

Flight Plan 2010:

Analysis of the U.S. Aerospace Industry



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EXECUTIVE SUMMARY

After a tumultuous 2008, 2009 was a relatively steady year for the U.S. and global aerospace industry. Even with the overall slow recovery of the U.S. and global economies, the U.S. aerospace industry continued to experience modest growth industry-wide. In comparison to 2008, when the near-term outlook was more uncertain, the recovering global economy points to sustained growth.

Despite the lingering effects of the global economic downturn, the U.S. aerospace industry continued to show reasonable strength in 2009. When viewed in the context of recent record performance, the industry's 2009 financial results are encouraging. According to the U.S. Bureau of the Census, the total value of aerospace shipments for 2009 was \$188.6 billion, an increase of 8.5 percent over 2008. The total value of aircraft and parts alone was \$161.8 billion, an increase of 6.5 percent over 2008.¹ Although the corporate parents of a number of aerospace manufacturers experienced income declines in 2009, in some cases the aerospace segment of these manufacturers not only booked a profit but actually realized a profit increase over the previous year. For example, GE, the corporate parent of aircraft engine manufacturer GE Aviation, realized a profit of \$19.3 billion in 2009, a 27 percent decline from the corporate profit of \$26.4 billion posted in 2008. For the same period, however, GE Aviation actually experienced a 6.5 percent profit increase.²

As has been the case historically, exports of U.S. aerospace products in 2009 played a significant role in the overall performance of the industry. Aerospace exports in 2009, valued at \$78.4 billion, accounted for about 42 percent of total U.S. aerospace industry output. While the value of U.S. aerospace exports in 2009 fell slightly from the 2008 figure (of \$80.2 billion), the decline in U.S. aerospace imports over the same period was larger (falling from \$35.8 billion in 2008 to \$31.1 billion in 2009). Consequently, the U.S. aerospace trade surplus in 2009, of \$47.2 billion, was an increase of 6.3 percent from the 2008 figure of \$44.4 billion. This positive trade balance was the highest of all U.S. manufacturing industries.

U.S. aerospace exports are an important factor in U.S. employment. In 2008, the most recent year for which data is available, aerospace exports supported over 770,000 U.S. jobs, the highest such number for all U.S. industries. Moreover, U.S. aerospace production workers are well paid, earning 80 percent more than workers in all manufacturing industries and more than twice as much as all U.S. private sector workers.

Aside from the continuing effects of the global economic downturn, other factors impacted the U.S. and global aerospace market. Continued weakness of the U.S. dollar against the euro and other major foreign currencies made U.S. products more affordable in foreign markets. Dollar-denominated goods such as large civil aircraft (LCA) manufactured by Boeing, aircraft engines from Pratt & Whitney and GE Aviation, rotorcraft produced by Bell/Textron and Sikorsky, and

¹ Total value of aerospace shipments and total value of aircraft and parts shipments reflect industry data for NAICS 33641 "Aerospace Product and Parts Manufacturing". Data sources are: U.S. Department of Commerce, Bureau of Economic Analysis; U.S. Department of Labor, Bureau of Labor Statistics; and the Federal Reserve Board. The data are summarized and available at http://trade.gov/mas/manufacturing/OAAI/aero_stats.asp

² GE Aviation's 2009 segment profit was \$3.923 billion; 2008 segment profit was \$3.684 billion. See GE 2009 Annual Report available at http://www.ge.com/ar2009/pdf/ge_ar_2009.pdf

unmanned aerial systems (UAS) produced by numerous smaller aerospace companies, benefitted from a favorable exchange rate in comparison to competitors from Europe, Japan and elsewhere. As a result, low U.S. dollar valuation continues to ease the effects of the global economic downturn on the U.S. aerospace market.

The steady rise in oil prices that began in 2003 continues to adversely impact the global commercial aviation industry. Unlike 2008, when a rapid rise in oil prices in the first half of the year was followed by an equally sharp decline, oil prices rose steadily in 2009. The long-term impact of higher fuel costs on the global aerospace industry, which provides aircraft, parts and service for commercial aviation, is significant. As a result of increasing oil prices over the last five years, fuel expenses accounted for an estimated 24 percent of operating expenses for global aviation companies in 2009, a 71 percent increase from the 2004 level of 17 percent. The long-term upward trend in fuel cost is incentivizing civil aviation operators to look more aggressively for ways to reduce their fuel expenses.³ This search is driving demand for more fuel-efficient aircraft like Boeing's 787 Dreamliner as well as new, more fuel-efficient engines like Pratt & Whitney's PW1000G PurePower Geared Turbofan and GE Aviation's GEnx models. These new, more efficient aircraft and engines will help operators reduce fuel consumption and lower operating expenses. Finally, aircraft and engine manufacturers are engaged in research on alternative aviation fuels produced from a variety of non-petroleum sources. In the long term, these alternative fuels may help operators reduce fuel costs and thus maximize profitability.

Another factor driving the global aerospace market is the ongoing trend towards consolidation. Both domestic and international ventures that facilitate market access, as well as cost, risk and information-sharing, are becoming more numerous. U.S.-only joint ventures (JV) like the Engine Alliance, a 50/50 JV between GE Aviation and Pratt & Whitney as well as international ventures like Superjet International, formed by Italian aerospace company Alenia Aeronautica and Sukhoi Civil Aircraft to market and sell Sukhoi's Superjet 100, are representative of this trend. The largest and potentially most influential consolidation, however, is Russia's United Aircraft Corporation (UAC). UAC is a Russian government-owned joint stock company that consolidates the collective research, design, financial and manufacturing resources of the Russian aircraft industry into a single state-owned and controlled entity.⁴ UAC has already negotiated design and production agreements with a number of U.S. and European aerospace companies, and UAC senior leadership has set a goal of becoming the world's third largest aircraft manufacturer by 2015.⁵

As in years past, the issue perceived by the aerospace industry to have the largest impact on competitiveness is U.S. export control policy. Concerns about the ability to receive a U.S. export license for aerospace products have incentivized foreign competitors to "design out" U.S. components, purchase products containing no U.S. parts, and strengthen partnerships with other countries in order to avoid the need to apply for a U.S. export license. Although the impact of

³ http://www.iata.org/pressroom/facts_figures/fact_sheets/Pages/fuel.aspx

⁴ <http://www.uacrussia.ru/en/>

⁵ Moscow International Aviation and Space Salon 2007 Show Program interview with Alexei Fedorov, President of United Aircraft Corporation

export control policy varies by industry sector, its effect is widely shared across the U.S. aerospace industry. Aside from economic security implications, the current export control regime also poses foreign policy and national security challenges.

With these considerations in mind, in August 2010 President Obama announced four major objectives the Administration will take to overhaul the U.S. export control process:

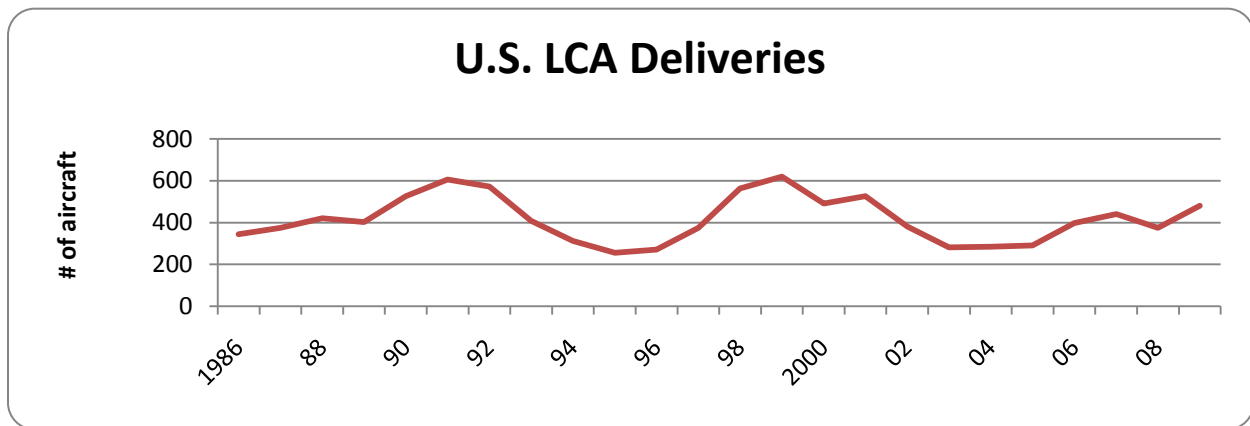
- Establish a single, tiered, positive list of products covered by export control regulations, with greater controls on the export of the most sensitive items and fewer controls on the export of less critical goods and technology;
- Link all export control agencies together under a single information technology platform, reducing unnecessary administrative snags in transferring license application information;
- Create, through an executive order, an Export Enforcement Coordination Center to coordinate and strengthen enforcement efforts; and
- Work towards the establishment of a single export licensing agency

Taking the uncertainty of economic conditions of the past eighteen months into consideration, it is difficult to predict overall aerospace industry performance in the near term. In the longer term, however, prospects are good for continued, steady growth. Large civil aircraft, rotorcraft, general aviation aircraft, regional and business jets, engines/power plants, communications satellites, military unmanned aerial systems (UAS), and airport infrastructure and safety equipment should continue to experience steady growth. Other sectors, such as launch services, are experiencing lower but steady growth as they recover from market disruptions and/or adapt to commercial markets. The launch services sector could experience faster growth if the demand for satellite telecommunications services increases. Growth in the maintenance, repair and overhaul (MRO) market will be led by expanding aircraft fleets in India, Eastern Europe, South America and China. The market for civil/commercial UAS remains stagnant in the absence of civil regulations for certification and operation in the national air space; however, the Federal Aviation Administration (FAA) and civil aviation authorities in Europe and Asia are working towards rationalization of civil certification procedures. Key markets for U.S. aerospace exports remain India, China, Russia, Japan, and Europe.

Large Civil Aircraft

Following its acquisition of McDonnell Douglas in 1997, Boeing is the only U.S. manufacturer today of large civil aircraft (LCA); that is, aircraft generally considered to have more than 100 seats or an equivalent cargo capacity. Boeing's LCA revenues typically account for more than half of the total non-government, civil output of the U.S. aerospace industry.

