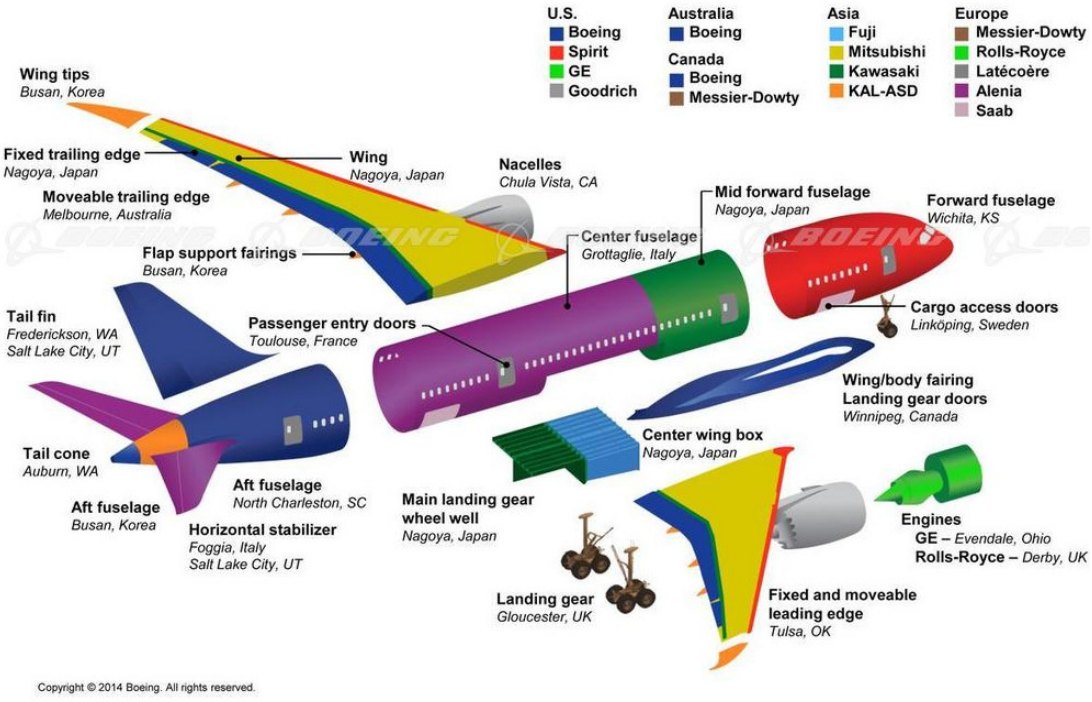
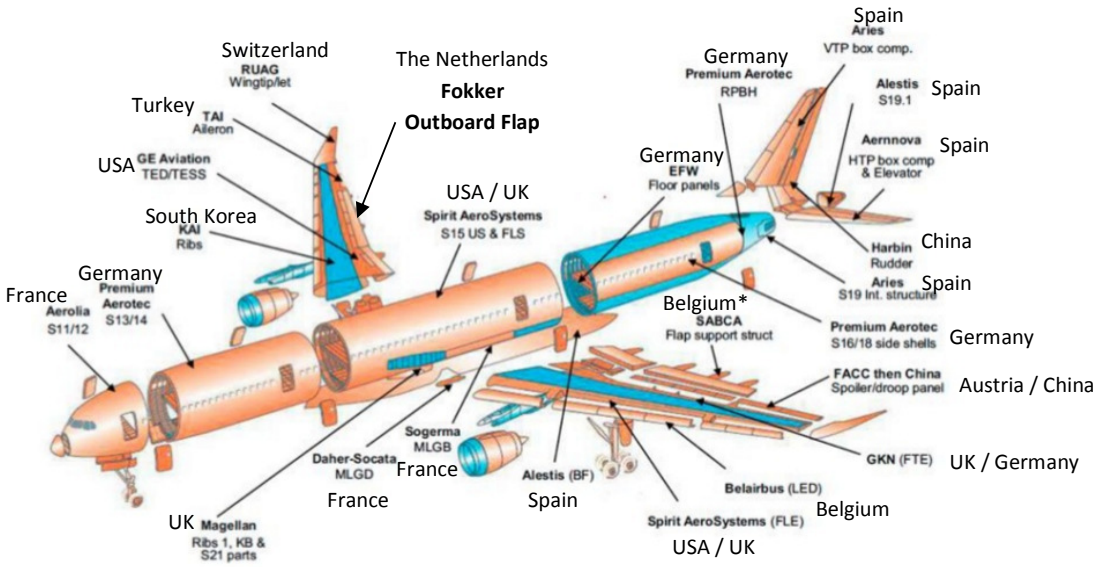


Figure 1: Global partners of the Boeing 787 Dreamliner, Source: Boeing



*SABCA was replaced by SAAB (Sweden) for A350-1000 flap support structure

Figure 2: A350 XWB Aerostructrue – Prime Suppliers, Source: Westworld Consulting

Risks of outsourcing and offshoring in the aerospace manufacturing industry

Several risks related to outsourcing and offshoring in the aerospace manufacturing industry are identified in the literature. These are summarized below.

i. Outsourced profits – Hart-Smith (2001) argues in his research that when work is outsourced, so are all the profits associated with that work. The basis of his conclusion is the DC-10 program, where the suppliers made all the profits instead of the systems-integrating prime manufacturer. More recent research done by WCIR (2008) confirms this and shows that the sub-components manufacturers are the ones with the best margins in the value chain of the aerospace industry, not the original equipment manufacturers.

ii. Being accountable for but having loss of control over the product – Hart-Smith (2001) claims that "it should be obvious that a company cannot control its own destiny if it creates less than 10 percent of the product it sells". He also adds that there are so many aircraft components, e.g. engines, avionics and systems, that must be outsourced because aircraft manufacturers do not have the expertise to develop them, that retention of a minimum fraction of the airframe structures work is a prerequisite to develop enough cash to develop new products. Airlines and the general public held accountable the prime aircraft manufacturer for any delay or any issue encountered with the planes they sell, not its suppliers.

iii. Underestimating complexity – WCIR (2008) found that firms often underestimate the complexity involved in the transitioning of manufacturing capabilities, which as a rule would always be more complex that if first seems. According to Bédier, Vancauwenberghe and van Sintern (2008), the complexity of the industry's technology was one of the reasons why Western OEMs limited their involvement in emerging countries.

iv. Suppliers not meeting expectations – WCIR (2008) did a survey of Chief Procurement Officers and found that the main areas where suppliers fail to meet their outsourcing targets are

quality, flexibility, responsiveness and cost targets. Suppliers have a guaranteed profit margin if they wrote the contract properly; they have also access to free technical advice if they encounter problems, because the OEM cannot allow them to fail; moreover, they have virtually no risk because if they encounter insuperable problems they are likely to be bought out by the OEM (Hart-Smith, 2001). E.g. after realizing that some tier-1 partners did not have the technological know-how to develop and produce their parts either the experience in managing tier-2 suppliers to develop the requisite components, Boeing had to send key personnel to different sites to fill suppliers' management vacuum and address production issues in person (Tang & Zimmerman, 2009). In another extreme case, Boeing was forced to buy one of its key Tier-1 suppliers to regain control of the development process of the 787 Dreamliner program in 2009 (Denning, 2013).

v. Risk of overspending – Around 90% of the manufacturing work for the 787 was outsourced to risk-sharing partners (Pritchard and MacPherson, 2008), unfortunately, the project incurred an overspending of billions of dollars and it was delayed three years on the initial production schedule (Joubloux & Vanpucke, 2016). Another issue is that the costs related to the transfer of knowledge and ramp up phase of the supplier are among the most important costs, but are often overlooked (Joubloux & Vanpucke, 2016).

vi. Risk of disruptions in the supply chain and delays - Risk of disruption and delays is increasing as the supply chains become more global (White, 2010; Mayer, 2014). Risk always remains with the OEM, and OEM manufacturing can be knocked off schedule and off budget by a misstep in a second, third or even fourth tier supplier due to its dependency on their performance and availability of raw materials and other components (Mayer, 2014; Mocenco, 2015). Research argues that aerospace supply chain is not prepared for the dual challenge of providing a larger volume of more sophisticated and complex aircraft (Mocenco, 2015; PWC, 2016a).

vii. Managing a global supply chain – In the 787 program, the efficiency and efficacy of the supply chain depends on the synchronized Just-In-Time deliveries of all major sections from Boeing's tier-1 strategic partners. If a system or section is delayed, then the delivery schedule of the whole aircraft is delayed. However, none of the strategic partners gets paid until the plane is delivered to the customer. "As strategic partners recognize the potential of being penalized unfairly if they complete their tasks before other suppliers, the risk-sharing contract payment may actually entice these strategic partners to work slower, which undermines the original intent of the risk-sharing contract" (Tang & Zimmerman, 2009).

viii. Risks in intellectual property protection – In the past, the critical importance of protecting intellectual property in areas such as aircraft engine design or avionics was one of the main reasons that limited the Western OEMS involvement in emerging markets or other countries (Bédier, Vancauwenberghe, & van Sintern, 2008). Emerging markets, such as China, are improving in the robustness of its intellectual property systems (Thurber, 2012). However, a remaining issue in that field is the intimate relationship between the military and the civilian technology (Bédier, Vancauwenberghe, & van Sintern, 2008).

ix. Communication and cultural discrepancies – "Culture has often been cited as one of the biggest barriers to successful offshore outsourcing" (Kaushik, 2009), mainly because of

miscommunications due to cultural discrepancies and languages differences (Tang & Zimmerman, 2009; White, 2010; Mocenco, 2015; Joubloux & Vanpucke, 2016).