LCA production is cyclical, with peaks in deliveries occurring at ten years intervals and valleys occurring in the intervening years.⁶ The last valley for Boeing ended in 2004, when Boeing delivered 285 aircraft. With the exception of 2008, deliveries have increased every year since then, with 481 aircraft delivered in 2009. In 2008, a strike caused deliveries to fall below the previous two years. However, in the first quarter of 2010, Boeing's deliveries were down 13 units over the first quarter of 2009.⁷



Narrow body aircraft dominated Boeing's 2009 deliveries. The 737 accounted for 372, or 77 percent, of the total of 481 aircraft delivered. Boeing's 2009 revenue from sales of LCA, \$34.051 billion, represented an increase of slightly more than 20 percent compared to 2008 revenue of \$28.263 billion. LCA sales revenue accounted for 49.9 percent of the company's total revenues in 2009. At the end of 2009, Boeing said that its LCA backlog (total value of all aircraft on order) was \$250.5 billion, more than double the value of the company's LCA backlog in 2005.

Between 2005 and 2007, Boeing experienced a dramatic rise in aircraft orders, with a company record of 1,413 set in 2007.⁸ Demand for the new 787 and growing passenger traffic in foreign markets contributed to the increase. However, demand fell sharply in 2008, with the number of net orders for new Boeing jetliners declining 53 percent from the year before (Boeing recorded net orders of 662 aircraft in 2008). To an extent, this fall was expected—by 2008, Boeing's delivery schedule was so full for some of its products that aircraft were not available well into the next

⁶ The source for this and other data in this report regarding aircraft orders, deliveries, and sales volumes for Boeing and Airbus are the companies themselves. Although widely accepted by aerospace industry analysts, the data has not been independently verified.

⁷ John Kell. "Boeing Delivers 108 Aircraft In 1Q, 13 Fewer Than Year Ago." Dow Jones Newswire. April 8, 2010. On the web at: <http://online.wsj.com/article/BT-CO-20100408-710684.html>.

⁸ 1,413 is the number of net orders for 2007. Net orders is the number of new orders received less orders cancelled. The aircraft orders cancelled may have been originally placed in a prior year.

decade. However, the situation was exacerbated by the growing difficulties of the airlines, which were becoming increasingly strapped by rising fuel prices, decreased access to capital, and a falling economy.

By early 2009, airlines had begun to request deferrals of deliveries or cancel orders. Demand for new jetliners continued to fall precipitously. At year's end, Boeing announced net orders for 142 jetliners, the lowest number since 1994.

Key events in 2009 for Boeing included:

- January: announcement of the company's intention to reduce Boeing Commercial Airplanes' workforce to 63,500, a reduction of 4,500 employees;
- June: release of a study conducted by Boeing and other companies calling attention to the favorable performance of biofuels in comparison with traditional petroleum-based jet fuel;
- July: acquisition from Vought Aircraft Industries of a facility in North Charleston, South Carolina that fabricates and assembles 787 aft fuselage sections;
- October: announcement that Boeing would open a second final assembly line for 787 aircraft in North Charleston, South Carolina;
- November: roll-out of the first 747-8 air cargo freighter;
- December: first flight of the Dreamliner following multiple production delays that placed the aircraft program two years behind schedule; and
- December: acquisition of Alenia North America's 50 percent stake in Global Aeronautica, a facility in South Carolina where 787 fuselage sections are assembled (Boeing acquired the other half of Global Aeronautica from Vought Aircraft Industries in 2008).

Access to foreign markets is crucial to Boeing. Over the next ten years, more than 70 percent of Boeing's large civil aircraft likely will be delivered to customers outside of the United States. Key foreign markets include China, Japan, and India.

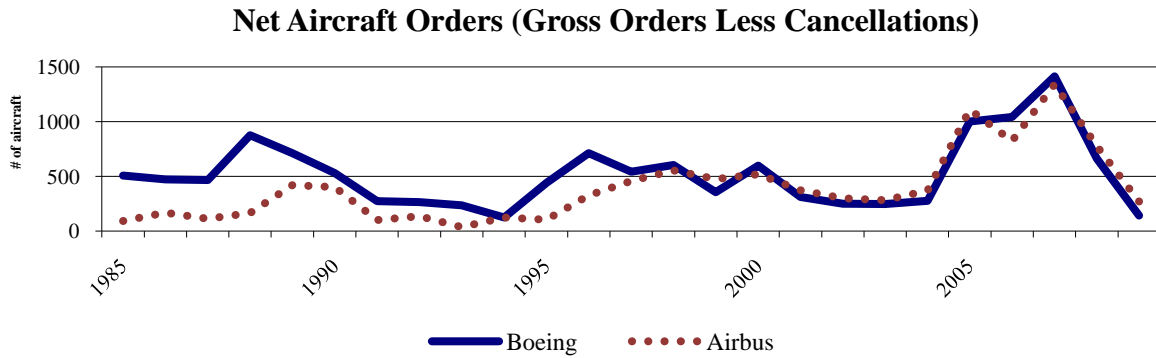
Competition

Boeing and McDonnell Douglas dominated the global LCA market in 1970s and 1980s. In the 1990s, Airbus became a serious competitor and remains Boeing's sole LCA competitor today. Airbus experienced the same boom and bust in aircraft deliveries from 2005 to 2009, though the drop-off was not as precipitous as Boeing's. In 2009, Airbus exceeded Boeing's share of the market as measured by three parameters. Airbus' market share was:

51 percent, measured by number of aircraft delivered (498 vs. Boeing's 481);
66 percent, measured by number of net aircraft orders (271 vs. Boeing's 142); and
51 percent, measured by LCA revenues, (\$35.5 billion vs. Boeing's \$34.1 billion).⁹

⁹ Airbus's reported 2009 revenue from the sale of LCA, €35.506 billion, was converted at the rate of €1.00 = US\$1.34645.

Other civil jet transport manufacturers with a significant global presence, especially Bombardier (Canada) and Embraer (Brazil), do not now produce aircraft comparable to Boeing and Airbus. However, over the past several years, various companies have announced projects that will compete with Boeing and Airbus in the narrow-body market. The first of these, the Bombardier CSeries, is expected to be delivered in 2013.¹⁰ China and Russia have also announced LCA projects, with deliveries projected to begin in 2016. As a result of this market pressure, both Boeing and Airbus are considering re-engining their current-generation narrow-body aircraft. Embraer expects to make a decision on whether to enter the narrow-body market by the end of 2010.



Boeing's orders before 1997 (when it acquired McDonnell Douglas) include aircraft ordered from McDonnell Douglas.

¹⁰ The CSeries will have passenger capacities of 100-145 seats, depending on model configuration. In February 2010, Bombardier announced the first CSeries sale to a U.S. customer.

Regional Jets

Global production of regional jets is dominated by two manufacturers—Canada’s Bombardier and Brazil’s Embraer. Regional jets are typically considered to be commercial jet transport aircraft with fewer than 100 seats. However, this traditional defining line is blurring as large regional jets come closer to the smallest product offerings of Boeing and Airbus. Orders and deliveries of regional jets grew rapidly in the 1990s as airlines used them to fill a unique market niche. More recently, deliveries have slowed, and some analysts believe that the natural annual market for regional jets is around 200 aircraft. Despite the downward trend in demand, three other countries—China, Russia, and Japan—are currently developing regional jets. Regional jet deliveries were up for Embraer but down for Bombardier in 2008; new orders, however were down for both companies (see Charts 1 and 2, next page).

Figure 1: Revenue for Regional Jet Manufacturers Embraer and Bombardier

Company	Products	2009 Revenue from Aviation ¹¹	2009 Net Income (all Business Units)	2008-2009 % Change in Income
Bombardier	Regional jets and turboprops; business jets	\$6.628 (through Q3)	\$528 million (through Q3)	-26%
Embraer	Regional jets, business jets	\$5.47 billion	\$248.5	-36%

Trends

Bombardier enjoyed a three-year head start over Embraer in delivering its first regional jet, but has not dominated the market. Embraer has delivered more jets each year since 2006 (see Chart 1, next page) and had a backlog 2.5 times as large as Bombardier (by number of aircraft) as of this writing. Both firms, however, experienced significant declines in 2009—total orders declined 70 percent from 2008 levels (see Chart 2).

Both regional jet manufacturers are beginning to focus on larger aircraft models. Though the regional jet market began with an emphasis on 50-seat jets, the largest market for today’s regional jets is 70-seats and larger. In fact, both manufacturers offer aircraft with more than 100-seats, which is traditionally the market segment dominated by Boeing and Airbus. Embraer’s ERJ 190, which seats up to 114, currently accounts for 70 percent of its backlog by number of units (up from 56 percent last year). Bombardier has launched an even larger product line—the C Series—which will compete with Boeing’s 737s and Airbus’s A320s.

¹¹ Neither company had released an annual report for the most current fiscal year as of this writing. Embraer figures for 2009 are available but Bombardier figures reported only through Q3. Bombardier’s revenue figures are for its aircraft division but its income figures are for the entire company; Embraer’s figures are for the firm as a whole. In both cases, number reflects both aircraft sales and the sale of related services.

Chart 1: Regional Jet Deliveries, 2000-2009¹²

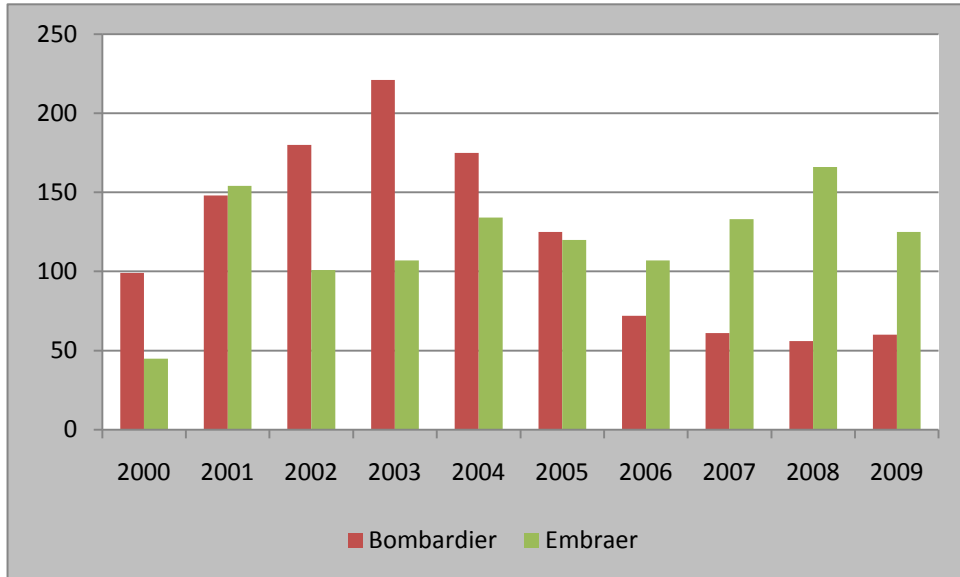
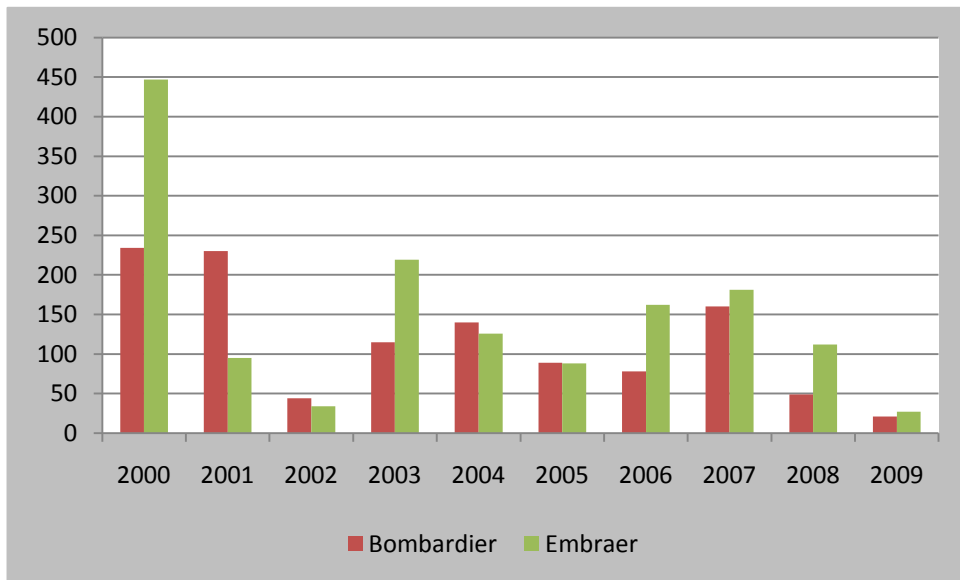


Chart 2: Regional Jet Announced Orders, 2000-2009



¹² U.S. Department of Commerce analysis of regional jet data from *Speednews*.

Outlook

Major manufacturers' forecasts agree that demand for larger regional jets will outpace the demand for smaller regional jets. In particular, the highest growth is forecast for the market over 100 seats, and this is spurring the development of larger aircraft by the regional jet manufacturers. As yet unclear, however, is whether the four companies will become direct competitors at the low-end of the single-aisle market, or whether Boeing and Airbus will focus on larger single-aisle aircraft.

Figure 2: Market forecasts, 2009-2028¹³

Rolls-Royce		Boeing	
30-50 seats	1,695	< 90 seats	2,100
70-90 seats	4,843	90-175 seats	16,430
Up to 110	1,307		
Bombardier (incl. turboprops)		Embraer	
20-59 seats	300	30-60	650
60-99 seats	5,800	61-90	2,450
100-149 seats	6,300	91-120	3,650

The United States typically has been the largest market for regional jet deliveries. Though North America should remain the largest market, industry forecasts predict that its market share will drop. Europe/Russia and China are expected to be the next largest markets for deliveries, though even combined their market share will account for less than North America's.

Regional jet development is becoming increasingly global, with new projects under way in China, Russia, and Japan. The Chinese and Russian jets are approximately the same size—the Chinese ARJ21 is 78-90 seats and the Russian SuperJet is 75-95 seats. A stretched version of the ARJ21 is planned that would increase its capacity to 105 seats. Both programs have been delayed multiple times, though they are both now in the test-flight phase. The Japanese Mitsubishi Regional Jet was formally launched in April 2008 and is expected to enter into service in 2013. All three aircraft will be seeking certification outside of their home markets.

¹³ Airbus was not included because the company does not provide a forecast for aircraft below 100 seats for this time period.

Figure 3: Backlogs

Company	End 2008¹⁴	End 2009¹⁵
Bombardier	127	93
Embraer	426	265
ACAC	75	240
UAC	40	153
Mitsubishi	15	15

It is unclear whether there is enough global demand to make all of these programs economically viable. Even the most optimistic forecasts predict that on-average only 300 aircraft with fewer than 100 seats will be delivered annually. The current regional jet manufacturers have been able to meet that level of production in the past. The Chinese market is expected to absorb somewhere between 600-900 aircraft with fewer than 100 seats by 2026 and Russia/CIS less than 200. Even if each country's demand goes entirely to its domestic manufacturer, on-average that means that they will deliver 45 and 10 planes per year, respectively. Though that level of production may be sufficient as these programs start off, they will require foreign markets to be sustainable. Likewise, given the size of the Japanese market, it is unlikely that those aircraft could all be absorbed domestically.

¹⁴ Speednews. "Status of Commercial Aircraft Programs: December 31, 2008." January 30, 2009.

¹⁵ Speednews. "Speednews Commercial Jet Aircraft Program Status: December 31, 2009." January 15, 2010.

General Aviation

Overview

General aviation (GA) manufacturers shipped 2,276 units in 2009, down 46.7 percent from 2007, which was the best year since the early 1980s.¹⁶ The decline is a direct result of the economic downturn and was accompanied by a significant cut in employment in the United States. As a result, U.S. manufacturers' market share dropped from 77.6 percent to 69.7 percent, perhaps the worst decline on record. While the GA market has somewhat stabilized, it is uncertain when the true recovery will begin. Current challenges to sales of new aircraft include the size of the used aircraft inventory, limited credit, and a decline in the fractional jet industry.

Though North America is expected to remain the top market for aircraft sales, over half of GA aircraft deliveries are now made to overseas customers. The European Union remains the next biggest market, but growth in other areas, particularly Asia and the Middle East, is expected to be significant in years ahead.

General Aviation Manufacturers	
Airbus	Gippsland Aeronautics
Alpha Aviation	Gulfstream
American Champion	Hawker Beechcraft
Aviat Aircraft	Liberty Aerospace
Boeing Business Jets	Maule Air Incorporated
Bombardier	Mooney Aircraft
Cessna Aircraft Company	Pacific Aerospace Corporation
Cirrus Design Corporation	Piaggio
Dassault Falcon Jet	Pilatus
Diamond Aircraft	Piper Aircraft, Inc.
Embraer	Quartz Mountain Aerospace
Emivest Aerospace Corp	Quest Aircraft Company

Company data from the General Aviation Manufacturers Association (GAMA). GAMA estimates their data covers over 90 percent of the total market.

¹⁶ All data taken from GAMA's 2009 General Aviation Statistical Databook and Industry Outlook unless otherwise indicated. Available on the web at: <http://www.gama.aero/publications>.

Trends

For 2009, shipments were down 48.5 percent and billings (value of shipments) were down 21.4 percent. Declines were registered in all three industry segments:

- turboprops (down 17.6 percent)
- business jets (down 33.7 percent)
- piston aircraft (down 54.5 percent)

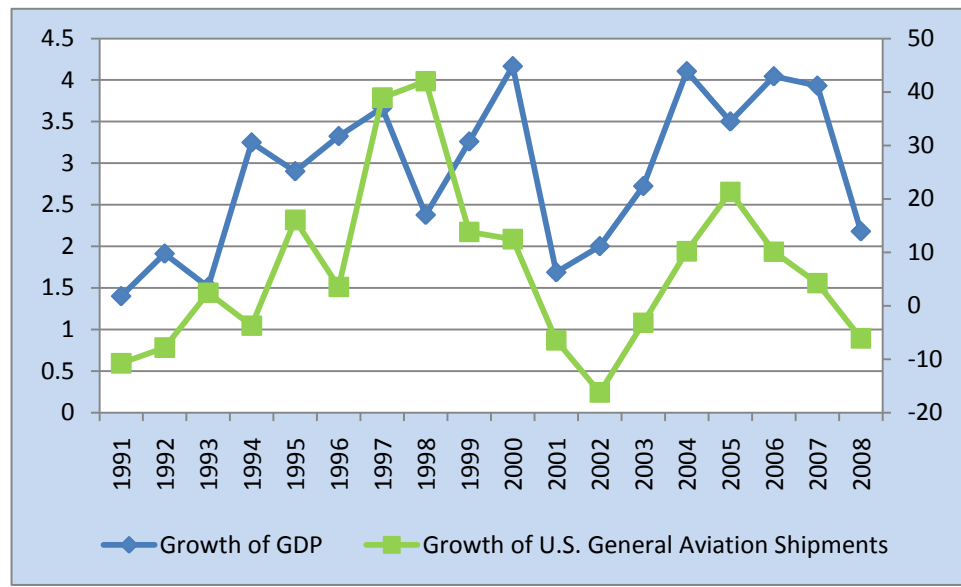
It should be noted that even with this precipitous decline, 2009 was still one of the top years for GA billings. This is due to the increasing market share of business jets relative to piston aircraft. Since 2004, the share of business jet shipments has risen from 20 percent to 38 percent while the share of piston aircraft has dropped from 69 percent to 42 percent. Business jets are significantly more expensive than piston aircraft—since 2004, business jets have accounted for an average of 88 percent of the market by value. As a result, 2009's dramatic drop in piston aircraft shipments did not have a large effect on the value of shipments for the industry as a whole. Meanwhile, while business jet shipments also saw a notable drop, the number was still the fourth best year on record. Total industry billings of \$19.5 billion thus represented the third best year for which data is available.

The U.S. manufacturers' share of the worldwide production fell significantly in 2009, from 77.6 percent in 2008 to 69 percent. In the 2001-2009 timeframe, 2008 was the only year in which U.S. market share expanded, resulting in an average growth rate of -3.5 percent for that time period. By contrast, the average growth rate for the rest of the world during that time period was 10.6 percent. The decline in U.S. market share is partially due to the decline of the piston aircraft market, which the United States dominates—approximately 87 percent of piston aircraft shipped from 1994 to 2010 were made in the United States. Over 58 percent of the decline in production between 2008 and 2009 can thus be attributed to the decline in U.S. piston shipments.

Also significant was the decline in market share for U.S.-made business jets, from 72.7 percent in 2008 to 59.1 percent in 2009. Shipments of U.S. business jets were down 46.2 percent in 2009, while worldwide shipments were down only 33.7 percent. The decline in U.S. market share was due to the closure of Eclipse Aviation, which stopped manufacturing in late 2008. However, while the remaining U.S. manufacturers all saw significant declines in production, their market shares were relatively constant. Brazil's Embraer, which has historically been a minor player in the business jet market, stepped into the void created by Eclipse with its own very light jet and increased its market share from 3 to 14 percent. Cessna also benefitted from sales of its very light jet. The success of Cessna and Embraer despite the economic downturn suggests future growth in the very light jet segment.