x. Financial risks – Mocenco (2015) notes financial risks such as fluctuations in the international currency exchange rates or uncertainties and restrictions regarding the availability of financing loans for suppliers.

xi. Compliance and safety risks – the aerospace industry has an extraordinarily high regulatory, quality and safety requirements (Bédier, Vancauwenberghe, & van Sintern, 2008; Mocenco, 2015).

xii. Trade risks – as the offshoring process involves foreign countries, risks encounter by OEMs can be in the form of impositions of domestic and international taxes, exports controls, tariffs, embargoes, sanctions and/or other trade restrictions (Mocenco, 2015).

xiii. Unforeseen circumstances – Mocenco (2015) also mentions as risks the emergence of unforeseen circumstances such as terrorism, war, epidemics and international conflicts.

xiv. Domestic unrest risks - "The Boeing's internationalization attitude has been considered as provoking the surrounding of American aircraft industry for foreign financial support" (Niosi & Zhegu, 2005). Offshoring is a sensitive topic in United States, for example the number of small supplier or subcontractors firms (Tier III) spread throughout the U.S. regions has been diminishing since the industry started its offshoring path. In 1980s, there were around 11000 of those companies, while in 1998 only 4000 had survived (Niosi & Zhegu, 2005). Moreover, outsourcing and offshoring were one of the main reasons behind the 8-week strike conducted by Boeing machinists' union from September to November of 2008 (Gates, 2008).

Reasons for outsourcing or offshoring in the aerospace manufacturing industry

The previous section presented the risks that companies in the aerospace manufacturing industry have encountered or could encounter by outsourcing or offshoring. This raises the question; why do companies outsource or offshore if it is so risky? Several reasons for globally outsourcing or offshoring have been identified in the literature. The main reasons are listed below.

i. Lower prices, cost reduction – This is probably the most cited and repeated reason for outsourcing and offshoring in any industry. Literature shows that the decision to outsource is typically driven by cost and lower prices (Bozarth, Handfield & Das, 1998; WCIR, 2008; Joubloux & Vanpucke, 2016). The costs associated with launching a new aircraft in the large commercial aircraft category are so high that systems integration based on cost-minimization, i.e. sharing the development costs with the suppliers, makes good financial sense, at least in the short-run (Pritchard and MacPherson, 2003; Mocenco, 2015). For example, Boeing's aim of highly outsourcing the 787 program was to optimize production costs and save $10 to $16 billion on the development costs (Joubloux & Vanpucke, 2016).

ii. Access to capital – In order to reduce the development costs mentioned before, access to capital is becoming one of the major reasons behind strategic outsourcing and offshoring (Mowery, 1999; Johnson, 1999; Pritchard and MacPherson, 2005; Mocenco, 2015; Joubloux & Vanpucke, 2016). Airframe firms have reduced their costs for large development projects through collaboration with subsidized foreign partners (Mowery, 1999; Pritchard and

MacPherson, 2005). The importance of this reason is shown in the table below, which highlights the proposed launch funding for the Boeing 7e7 (which later became the 787 Dreamliner program) provided by Pritchard and MacPherson (2003):

Table 2: Funding of aircraft development

Funding Source	**Millions $**	**Item**	**Launch Aid**
State of Washington	$3,200	Final Assembly	Production Subsidy
State of Kansas	$200	Nose and Cockpit	Interest Free Bond
Japanese Government	$1,588	Wing and Fuselage	Production Subsidy
Italian Government	$590	Rear Fuselage	Production Subsidy
747 Special Freighters	$500	Production Transport	Production Subsidy
7e7 Rail Barge	$16	Production Transport	Production Subsidy
Supplier's support	$3,100	Non-airframe suppliers	Non-Recurring Cost
Boeing	$4,200	7e7 launch funding	Self-Financed

iii. Spread risk – Apart from spreading the costs, another reason for outsourcing is to spread the risk, i.e. risk sharing, between the different partners (Mowery, 1999; Johnson, 1999; Pritchard and MacPherson, 2005; Mocenco, 2015). Airbus and Boeing are using the denomination risk-share partners with its strategic partners because they have also to deal with challenges in terms of performance, reliability and financial risks (Mocenco, 2015).

iv. Shorter product development and life cycles – Within the development programs of the new generation of aircrafts, the producers had as a main objective to reduce the time of the products release on the market, i.e. to shorten development times and to increase the speed to market (Bozarth, Handfield & Das, 1998; WCIR, 2008; Mocenco, 2015; Joubloux & Vanpucke, 2016). The idea is to decrease the development time by exploiting the ability of suppliers to develop different sides simultaneously (Mocenco, 2015).

v. Ability to focus on core business – Another idea behind outsourcing is to be able to focus on the core competences of the company. Companies belonging to the aerospace industry are only offshoring parts of their production activities while keeping core business activities and focusing on higher value added portions such as highly technical production (final assembly), innovation, new program development in-house, and sales and marketing (WCIR, 2008; Joubloux & Vanpucke, 2016).