Economic growth is the major factor in determining the health of the GA industry. Businesses tend to purchase a new plane or replace an old one when the economy is strong and profits are up. The chart below indicates that in recent years, changes in the GA market tend to lag economic growth by one year. GA shipments thus suffered during the recessions in the early 1990s and early 2000s and recovered when the economy grew during the second half of the decade.

Chart 1: Global GDP Growth and U.S. General Aviation Shipment Growth, 1991-2008¹⁷



Outlook

Forecasting at this point is uncertain, reflecting the uncertainty in the economy overall. Some analysts are relatively optimistic due to improved aircraft usage rates (defined as takeoffs and landings). Others do not believe that this will translate into improved sales in 2010.¹⁸

The FAA’s last forecast for the United States, made public in March 2010, predicted continued growth in the fleet, but at a slower rate than was expected two years ago.¹⁹ The FAA estimated that the U.S. business jet fleet will grow at an average of 4.2 percent per year through 2030 and that growth in the turboprop market will be a moderate 1.4 percent. Since the actual growth rate for the turboprop market has been declining (5.7 percent per year from 2000-2006 versus 5.1 percent from 2000-2009), presumably the expectation is that some old turboprop customers may turn to smaller jets. The FAA also predicted a stagnant piston-aircraft market (at .1 percent growth). Mirroring GAMA’s statistics, the FAA shows that this market segment actually experienced a decline of .6 percent from 2000-2009.

¹⁷ Data points represent percent changes over the previous year. GDP data from the National Accounts Main Aggregates Database, United Nations Statistical Division. (Search terms World, GDP (constant 1990 dollars), and years 1991-2008). Available at: <http://unstats.un.org/unsd/snaama/selectionbasicFast.asp>.

¹⁸ GAMA data for 2010 indicates that so far the pessimists have been correct. Available on the web at: <http://www.gama.aero/media-center/industry-facts-and-statistics/shipments-billings>

¹⁹ Compare FAA Aerospace Forecasts 2008-2025, Table 27 with FAA Aerospace Forecasts 2010-2030, Table 27. Available on the web at: http://www.faa.gov/data_statistics/aviation/aerospace_forecasts/2008-2025/ and http://www.faa.gov/data_research/aviation/aerospace_forecasts/2010-2030/.

Figure 1: Fixed-wing Turbine Corporate Aircraft Fleet by Region, 2008²⁰-9²¹

Region	2008	2009	% change
North America	18,128	18,531	2.22%
Europe	3,288	3,712	12.90%
Latin America	2,685	2,955	10.06%
Rest of World	1,994	2,211	10.88

Though the United States is still the biggest market for GA aircraft, foreign markets are growing in importance. GAMA data showed that exports represented over half of U.S. sales by value in 2009. According to data published by Flight Global (Figure 1), corporate fleet growth outside the United States was significant despite the recession.

²⁰ Sarsfield, Kate. "Business Aviation Census: Winds of Change." September 30, 2008. On the web at: <http://www.flightglobal.com/articles/2008/09/30/316583/business-aviation-census-winds-of-change.html>

²¹ Sarsfield, Kate. "Business Aviation Census: Global Fleets Buoyant but Traditional Markets Suffer." October 11, 2009. On the web at: <http://www.flightglobal.com/articles/2009/10/11/333296/business-aviation-census-global-fleets-buoyant-but-traditional-markets-suffer.html>

Rotorcraft

Overview

The rotorcraft industry produces aircraft, powered by either turboshaft or reciprocating engines, capable of performing vertical take-off and landing (VTOL) operations. The rotorcraft sector includes helicopters, gyrocopters, and tiltrotor aircraft. Helicopters, which employ a horizontal rotor for both lift and propulsion, are the mainstay of the industry. Gyrocopters are produced in much smaller quantities, primarily for use in recreational flying. Tiltrotor aircraft, such as the V-22 Osprey²², can take off vertically and then fly horizontally as a fixed-wing aircraft.

Rotorcraft are manufactured in most industrialized countries, based on indigenous design or in collaboration with, or under license from, other manufacturers. U.S. manufacturers of civilian helicopters include American Eurocopter, Bell, Enstrom, Kaman, MD Helicopters, Robinson, Schweizer (now a subsidiary of Sikorsky), and Sikorsky. However, Bell moved its civilian helicopter production to Canada, with the last U.S. product completed in 1993.²³ American Eurocopter—a subsidiary of the European manufacturer and subsidiary of EADS NV—has manufacturing and assembly facilities in Grand Prairie, Texas and Columbus, Missouri.

European producers include AgustaWestland, Eurocopter, NHIndustries, and PZL Swidnik. Russian manufacturers of Mil Moscow, Kamov and Kazan helicopters, as well as a number of other rotorcraft related companies, have been consolidated under the Russian government majority-owned OAO OPK Oboronprom.²⁴ (See this report’s Russia Country Analysis for a more detailed description of Oboronprom.)

U.S. Manufacturers

Company	Products
American Eurocopter	military helicopters for U.S. Army
Bell Helicopter	civil & military helicopters, military & civil tiltrotors, unmanned aerial systems
Boeing Rotorcraft Systems	military heavy & attack helicopters, military tiltrotors, UAVs
Enstrom Helicopter	piston & light turbine-powered helicopters
MD Helicopters	NOTAR [®] -equipped turbine-powered helicopters
Robinson Helicopter	light piston- and turbine-powered helicopters
Schweizer Aircraft	piston & light turbine-powered manned & unmanned helicopters, fixed-wing airplanes & airframe components
Sikorsky Helicopter	civil & military medium & heavy turbine-powered helicopters

²² The V-22 Osprey was developed by Bell Helicopters and is manufactured by Bell in conjunction with Boeing Rotorcraft Systems. See <http://www.boeing.com/rotorcraft/military/v22/>

²³ Aerospace Industries Association, *Aerospace Facts & Figures 1995-96*, p.37

²⁴ <http://www.oboronprom.com/en/show.cgi?corporation/structure.htm>

Foreign Competitors

Company	Products	Countries
Eurocopter	civil turbine-powered helicopters	France-Germany
PZL Swidnik	single-engine, twin-engine light & light-medium turbine-powered helicopters	Poland
OAO OPK Oboronprom	Mil Moscow, Kazan, Kamov turbine-powered light, medium and heavy helicopters, rotorcraft related companies	Russia

Joint Ventures

Company	Products	Countries
AgustaWestland	civil & military turbine-powered helicopters	UK-Italy
Bell/Agusta Aerospace	civil tiltrotors	U.S.-Italy
NHIndustries	military large turbine-powered helicopters	Italy, UK, France, Germany, Netherlands

Trends

Helicopter deliveries in 2009 fell below 2008 levels and are expected to decline further in 2010 and 2011 as backlogs depleted during 2009 will not support sustained deliveries until order rates recover. Moreover, some helicopters already ordered may not be delivered in 2010 as customers may be unable to obtain the necessary credit due to the slow economic growth. Honeywell Aerospace is forecasting that during the five-year period 2010-14, new turbine-powered civil helicopter deliveries will be 3,750 to 4,250.²⁵ Rolls-Royce forecasts deliveries of more than 16,400 new military and civil turbine helicopters, valued at \$140 billion during the period 2010-2019. The civil market is expected to experience modest unit growth, especially for new entry-level turbine helicopters. Rolls-Royce projects about 10,300 civil helicopters to be delivered during the ten-year period with an estimated value of \$38 billion. The civil market will be characterized by emerging near-term recovery followed by long-term growth²⁶

Future Markets

While the global economic downturn has adversely affected the ability of some customers to secure credit to purchase new equipment, the global rotorcraft industry is optimistic about future

²⁵ http://www51.honeywell.com/aero/common/documents/Aerohomepage-documents/HAI_10_Forecast_FINAL.pdf

²⁶ http://www.rolls-royce.com/investors/news/2010/100221_rr_ten_year_forecast.jsp

orders in the long term. This optimism is based in part on the relative average age of the current fleet of operating helicopters, which is nearly thirty years old. Major customers like emergency medical service (EMS) providers and operators supporting offshore oil and gas exploration and production are seeking new, replacement aircraft that meet the latest standards for design and safety features. Additionally, the rotorcraft market is much broader than it was during the last market downturn in the 1970s, so a decline in one sector of the market is less likely to trigger a steep decline in aggregate helicopter demand.

Unmanned Aircraft Systems (UAS)