vi. Flexibility – Firms are more and more leaving cost-cutting motivations behind in favor of considerations for flexibility (Joubloux & Vanpucke, 2016).

vii. Quality – Some suppliers might have a better expertise in an area and therefore, they produce higher quality products (Bozarth, Handfield & Das, 1998; Joubloux & Vanpucke, 2016), e.g. engines and avionics are totally outsourced because prime airframe manufacturers do not have the know-how to develop them. "It is better to obtain precision parts from outside sources than it is to make imprecise details in-house" (Hart-Smith, 2001).

viii. Access to technology and resources – Highly linked to the previous point, companies in the aerospace industry are willing to develop sustainable commercial partnerships in emerging countries to benefit from new capacities and resources (Bozarth, Handfield & Das, 1998; Mowery, 1999; Johnson, 1999; Joubloux & Vanpucke, 2016). Joubloux and Vanpucke (2016) state that one of the four main types of benefits for foreign investment is resource seeking advantage, i.e. availability of raw materials, infrastructure or local partners. Johnson (1999) explains, as an example, that outsourcing can also avoid having to develop technology that already exists.

ix. Access to new markets and commercial opportunities – One of the main reason behind the offshoring strategy of companies is to gain access to a new market and/or find new commercial opportunities (Bozarth, Handfield & Das, 1998; Mowery, 1999; Johnson, 1999; Pritchard and MacPherson, 2005; Joubloux & Vanpucke, 2016). As said before, one advantage if that it can reduce the time of the products release on that market (Mocenco, 2015). All the top-tier aircraft manufacturers are aggressively pushing foreign sourcing as a marketing tool in order to lure airlines to buy their products by telling them that they are helping their own domestic economy (Watkins, 1999).

x. Offset requirements, local content (Bozarth, Handfield & Das, 1998; Mowery, 1999; Herrnstadt, 1999; Hart-Smith, 2001; Pritchard and MacPherson, 2003; WCIR, 2008; White, 2010; Joubloux & Vanpucke, 2016) – Sometimes the commercial opportunities mentioned before come in the form of offset requirements, which are of particular interest for companies operating in the aeronautic industry (Joubloux & Vanpucke, 2016). Demand for aircraft in emerging markets is surging, and naturally, the countries of these markets want a piece of the action as suppliers of higher-value components (WCIR, 2008; Bédier, Vancauwenberghe, & van Sintern, 2008). An offset requirement is a trade condition that requires the prime manufacturer that wants to sell aircraft to a particular country to purchase domestic products within that country and/or invest in the importing country.

According to Joubloux and Vanpucke (2016), offsets requirements is one of the main factors that aerospace companies base their location decisions on. However, offsetting it is often overlooked by the academics. Joubloux and Vanpucke (2016) conclude that offset considerations could be acknowledged more in the academic literature dealing with the manufacturing location decision due to the fact that these contractual commercial agreements were key in the decision-making process of several of the companies they studied in their research.

Airlines and their aircraft fleet purchase decision

An airline fleet is the total number of aircraft that an airline operates, as well as the specific aircraft types that comprise it (Belobaba, 2006). Commercial aircraft are most commonly defined by their size or payload, i.e. the number of passengers that it is able to carry, and by their range, i.e. the distance that it can fly without stopping for additional fuel with a reasonable payload. Figure 3 presents how the main aircraft of Boeing and Airbus are distributed taking into account both characteristics.

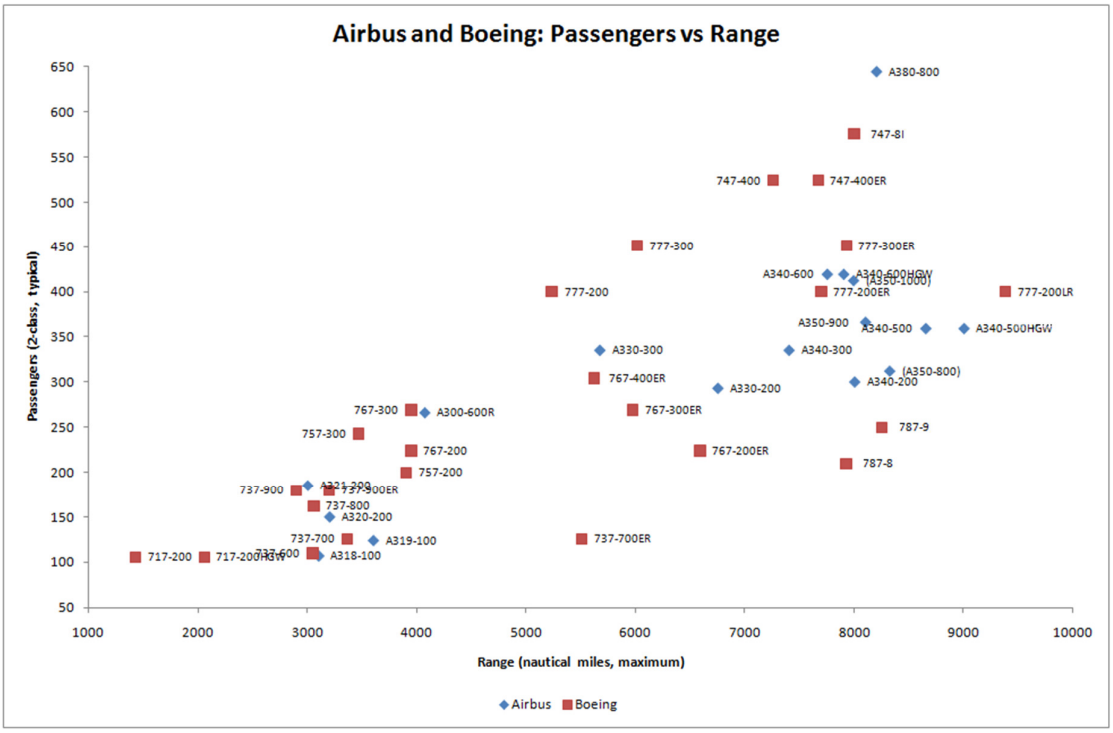


Figure 3: Airbus and Boeing aircraft classification, Source: Tak (2009)

Fleet planning, which can be defined as selecting the right aircraft at the right time, is one of the most important steps in the airline planning process (DLR, n.d.). Fleet composition is a critical long-term strategic decision for an airline, because it is a huge capital investment with a long-term horizon (Belobaba, 2006). According to Belobaba (2006), aircraft evaluation criteria for airlines include:

i. Technical and performance characteristics, e.g. payload/range curve, maximum take-off and landing weights, fleet commonality.

ii. Economics of operations and revenue generation: aircraft purchases require a lot of financing up-front, which means that it is vital to do a financial evaluation of the models to determine costs and revenues, as well as the source of financing the company could use, e.g. leasing.

iii. Marketing issues: as mentioned before, offshoring can be used as a marketing tool for airlines showing that they buy aircraft that are partially manufactured in the country of the airline.

iv. Environmental issues: Noise performance has become a major concern as well as air pollution regulations.

v. Political and international trade concerns: pressure to purchase from a particular manufacturer or country, especially at government-owned national airlines.

“Despite detailed financial and economic evaluations and careful consideration of the technical, performance and other selection criteria described above, it is also true that political influences and international trade issues can dominate airline fleet decisions” (Belobaba, 2009, pp. 158). According to Belobaba (2009), there are several examples of political pressure for an airline to purchase from a particular manufacturer or country, especially at government-owned national airlines. Moreover, he adds that “political decisions can overrule even the best analysis of options” (Belobaba, 2009, pp. 162).

In contrast, Spreen (2016) states that sales of commercial airlines are not normally tied to formal offset requirements, despite this, aircraft manufacturers strive to place industrial work in the country of the purchaser in order to strengthen relationships with the local government.

One can argue that the number of government-owned national airlines has been decreasing and therefore, to worry about government "suggesting" which aircraft to buy is no longer a problem of tomorrow's airline managers. However, as presented by Swelbar and Belobaba (2009, pp. 478): "In the end, tomorrow's airline managers will struggle with many of the same issues that confront this exciting, dynamic and perplexing industry today. Fundamental to the success and survival of virtually every airline will be the identification of an operating and financial model that can be sustainably profitable and which allows the airline to reinvest in itself. Managers will still face an industry that is both capital and labor intensive and subject to the cyclicality of macroeconomic forces. *And many commercial and strategic decisions will continue to face political scrutiny in an industry that is perhaps the most regulated deregulated industry in the world*".

OFFSET AGREEMENTS IN THE AEROSPACE INDUSTRY

As tariffs have been decreasing with every round of the World Trade Organization, non-tariff barriers have been gaining in importance. Non-tariff barriers in international trade, including such barriers as offsets, are responsible for much of the growth in international joint ventures and industry cooperation (Mowery, 1999). There are two kinds of offset: direct and indirect. The main difference is if the offset is related to the product sold or not (Johnson, 1999; IFBEC, 2015). Examples of direct offsets include allowing the purchasing country to manufacture some share of the product it is purchasing and/or providing training and transfer of technology to undertake such production (Johnson, 1999). Indirect offsets are more diverse: the selling company may purchase goods from the customer country that are unrelated to the item being sold, it may involve providing marketing assistance to increase overall exports, or it may involve investing in the purchasing country to stimulate non-traditional industry (Johnson, 1999). Since the 1980s, indirect offsets have been growing faster than direct offsets (Herrnstadt, 1999) and market observers forecast that both will continue to grow dramatically in value terms in the next five to ten years as well as in complexity (IFBEC, 2015).