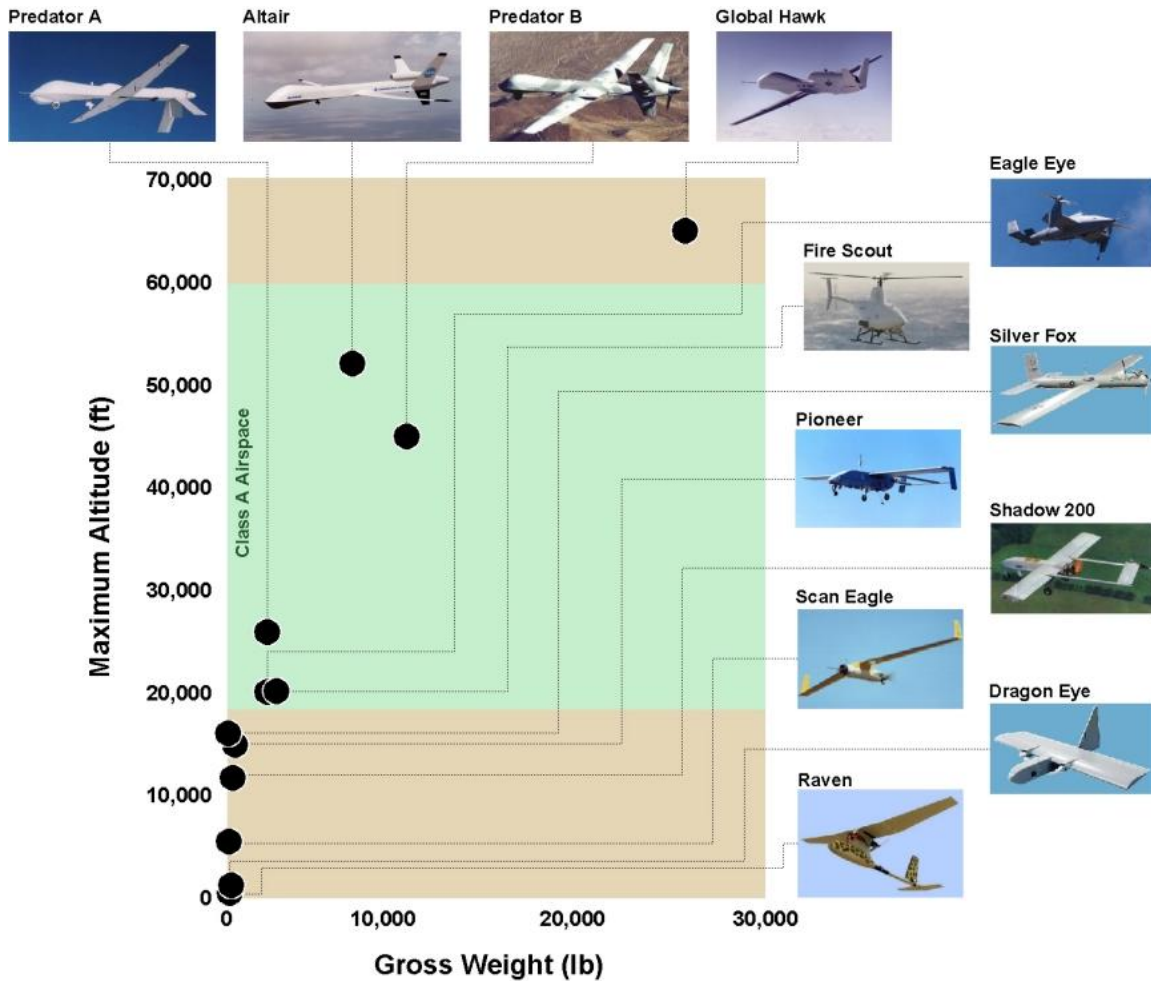
Unmanned Aircraft Systems (UAS), also commonly referred to as Unmanned Aerial Systems or Unmanned Aerial Vehicles (UAVs), are air vehicles and associated equipment that do not carry a human operator, but instead fly autonomously or are remotely piloted. UAS must be considered in a systems context (Figure 1) which includes the remote human operator(s), a command, control and communications (C3) system as well as the air vehicle, or multiple vehicles.

There currently is no widely accepted common classification system for UAS vehicles or systems due to the wide variety of capabilities, size, and operating characteristics of different systems. Most UAS are described in terms of weight, endurance, purpose of use, and altitude of operation. For the purposes of this report, broad categories and uses are as follows:

Table 1: UAS Categories and Uses

Name	Altitude	Typical flight duration	Typical Uses
High Altitude	Over 60,000 ft (above class A airspace)	Days/weeks	Surveillance, data gathering, signal relay
Medium Altitude	18,000 – 60,000 ft (class A airspace)	Days/weeks	Surveillance, cargo transportation
Low Altitude	Up to 18,000 ft (class E airspace)	Up to 2 days	Surveillance, data gathering
Very Low Altitude	Below 1,000 ft	A few hours	Reconnaissance, inspection, surveillance

Figure 1: Current U.S. Operational UAS²⁷



Military Markets

The U.S. Department of Defense (DOD) continues to lead the development, ownership, and operation of UAS globally. As of October 2009, DOD had more than 6,800 unmanned aircraft in its inventory, compared to fewer than 50 in 2000.²⁸ The majority of these aircraft are currently being used in support of ongoing operations overseas and range in size from small, handheld UAS to large units similar in size to manned general aviation aircraft.²⁹ In particular, the use of smaller, shorter range UAS has increased dramatically. Today's operational military UAS encompass a wide range of sizes, gross weights, speeds, and operating altitudes (Figure 1).

²⁷ "The Impact of Unmanned Aerial Vehicles on the Next Generation Air Transportation System: Preliminary Assessment", Unmanned Aerial Vehicle National Task Force, October 22, 2004

²⁸ Unmanned Aircraft Systems: Comprehensive Planning and a Results-Oriented Training Strategy Are Needed to Support Growing Inventories GAO-10-331, March 26, 2010. Available at <http://www.gao.gov/new.items/d10331.pdf>.

²⁹ Unmanned Aircraft Systems: Federal Actions Needed to Ensure Safety and Expand Their Potential Uses within the National Airspace System – GAO-08-511, May 15, 2008, p. 1. Available at <http://www.gao.gov/new.items/d08511.pdf>.

The smallest operational UAS is the four-pound Raven that flies for about one hour at 50 knots and normally below 1000 feet. The largest is the Global Hawk, which weighs 25,600 pounds, and flies at 400 knots for over 30 hours at 65,000 feet.

The Department of Defense (DOD) plans to invest billions of dollars in the development and procurement of UAS. In fiscal year 2010 DOD requested \$6.1 billion and expects to need more than \$24 billion from 2010 through 2015 for new UAS and expanded capabilities in existing ones.³⁰ Several Government Accountability Office (GAO) reports have identified issues with DOD's UAS programs, including cost increases, schedule delays, performance shortfalls and the need for personnel, facilities and communications' infrastructure to support growing UAS inventories.³¹

A July 2009 GAO report³² and two March 2010 follow-on reports³³ analyzed cost, schedule, and performance data for ten UAS programs—accounting for over 80 percent of DOD's total planned investment in UAS from 2008 through 2013. The reports also examined the extent to which the different military branches are collaborating and identifying commonality among their UAS programs. The GAO found that cumulative development costs for the ten programs increased by over \$3.3 billion (37% in 2009 dollars) from initial estimates and that several programs experienced significant delays in achieving initial operational capability, ranging from 1 to 4 years.³⁴ The GAO recommended that DOD direct a comprehensive analysis and develop a strategy to gain commonality among current UAS programs and require new programs to demonstrate that opportunities for commonality were adequately assessed.

In recognition of the broad use of unmanned ground and maritime systems and the need to facilitate the integration among platforms as well as with manned systems, DOD released the second edition of its integrated "Unmanned Systems Roadmap 2009-2034" (Roadmap) in March 2009.³⁵ The roadmap identifies a DOD-wide vision for all unmanned systems, identifying critical capabilities, obstacles and priorities for the next 25 years. The DOD is implementing the Roadmap despite a November 2008 GAO report that identified problems in the effectiveness of DOD's management and integration efforts.³⁶

The DOD Quadrennial Defense Review (QDR), released in February, 2010, called for increased reliance on UAS for intelligence, surveillance, and reconnaissance (ISR) to succeed in DOD's counterinsurgency, stability, and counterterrorism operations. In FY 2010, the DOD made a

³⁰ Unmanned Aircraft Systems: Comprehensive Planning and a Results-Oriented Training Strategy Are Needed to Support Growing Inventories GAO-10-331, March 26, 2010. Defense Acquisitions: DOD Could Achieve Greater Commonality and Efficiencies among Its *Unmanned Aircraft Systems* GAO-10-508T, March 23, 2010. Available at <http://www.gao.gov/new.items/d10508t.pdf>.

³¹ GAO-10-331; GAO-08-511; GAO-09-520.

³² Defense Acquisitions: Opportunities Exist to Achieve Greater Commonality and Efficiencies among Unmanned Aircraft Systems GAO-09-520, July 30, 2009. Available at <http://www.gao.gov/new.items/d09520.pdf>.

³³ GAO-10-331; GAO-10-508T

³⁴ GAO-09-520

³⁵ Department of Defense (DOD) Unmanned Systems Roadmap 2009-2034. Available at <http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA522247>.

³⁶ Unmanned Aircraft Systems: Additional Actions Needed to Improve Management and Integration of DOD Efforts to Support Warfighter Needs - GAO-09-175, November 14, 2008. Available at <http://www.gao.gov/new.items/d09175.pdf>.

commitment to grow to a capacity of 50 sustained orbits of Predator/Reaper UAS by FY 2011. The Air Force is on track to achieve this goal and will continue to expand the force to 65 orbits by FY 2015. The Army is expanding all classes of UASs, including the accelerated production of the Predator-class Extended Range Multi-Purpose (ER/MP) UAS. The Navy is introducing sea-based UASs. And DOD is exploring ways to enhance the effectiveness of its fleet of ISR aircraft by developing innovative sensor technologies, support infrastructures, and operating concepts.³⁷

Most governments around the world are seeking to integrate UAS capabilities into their defense forces, either through acquisition of foreign systems or through development of indigenous systems. Coalition forces are using UASs in Iraq and Afghanistan, as well as in security operations around the world.

Israeli manufacturers have influenced UAS development programs, entering into industrial partnerships, and marketing and co-production agreements around the world. Elbit Systems' Silver Arrow subsidiary is currently the Israeli Defense Force's principal supplier of UAS with the Hermes family of vehicles, and has worldwide business relationships. Israel Aircraft Industries' Malat division (IAI-Malat) has produced a broad range of UASs including the Searcher, Heron and Hunter lines.

According to a 2010 market forecast by the Teal Group, a Virginia-based aerospace and defense market analysis firm, the European UAS market is expected to be worth around \$7.6 billion by 2014, providing the world's second largest market for UAS and unmanned combat vehicles.³⁸ Although many European companies are developing indigenous capabilities and technologies, some have entered into joint agreements with U.S. companies to develop and/or build new and derivative aircraft. For example, European Aerospace Defense and Space (EADS) and Northrop Grumman established a joint venture to develop the Euro Hawk, a derivative of the Global Hawk.

Civil Markets

There is large potential for civil applications of UAS, ranging from surveillance and reconnaissance to scientific data gathering or delivery of services (crop dusting, telecom relays, etc.) However, the absence of standards, regulations and procedures to govern the safe integration of civil-use UAS into civil airspace are key factors limiting growth in the non-military UAS sector. As a result, most civil operations of UAS in 2009 were related to test or demonstration flights. According to a 2010 study by the Teal Group, world civil UAS production is forecast to make up 5.3 percent (\$237 million) of the \$2.9 billion in 2010 global

³⁷ 2010 DOD Quadrennial Defense Review, p. 22. Available at http://www.defense.gov/QDR/images/QDR_as_of_12Feb10_1000.pdf.