Most of the offset literature has been linked to the military aerospace industry. After the 1970s, the pressures of foreign governments led the U.S. government toward the acceptance of joint collaborations including R&D. From that point forward, offset agreements became the currency in the military sector collaborations (Johnson, 1999; Niosi & Zhegu, 2005). Since the 1980s, offset agreements represent from 40 to 98 percent of military exports in the U.S. (Niosi & Zhegu, 2005). In 2015, offsets are required in the defense industry by about 80 countries worldwide when purchasing defense equipment, systems or services (International Forum on Business Ethical Conduct, 2015). According to IFBEC (2015), with the opening up of Direct Foreign Investment, the scope of potential offsets widened to include homeland/costal security, civil aerospace products and services amongst other areas.

The forces that drove the aircraft civil sector toward international collaboration were more complex than just foreign governments' pressures, even though they played, and play, a very important role (Niosi & Zhegu, 2005). Building on precedents established in U.S. exports of military aircraft, foreign purchasers of U.S. commercial transports in the late 1960s and 1970s began demanding that their

purchases contain some domestic content (Mowery, 1999). During the subsequent years, foreign governments increasingly demanded more generous benefits, including opportunities for their firms to participate in developing and producing more-complex components (Mowery, 1999; Pritchard & MacPherson, 2008). The outcome of failing to provide them is exemplified with the McDonald Douglas' history. In the 1980s there were mainly three aircraft integrators in the world: Boeing, McDonald Douglas and Airbus. From that time forward, Airbus and Boeing started to grow the participation of foreign firms in the design and development process of aircraft components. McDonald Douglas was much more reluctant to this type of international collaboration development and after a series of unsuccessful cooperation attempts, the company avoided risk-sharing ventures in new aircraft developments (Niosi & Zhegu, 2005). The direct consequence of the lack of foreign partners was the lack of new aircraft. The choice of being an independent producer constituted a major impediment for the viability of the company in the competition race and eventually McDonald Douglas ceased to exist as it merged with Boeing in 1997 (Niosi & Zhegu, 2005).

As was stated previously, the aerospace industry tends to be seen by governments of economically developed as well as industrializing countries as a key industry and this is an important motive for offset requirements (Johnson, 1999). Demand for aircraft in emerging markets is surging, which has given these countries a substantial buyer power and with it the opportunity to require Western companies to invest in industrial cooperation (another name for offset requirements) in return for the goods and services that they are exporting to them (WCIR, 2008; Bédier, Vancauwenberghe, & van Sintern, 2008; Joubloux & Vanpucke, 2016; Richter & Witt, 2017). The power of these emerging markets and foreign countries lies on the fact that their domestic airlines are often directly government owned or subjected to substantial administrative guidance in their purchasing decisions (Mowery, 1999; Johnson, 1999; Watkins, 1999). For purchasing countries, offsets offer opportunities to acquire technological know-how, support local industry and other economic benefits (IFBEC, 2015). The idea of industrial offsets is that they increase or guarantee the orders and sales of aircraft in a particular country (Herrnstadt, 1999; Mowery, 1999; Pritchard & MacPherson, 2003; Pritchard & MacPherson, 2005; WCIR, 2008; White, 2010) and therefore, these requirements dictate the need and obligation of offshoring items in the aircraft value chain (WCIR, 2008; Richter & Witt, 2017). Boeing has become America's largest corporation in terms of offset-related commitments (Hart-Smith, 2001; Pritchard & MacPherson, 2005). In 1999, Mowery (1999) already concluded that "continued bilateral competition between Boeing and Airbus, and trilateral competition among Rolls-Royce, Pratt & Whitney and General Electric, will continue the pressure of offset agreements".

Controversy of offset requirements

Offset requirements are a controversial practice. They can create trade and competition distortions, as well as be a source of corruption practices. According to the OECD, the defining characteristics of industries identified as susceptible to corruption risk in procurement include: strong capital intensity, advanced technology and sophistication of materials, and economy rarity (IFBEC, 2015). These are criteria that characterize the defense and the aerospace industry. Reliable figures about the size of offset obligations are not easily verifiable (IFBEC, 2015). Especially on the commercial side, it is hard to collect data on trends, magnitude, and content of offsets (Mowery, 1999). This reinforces the controversy of offsets, mainly because they are complex, very heterogeneous, poorly understood and negatively reported in the media (IFBEC, 2015). Mowery (1999) and Johnson (1999) mentioned three more criticisms of offsets in both civil and military aerospace: belief that international collaboration

contributes to job losses, belief that the technology transfer work against the long-term national security and the necessity of balancing the impact of one corporation's offset arrangements against the interests of another corporation.

Offset is prohibited by some countries, as well as the EU (IFBEC, 2015). This prohibition comes in the form of a pluri-lateral Agreement on Trade in Civil Aircraft that was entered into force on 1st January 1980 and has now 31 signatories (World Trade Organization, 1980). This agreement is one of the two pluri-lateral agreements signed by a reduced number of WTO members. The agreement states clearly in Article 4 that purchasers of civil aircraft should be free to select supplies on the basis of commercial and technological factors. Article 2.2 (Government-directed procurement) states that "signatories shall not require airlines, aircraft manufacturers, or other entities engaged in the purchase of civil aircraft, nor exert unreasonable pressure on them, to procure civil aircraft from any particular source, which would create discrimination against suppliers from any signatory". Furthermore, by emphasizing that the only factors which should be involved in purchase decisions are price, quality and delivery terms, the signatories agree that Article 4.3 (mandatory sub-contracts) does not permit Government-mandated offsets. Further, they will not require that other factors, such as subcontracting, be made a condition or consideration of sale. Specifically, a signatory may not require that a vendor must provide offset, specific types or volumes of business opportunities, or other types of industrial compensation. Article 4.4 (inducements) states that "signatories shall refrain from the use of negative or positive linkages between the sale or purchase of civil aircraft and other government decisions or policies which might influence such sale or purchase whenever there is a competition between suppliers of signatories".

It should be noted that there are hundreds of disputes in the WTO over subsidies to aircraft manufacturers. A recent one was filed by Brazil concerning Canadian subsidies to Bombardier in 2017. However, there are no disputes regarding the Agreement on Trade in Civil Aircraft and there have been none for 37 years. This is despite that offsets that concern flag carriers buying particular aircraft in exchange of some participation on the aircraft by its country are still mentioned in the literature. According to Spreen (2016,), "apart from official international agreements that prohibit offsets related to civil aircraft sales, the offsets continue to occur under various guises, although they are rarely referred to as offsets. Aerospace firms recognize the importance of nurturing beneficial long-term relationships with the countries in which they aspire to sell, and they often use industrial cooperation as a way to gain local recognition and government support".

Example of offset agreements in the aerospace industry

An example of offset in the aerospace industry is found in Japan. The Japanese government uses its good offices (and regulatory powers) to encourage Japanese airlines to purchase Boeing aircraft, even though they are privately owned, in exchange for Boeing's increased use of components made by Japanese aerospace suppliers (Flamm, 1999; Pritchard & MacPherson, 2008).

This practice started in 1974, when Mitsubishi was given contracts to produce the inboard flaps for the Boeing 747 aircraft. Major purchases of Boeing 747s were done by Japanese airlines after this agreement (Pritchard & MacPherson, 2005). The partnership between Japan and Boeing continued with the 767 program, where Japanese suppliers manufactured fuselage sections (Pritchard & MacPherson, 2008). The latest Boeing plane, i.e. the 787 Dreamliner, has around 90% of the manufacturing work outsourced. Japanese suppliers are responsible to manufacture around 35% of

the 787 aircraft (Pritchard & MacPherson, 2003; Hyde, 2006). This work includes the wing manufactured by Mitsubishi, the fuselage manufactured by Kawasaki, and the manufacture of the center wing by Fuji (Sobie, 2003; Pritchard & MacPherson, 2003). All Nippon Airways was the launch customer of the Boeing 787 Dreamliner. The airline is also the biggest customer of this plane with a total of 83 aircraft ordered to date (The Boeing Company, 2017). Its main competitor, Japan Airlines, is also one of the biggest 787 customers with 45 planes ordered (The Boeing Company, 2017). Table 3 illustrates the difference in plane orders between Airbus and Boeing in the Japanese market (The Boeing Company, 2017; Airbus, 2017b):

Table 3: Japanese orders and deliveries

	Airbus	Boeing
Orders	165	824
Deliveries	84	756
Unfilled	81	68

Japan Air Systems, the smallest of the big three Japanese airlines that merged with Japan Airlines in 2006, reportedly defied the government pressure and purchased Airbus aircraft at a very good price at the cost of considerable negative campaign in the press and elsewhere against it (Flamm, 1999). In essence, during a lot of years Airbus became a “less favored nation” when selling into the Japanese market. According to Airbus Japan CEO Glen Fukushima, when he joined the company in 2005 he was told that with the exception of Japan and Israel, Airbus was extremely successful around the world (Hyde, 2006). In 2005, Airbus had just a 4% share of the Japanese market (Hyde, 2006) and part of that came from new airline startups in Japan who were eager purchasers of Airbus, even though they reported receiving questions from mass media and government regulators about why they chose Airbus instead of Boeing (Hyde, 2006). Airbus, knowing its weak position in the Japanese market, has decided to increase its industrial partnerships in Japan. In 2007, Airbus stated that it was planning to order more than 5 percent of parts and material for its new A350 jetliner from suppliers in Japan (Suga, 2007). Airbus’ commercial and industrial presence in Japan has grown considerably in recent years. This is reflected in an increased number of aircraft orders by Japan’s airlines for both the company’s market-leading wide-body and single-aisle product lines (Airbus, 2017c). This is depicted in Figure 4.