³⁸ Teal Group: 2010 World UAV Market Profile and Forecast. Executive Summary available at http://www.tealgroup.com/index.php?page=shop.product_details&category_id=2&flypage=flypage.tpl&product_id=98&option=com_virtuemart&Itemid=5.

production value, rising to 10.5 percent (\$3.8 billion) of global production value (\$44.9 billion) by 2019.³⁹

The FAA has imposed strict limitations on UAS operations in the national air space (NAS) until sufficient standards and regulations can be developed. In February 2007, the FAA published policy guidance to clarify exactly which authorities exist for UAS operations in the NAS.⁴⁰ At the same time the FAA continued work to develop domestic certification regulations that will address all relevant technology, policy, regulatory and infrastructure issues necessary to safely integrate UAS into the NAS. The Unmanned Aircraft Program Office (UAPO), responsible for coordinating all FAA certification and operational policy activities related to UAS, is expected to publish a UAS roadmap to clarify the path toward normal certification and operation of UASs in the NAS. Publication of the roadmap has been delayed since March 2007 due to the FAA management review and approval process. In the interim, civil UAS certification is granted by the FAA through UAPO under a special airworthiness certificate (experimental category) for operation within specifically prescribed areas. For public operation, UAS certification is granted under a Certificate of Authorization (COA) or Waiver.⁴¹

In the United States, access to national air space is predominately granted through special COAs issued by the FAA for public UAS operation. Even under a COA, UAS operations are permitted only for specific times, locations and operations. The number of COAs issued by the FAA has grown significantly in recent years, reflecting growing demand by military and civil users. 85 COAs were issued in CY 2007, 164 in CY 2008, and 146 in CY 2009.⁴² As of August 2010 the agency has issued 268 COAs⁴³. UAS also may be operated in restricted airspace. In July 2007, the FAA introduced an on-line COA application system for federal users to reduce processing and approval time for COA applications.

Most other countries also do not have civil certification regulations that permit the operation of non-military UAS in civil air space. However, extensive civil-use UAS operations exist in Japan, where unmanned rotorcraft are widely used in agriculture (primarily spraying). In May 2009, there were an estimated 2,300 unmanned helicopters and over 12,000 certified UAS operators in Japan, compared to a total of 730 non-government-operated manned helicopters and 3,600 professional helicopter pilots.⁴⁴ Yamaha Motors Company currently supplies over 60 percent of the Japanese market for unmanned agricultural spraying applications. Yanmar Agricultural Equipment Co., Kawada Industries, Inc. and Fuji Heavy Industries share the rest of the market.⁴⁵

³⁹ Teal Group: 2010 World UAV Market Profile and Forecast. Executive Summary available at http://www.tealgroup.com/index.php?page=shop.product_details&category_id=2&flypage=flypage.tpl&product_id=98&option=com_virtuemart&Itemid=5

⁴⁰ *Federal Register*: February 13, 2007 (Volume 72, Number 29), Rules and Regulations, Pages 6689-6690; available at <http://www.gpoaccess.gov/fr/retrieve.html> .

⁴¹ http://www.faa.gov/aircraft/air_cert/design_approvals/uas/cert/

⁴² FAA UAS Factsheet, November 12, 2009. Accessed March 29, 2010. Available at http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=6287

⁴³ FAA UAS Factsheet, November 12, 2009. Accessed September 1, 2010. Available at http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=6287.

⁴⁴ UVS International 2009/2010 UAS Yearbook - UAS: The Global Perspective - 7th Edition - June 2009.

⁴⁵ "UAV Systems: The Global Perspective 2005", UVS International

Competitors

The U.S. UAS industry is undergoing a major transition. Almost all major U.S. aerospace prime contractors are involved in UAS programs and are expected to remain working on UAS for the foreseeable future. Numerous small and mid-sized companies also entered the market in the 1990s. Some small companies failed or withdrew from the UAS market, others were acquired (part of the industry consolidation), and a few new companies entered the market. Industry consolidation is expected to continue for the next several years.

U.S. manufacturers are a mix of public and privately owned companies. Five of the twelve U.S. manufacturers of UAS that have operated in Operation Iraqi Freedom and/or with systems that have received experimental civil certification from the FAA are part of publicly traded corporations (AAI Corporation was acquired by Textron Inc. in December 2007). For each of the publicly traded companies, UAS development, manufacture and operation make up a relatively small percentage of overall corporate revenues. Most privately held U.S. UAS manufacturers are not widely diversified out of this market segment, although they may produce a variety of UAS. A number of U.S. manufacturers have established partnerships with non-U.S. companies to strengthen their market presence and to supply UAS to the U.S. military. In addition, some foreign companies have established subsidiaries in the U.S.

There are a number of publicly available, authoritative studies by other federal agencies and private organizations about the military UAS manufacturing industry, which provide details about the military UAS market structure and competition. However, given the large number of uncertainties in the civil UAS market (absence of a measurable civil-use UAS market; prevalence of international partnerships to develop, manufacture and operate UAS; incomplete legal and regulatory structure to integrate civil-use UAS into the NAS), it is extremely difficult to perform an accurate and comprehensive assessment of competitors in the civil-use UAS market.

The following list of companies is intended only to provide a representative snapshot of the UAS industry through 2009. The following U.S. companies manufacture UAS currently in use in Operation Iraqi Freedom (excluding very small “micro/mini” UAS) and/or have been granted experimental airworthiness certification by the FAA:

Table 2: U.S. UAS Manufacturers*

Company	Products	2009 Revenue (millions)	2009 Total Net Income (millions)	2009-2008 % Change in Net Income
Aerovironment	Raven, Pointer, Dragon Eye	\$247.7 ⁴⁶	\$24.2	12.92%
Aurora Flight Sciences	GE-50*	N/A		
Cyber Defense Systems, Inc.	CyberBug*	N/A		
General Atomics	Predator*, Altair, Sky Warrior*, GNAT, Mariner	\$132 ⁴⁷		
Honeywell	gMAV*	\$30,908 ⁴⁸	\$2,153	(22.89%)
Insitu (acquired by Boeing July 2008)	Scan Eagle, GeoRanger, Insight	N/A		
Lockheed Martin	Desert Hawk	\$45,200 ⁴⁹	\$3,024	(6.00%)
Northrop Grumman	Global Hawk, Fire Scout	\$33,755 ⁵⁰	\$1,686	234%
Raytheon	Cobra*	\$24,881 ⁵¹	\$1,936	15.79%
Textron	Bell Eagle Eye*, AAI Shadow*	\$10,500 ⁵²	(\$31)	1667%
Telford Aviation	SkyBus 30K*	N/A		

* Has received a civil experimental airworthiness certification

Outlook

In 2010, military use of unmanned systems is expected to grow as new systems are fielded and new capabilities are tested. The U.S. military is seeking new UAS capabilities to support new war-fighting doctrines and operations. DOD is seeking improved payload capabilities, adding the number and types of sensors available on different platforms. For example, they are pursuing

⁴⁶ http://www.hoovers.com/company/AeroVironment_Inc/rhcffci-1-1njea5.html#balance

⁴⁷ Lexis-Nexis Company Dossier

⁴⁸ Ibid.

⁴⁹ Lockheed Martin 2009 Statement of Earnings: <http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9MjkzNzJ8Q2hpbGRJRjRD0tMXxUeXBIPtM=&t=1>

⁵⁰ Northrop Grumman Investor Relations: <http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9MjkzODF8Q2hpbGRJRjRD0tMXxUeXBIPtM=&t=1>

⁵¹ Raytheon Co. Investor Relations: <http://investor.raytheon.com/phoenix.zhtml?c=84193&p=irol-newsArticle&ID=1380075&highlight=>

⁵² Lexis-Nexis Company Dossier

new operational capabilities such as autonomous mission operations, multi-vehicle systems and aerial refueling, as well as increased modularity to enable “plug-and-play” systems and maintenance. They also are evaluating options for weaponized unmanned combat air vehicles (UCAV) as force multipliers for fighter and bomber aircraft. Previous year estimates of growth across all sizes and classes may be impacted by current economic conditions. The greatest increases in 2010 will be in small UAS as more systems are deployed in active combat at the unit level.

U.S. federal agencies plan to expand their use of non-military UAS as well. Some examples:

- NOAA established three UAS test centers in 2008 to further explore opportunities to use unmanned systems.
- NASA will conduct further tests with existing systems and initiated its first official scientific research flight with one of its three newly acquired Global Hawks in April 2010.
- DHS will take delivery of a fourth UAS for border patrol activities.
- Various law enforcement agencies will continue additional demonstration tests.

The FAA has initiated development of special regulations to govern operation of small, low-flying UAS within visual line-of-sight that are used for commercial purposes. Such guidance could enable small UAS users to initiate or continue operations that do not present a safety threat to the public or to other aircraft prior to the finalization of complete certification regulations for all classes of UASs. To make recommendations on how to proceed with regulating small UAS (SUAS), the FAA chartered an Aviation Rulemaking Committee (ARC) composed of government and industry officials which submitted its recommendations in April 2009. The recommendations subdivide SUAS into five groups and provide guidance on operational capabilities and limitations, pilot-in-command (PIC) and observer training, airworthiness eligibility and certification and other issues. The FAA is drafting a proposed rule that it plans to publish in spring 2011, and a final rule in early 2012.

At the same time, FAA will continue to develop standards and policies for all UAS systems, drawing on technical recommendations from the Radio Technical Commission for Aeronautics (RTCA) Special Committee-203⁵³, coordination with other civil aviation authorities directly and through the International Civil Aviation Organization (ICAO), and interagency collaboration as a member of the Department of Defense Joint Integrated Product Team (JIPT) for UAS. However, little appreciable increase in UAS operations will occur in the United States in 2010, based on the cumulative number of experimental airworthiness certifications estimated by the FAA to date.