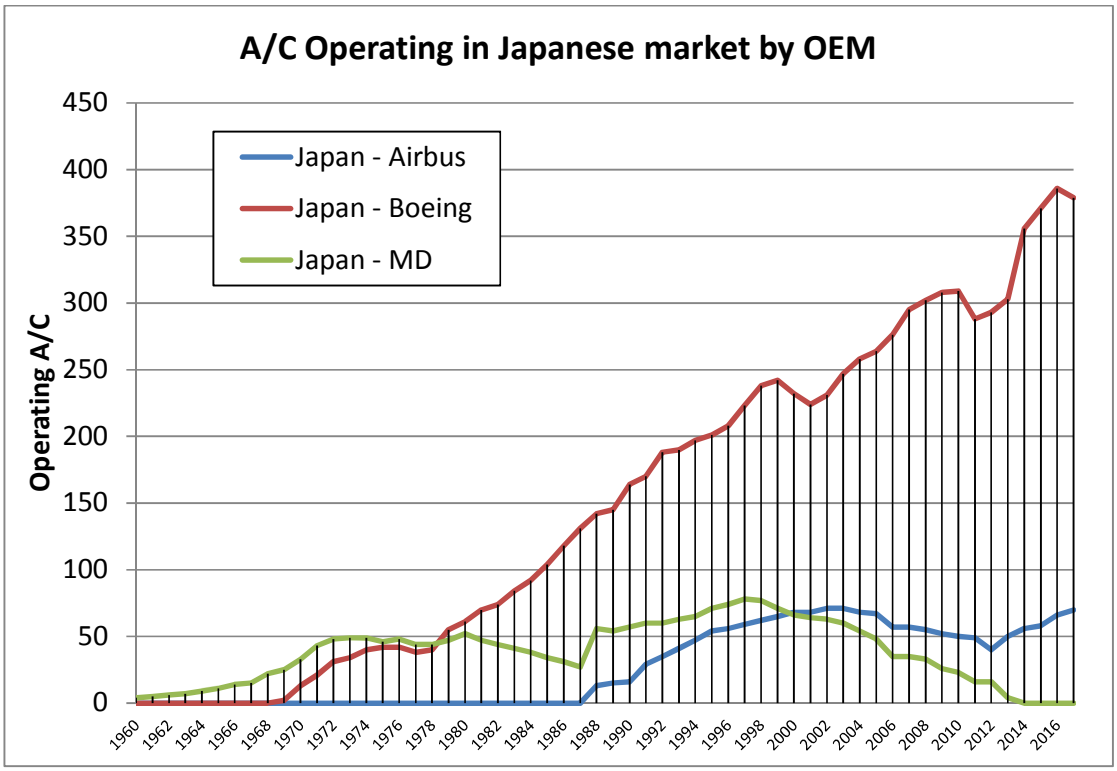


Figure 4: Aircraft operating in the Japanese market, Source: The Boeing Copany (2017) & Airbus (2017b)

CONCLUSION

The purpose of this study was to gain insight into the offset-process in the aerospace industry. Companies in the aerospace industry often use processes such as outsourcing and offshoring. These approaches contain risks. Nevertheless, companies have reasons to follow such approaches for example in gaining access to low production costs. What is typically ignored in the literature is the reason to use outsourcing or offshoring due to offset requirements. The aerospace industry is particularly prone to offset requirements because of its perceived importance for nations, and thus their governments. The high demand for aircraft, in particular from emerging economies where governments may control part of the airline purchasing behavior, gives governments the ability to negotiate offset deals. This is despite the controversy over this approach and questions about legality. The example from Japan has shown how Boeing has achieved a considerable lead in the market over Airbus by working with Japanese suppliers, and how Airbus is trying to cut the difference by increasing the percentage of aircraft parts made by Japanese aerospace companies.

This study was based on a desk research approach. One of the weaknesses for this type of approach is that it uses existing material and in the case of offset agreements, the existing material is limited. It is proposed that further studies include primary data collection although this can be challenging due to the sensitive nature of the material.

Another recommendation is that offset agreements, which as shown, play a key role in the aerospace industry, should be added in the literature as a motive for internationalization. For example, it is not part of Ferdows (1996) model. However, it is also clear that offset may not always

play a role. What this points out is that the typical academic models, which look for general patterns, do not necessarily fit well with what is happening in aviation. This indicates that another dimension, i.e. the strategic importance of the industry for a nation, may play a role. The study has shown that the behavior of governments, and by extension the firms in the negotiation process of purchasing aircraft, is related to the strategic importance attributed to the manufacturing process of (parts of) aircraft. Therefore, the global dispersion of manufacturing is not just an issue of the main factors identified in the academic literature but the strategic importance of an industry should be added. This factor needs more research, especially because it expands the traditional business viewpoint with that of a government entity that is interacting with the business purchasing decision.

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