Given the rapid growth of UAS operations for governmental purposes, there appears to be tremendous potential for U.S. industry in the evolving commercial UAS sector. However, it is extremely difficult to determine actual commercial market size in light of the many regulatory and technological obstacles to be overcome before UAS can be integrated into civilian air space. Various studies have been conducted regarding the future market opportunities for civil UAS

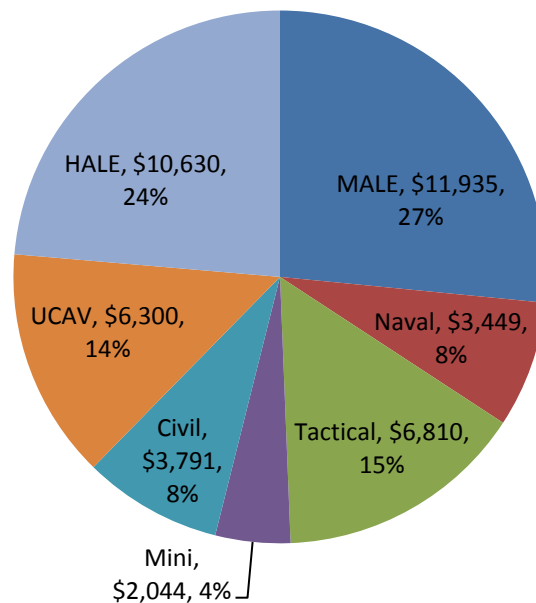
⁵³ RTCS Special Committee-203 UAS Homepage: <http://www.rtca.org/comm/Committee.cfm?id=45>

sales worldwide. Many analysts are bullish on market growth, although there is wide variance in views about the actual market size, which range from a healthy 10-15 percent per year to order of magnitude growth in civil market opportunities. According to a 2010 market study by the Teal Group, the current UAS market will more than double in the next decade: worldwide UAS Research, Development, Test & Evaluation (RDT&E) and procurement expenditures are expected to increase from \$4.9 billion in 2010 to over \$11.5 billion in 2019.⁵⁴ The study suggests that the U.S. will account for 76% of RDT&E spending on UAS technology over the next decade and 58% of the procurement.⁵⁵ Finally, the study predicts that UAS demand will be highest in the U.S., with Europe representing the second largest market, followed closely by Asia-Pacific.⁵⁶

On the civil side, the time needed to resolve UAS airspace issues will likely slow the growth of the global civil UAS market for the next several years. During this period, the civil UAS market will be concentrated around government organizations requiring military-type surveillance systems, such as coast guards, border patrol organizations and similar national security organizations. Once the airspace issues are resolved, a commercial, non-governmental UAS market should slowly emerge.⁵⁷

Figure 2.

UAS Production Value: 2010-2019 by UAS Category (\$ Billions)



Source: Teal Group, "World UAV Systems 2010 Market Profile & Forecast"

⁵⁴ Teal Group: 2010 World UAV Market Profile and Forecast. Executive Summary available at http://www.tealgroup.com/index.php?page=shop.product_details&category_id=2&flypage=flypage.tpl&product_id=98&option=com_virtuemart&Itemid=5

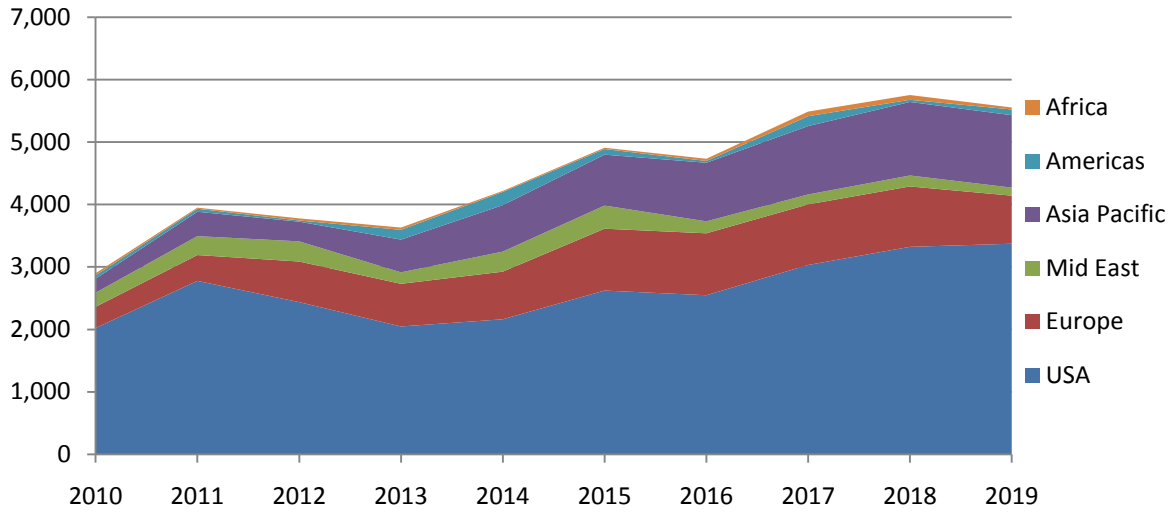
⁵⁵ Ibid.

⁵⁶ Ibid.

⁵⁷ Ibid.

Figure 3.

World UAS Production Forecast by Region (Value, \$ Millions)
Contribution of each region to total value



Source: Teal Group, "World UAV Systems 2010 Market Profile & Forecast"

Engines/Powerplants

The large civil aircraft jet engine market is dominated by a few individual manufacturers and several joint ventures comprised of one or more of these players along with a smaller company or companies. With one exception, the major engine manufacturers are part of diversified corporations⁵⁸ producing engines for both civil and military aircraft, either alone or as part of one or more joint ventures.

U.S. and Foreign Manufacturers

Three major manufacturers dominate the large commercial jet engine market.

Company	Products	2009 Revenue (millions)	2009 Income (millions)	2008-2009 % Change in Income
General Electric (Parent of GE Aviation)	Turbofan, turboprop, and turboshaft engines for a variety of civil and military aircraft	\$156,783	\$11,025	(36.67)
United Technologies Corp. (Parent of Pratt & Whitney)	Turbofan and turboprop engines for a variety of civil and military aircraft	\$52,920	\$3,829	(18.34)
Rolls-Royce PLC	Turbofan, turboprop, and turboshaft engines for a variety of civil and military aircraft	£ 10,414 \$16,714*	£ 2,217 \$3,358*	264.83

*At an exchange rate of £1 = \$1.6050

Of the three companies listed above, General Electric Aviation (GE Aviation) and Pratt & Whitney (P&W) are the two largest U.S. manufacturers. The United Kingdom's Rolls-Royce PLC is the largest non-U.S. producer.

⁵⁸ In FY 2009, Rolls-Royce civil and defense aerospace segments comprised a combined 64 per cent of the company's total revenues and 73 per cent of its total income. See Rolls-Royce PLC 2009 Notes to Consolidated Financial Statements, available at http://www.rolls-royce.com/reports/2009/img/downloads/Consolidated_financials_notes.pdf

Joint Ventures

The three dominant engine manufacturers also participate in various joint ventures. These ventures are formed to capitalize on emerging market demand for engines, while at the same time allowing partners to share development and production costs along with risk.

Company	Partners and Ownership Percentages
The Engine Alliance	GE Aviation – 50% Pratt & Whitney -50%
CFM	GE Aviation – 50% Snecma Moteurs – 50%
International Aero Engines (IAE)	Rolls-Royce – 32.5% Pratt & Whitney – 32.5% Japanese Aero Engines Corporation – 23% MTU Aero Engines -12%
PowerJet	NPO Saturn JSC – 50% Snecma Moteurs – 50%

- The Engine Alliance, a 50/50 joint venture between GE Aviation and P&W, was formed to produce an engine for the Airbus A380. The Engine Alliance competes directly with Rolls-Royce for A380 engine business holds a roughly equal market share with Rolls-Royce.
- CFM International, a joint venture of GE Aviation and Snecma Moteurs, a unit of the SAFRAN Group of France, produces the CFM56 engine. The CFM56 is used in various Boeing and Airbus aircraft and is the sole engine option for the Boeing 737.
- International Aero Engines AG, a consortium comprised of P&W, Rolls-Royce, German engine manufacturer MTU Aero Engines GmbH and the Japanese Aero Engines Corporation, produces the V2500 engine for use in the Airbus A319/A320/A321 aircraft.
- PowerJet is a 50/50 joint venture between Snecma Moteurs and Russian engine manufacturer NPO Saturn JSC. PowerJet's entry into the jet engine market is significant, as it is representative of the Russian civil aviation/aerospace industry's efforts to compete with U.S., EU and Japanese manufacturers as a viable alternative for commercial aircraft, engines and other components. PowerJet's initial offering, the SaM146 engine, is being developed for use initially in Russian aircraft manufacturer Sukhoi's Superjet 100. PowerJet is marketing their engine as part of an overall package of customer support and maintenance services for the entire propulsion system to include long-term engine maintenance, parts management by the hour, and engine leasing and exchange programs.⁵⁹ In addition to the Sukhoi Superjet 100, PowerJet plans to develop additional engine variants as well as find additional regional jet customers for their engine.⁶⁰

⁵⁹ <http://www.powerjet.aero/?id=222&selt=1>

⁶⁰ <http://www.powerjet.aero/?id=190&selt=1>

With the exception of Rolls-Royce, EU and Japanese engine manufacturers compete mainly through their holdings in joint ventures. Most notably, as a 50/50 partner with GE Aviation in CFM International, Snecma Moteurs of France maintains a significant market presence. In addition, MTU Aero Engines GmbH of Germany, along with the Japanese Aero Engines Corporation, maintains a presence via its equity holdings in IAE.

Since no Russian engine manufacturers currently produce engines for use on Boeing or Airbus aircraft, the impact of Russian jet engines on the LCA jet engine market is negligible at the time of this report. As discussed above, however, Russian manufacturers are looking to participation in joint ventures such as PowerJet in order to gain access to the global aircraft engine market.⁶¹⁶²

China possesses a growing cadre of small domestic aircraft engine parts manufacturers, along with a number of established major manufacturing entities. In addition, China is taking steps to raise the profile of its domestic jet engine manufacturing capability. In January, 2010, the China Aviation Industry Corporation, a shareholder in the state-owned Commercial Aviation Corporation of China (COMAC), began construction of a research and development center in Shanghai to develop engines for domestically produced civil aircraft. COMAC officials have stated that their goal is to eventually use domestically produced engines to power COMAC's ARJ21 regional jet and C919 narrow-body airliner; however, the ARJ21 and C919 will initially feature engines manufactured by GE Aviation and CFM International.⁶³⁶⁴

Market Trends

Market trends in the aircraft engine market are linked to aircraft sales. With the notable exception of Boeing's 737, Boeing and Airbus typically have two engine options for each model offering. The same arrangement exists for most regional jet aircraft. Therefore, an end user-customer could, and often does, purchase a U.S.-manufactured Boeing 747 aircraft and equip it with UK-manufactured Rolls-Royce engines. Similarly, customers may choose to equip Airbus aircraft such as the A330 and A320 with P&W and CFM56 engines respectively.

GE Aviation, Rolls-Royce and CFM⁶⁵ currently lead the LCA jet engine market on both a unit and total value basis. CFM's strength in the market is driven by current and projected continued high unit sales of the CFM56 engine. The CFM56 is the sole engine choice for the entire Boeing 737 series, and it is also used in a number of Airbus aircraft. As neither Boeing nor Airbus have divulged any plans to replace their single-aisle (e.g. 737, A320) aircraft in the near term, the large number of 737 and competing Airbus aircraft in service means deliveries of the engine should remain high for the foreseeable future.

⁶¹ Industry Analysis of Aircraft and Aircraft Parts Sector in Russia, U. S. Department of Commerce October, 2002, available at <http://www.bisnis.doc.gov/bisnis/isa/021001RusAir.htm>.

⁶² "Powerplant: PowerJet has won over sceptics by delivering a Western-standard engine with Russian help", available at <http://www.flightglobal.com/articles/2007/02/06/211877/powerplant-powerjet-has-won-over-sceptics-by-delivering-a-western-standard-engine-with-russian.html>

⁶³ "C919 Engine Plans Take Shape", available at <http://www.airshow.com.cn/en/Article/yjxx/2010-01-15/11243.html>

⁶⁴ "AVIC Commercial Aircraft Engine Co. Ltd. Builds R&D Center for Jumbo Jet Engine", available at <http://investing.businessweek.com/research/stocks/private/snapshot.asp?privcapId=52297984>

⁶⁵ For purposes of this analysis, CFM deliveries are counted separately from those of GE Aviation, which owns 50 per cent of CFM. However, revenue from CFM deliveries is shared on a 50/50 basis by GE Aviation and Snecma Moteurs.

By comparison, GE Aviation and Rolls-Royce's current strength and projected growth are predicated upon higher per unit engine prices. GE Aviation's market share is largely built on deliveries of its CF6 and GE90 engines, which power the Boeing 747, 767, and 777 as well as multiple Airbus aircraft. Rolls-Royce's market position is based upon sales of the company's Trent series of engines, which are used in the Boeing 747, 757, 777 and 787 Dreamliner and Airbus A330, A340, and A380. Rolls-Royce is also developing the Trent XWB engine for the redesigned A350XWB.

P&W's position as the second largest aircraft engine manufacturer in the United States is increasingly based on its revenue from military sales as well as its commercial aftermarket services. Two of the company's most promising aftermarket services offerings are its Global Material Solutions business unit, which offers maintenance, repair and overhaul (MRO) services for the CFM56 engine offered by its competitor CFM, and EcoPower, a closed-loop, environmentally friendly engine wash service that yields improved engine fuel economy and performance.

P&W's most promising new product is its geared turbofan (GTF) engine, designated the PurePower PW1000G. The PW1000G offers significant fuel consumption savings over similar size engines, and the company is working with NASA to demonstrate the engine's ability to use alternative, non-petroleum based aviation fuels.⁶⁶ The PW1000G has been selected as an engine option for Russia's United Aircraft Corporation/Irkut MS-21 and as the sole engine choice for Japan's Mitsubishi Regional Jet (MRJ) and Canada's Bombardier C-Series aircraft.⁶⁷

P&W currently leads the market in terms of number of engines in service, but the company's lead is projected to give way to competitors as newer engine models begin service and older model aircraft are retired. The effect of this competition is mitigated somewhat by P&W's partnership in both the Engine Alliance and IAE. From these cooperative efforts, P&W still stands to benefit from the introduction of new aircraft and engines.

Outlook

The overall outlook for the global jet engine market is for increasing cooperation among manufacturers resulting in more joint ventures and, in the case of EU-based/Euro-denominated manufacturers, production shifts towards lower-cost, dollar-denominated countries.

The prevalence of joint ventures in the aircraft engine industry will continue. New mergers like the PowerJet venture between Russian manufacturer NPO Saturn JSC and Snecma Moteurs of France will continue to form as the next generation of narrow-body aircraft come online, augment and ultimately replace existing aircraft. In addition, P&W will use its own joint venture channel to market its PW1000G engine through membership in IAE. German manufacturer (and fellow IAE member) MTU is working closely with P&W on product testing.⁶⁸ P&W is also

⁶⁶ "Pratt & Whitney's Geared Turbofan(TM) Engine Demonstrates Alternative Fuel Capabilities" available at <http://www.portfolio.com/resources/company-profiles/UTX/press/2008/02/19/pratt--whitneys-geared-turbofantm-engine-demonstrates-alternative-fuel-capabilities>

⁶⁷ <http://www.pw.utc.com/Products/Commercial/PurePower+PW1000G>

⁶⁸ "Pratt & Whitney Begins Final Assembly of Geared Turbofan Demonstrator Engine" available at <http://www.pratt-whitney.com/vgn-ext->

considering adding additional partners to the team developing the PW1000G engine. In addition to IAE partner MTU and Volvo Aero, Singaporean maintenance, repair and overhaul company SIA Engineering Co (SIAEC) became a risk-sharing partner in January 2010.⁶⁹

Anecdotal evidence from various U.S. engine manufacturers indicates that Airbus has begun linking aircraft sales to engine selection. More specifically, Airbus has begun to rely on a “package” of Airbus aircraft and Rolls-Royce engines. The package price is contingent on the end-user/customer selecting Rolls-Royce engines in conjunction with the Airbus aircraft at the time of purchase. Previously, engine selections were not typically linked to the aircraft selection and purchase, and the customer was free to make the engine selection on factors such as acquisition cost, fuel efficiency, MRO availability and life-cycle costs. Generally, Rolls-Royce’s aircraft engine sales proposals focus more on acquisition cost and less on the downstream expenses involved with MRO and overall life cycle. Therefore, an EU aircraft and engine pair (e.g. Airbus/Rolls-Royce) provides the pair with bargaining leverage. Although the same opportunity may exist for packaging U.S.- made aircraft and engines together, this trend will almost certainly prove more challenging to U.S. engine manufacturers, as they are much more focused on the downstream cost benefits of their engines and typically do not compete solely on an acquisition cost basis.

Notable Developments

The creation of an open joint stock company by the Russian Federation consolidating many of the state-owned aerospace companies under a single entity could influence the future landscape of the global jet aircraft engine business. This consolidated entity, the United Aircraft Corporation (UAC), has moved quickly to transform and revitalize the Russian aviation industry and has positioned itself as both a formidable competitor and potential partner in the global aviation market. Partnerships such as the PowerJet joint venture, as well as future cooperation between the United States, EU and UAC on development of next generation civil aircraft will certainly open up new business opportunities for the aircraft engine industry.

Over the longer term, development of the Chinese large civil aircraft industry will certainly have an impact on the global aircraft engine business. Chinese aviation industry and government officials have acted upon their stated intent to produce indigenously designed and manufactured civil aircraft with development of the ARJ21 regional jet and C919 narrow-body airliner. China is also taking steps to develop its domestic jet engine manufacturing capability to power Chinese designed and manufactured aircraft. As China does not yet produce a suitable engine in the size and thrust range for an LCA application, the possibility exists for direct engine sourcing as well as collaboration and/or joint ventures similar to those described above.⁷⁰

templating/v/index.jsp?vnextoid=2e35288d1c83c010VgnVCM1000000881000aRCRD&prid=fb5988c63af33110VgnVCM100000c45a529f_____

⁶⁹ “SIA Engineering Invests in PW1000G Engine”, available at

http://www.aviationweek.com/aw/generic/story_channel.jsp?channel=mro&id=news/awx/2010/01/21/awx_01_21_2010_p0-198616.xml

⁷⁰ “China to develop large commercial aircraft by 2020” available at

<http://www.iht.com/articles/2007/03/12/business/jet.php>

Currency movements will also affect the market outlook. The general downward trend of the dollar against the pound and the euro has compelled Rolls-Royce to shift its industrial base away from the United Kingdom to lower-cost, dollar-denominated markets. In 2008, Rolls-Royce CEO Sir John Rose noted:

"Ninety per cent of our revenue comes from outside the UK, and the manufacturing balance will continue to move that way... Over time we will increasingly ensure that our supply chain is either dollarized or low-cost so that we can get a hedge against the dollar." ⁷¹

Rolls-Royce already manufactures turboprop engines through its U.S.-based subsidiary Rolls-Royce North America, Inc. and further shifts toward dollar-based production would make Rolls-Royce products increasingly price competitive against U.S. manufactured engines and less exposed to currency fluctuations.

⁷¹ "Rolls-Royce to shift production away from Britain" available at http://findarticles.com/p/articles/mi_qn4158/is_20080208/ai_n21280488?tag=content;col1

Airport Infrastructure/Aviation Security

Overview

The Airport Infrastructure and Aviation Security markets continue to grow due to a number of factors. Rebounding air traffic growth across all regions, post-9/11 security concerns, and expected growth in the next 20 years are major contributors to this upward trend. Worldwide airport capital expenditures grew from \$44 billion in 2008 to \$46 billion in 2009.⁷² Although constrained by local, state, and federal regulations, U.S. airports will need to expand capacity to meet future demand. Moreover, evolving security needs both within the U.S. and throughout the world will ensure long-term viability of the market for aviation security technologies.

U.S. Infrastructure Manufacturers

Airport Infrastructure		Aviation Security	
Magnetic Automation Corp.	Parsons Transportation Group	Battelle SRS Technologies, Inc.	SRA International/Galaxy Security
Daktronics, Inc.	ESRI	TransCore	SecureScan
ARINC	URS Corporation	Raytheon/McNeil Security	ARINC (Verified Identity Pass/Clear)
Arconas	Airports Seating Alliance		
Penta Corporation	NEC Display Systems	Nabco, Inc.	Matrix Systems, Inc.
Vidtronix	Unimark, Inc.	URS Corporation	Zortek Systems
FMC Technologies, Inc.	Trident Computer Corp.	Honeywell Aerospace	UTC
Vaculex	Unisys	MITRE/CAASD	TransSecure, Inc.
FMC Technologies, Inc.	Dewbridge Airport Systems	I.D. Systems, Inc.	DefenderTech
Elgin Sweeper Company	Zortek Systems	Pure Tech Systems	ICx Technologies
Tymco International, LTD.	Oshkosh Truck Corporation	GE Security	Privaris
Global Ground Support, LLC	Vanderlande Industries	American Science and Engineering, Inc.	L-3 Communications, Security and Detection Systems, Inc.
All Weather Inc.	Bradford Airport Logistics		
	NBP Corporation		

Analysis and Trends

While the economic downturn led to reduced traffic flows and capital expenditure delays, both industry and government analysts predict and are preparing for significant increases in demands on the commercial air transportation system. Through the auspices of the Joint Planning and

⁷² Airports Council International. "New Release: ACI Airport Economics Report 2009." Press Release. December 22, 2009.

Development Office (JPDO)⁷³, a multiagency organization that manages a public/private partnership responsible for bringing the Next Generation Air Transportation System (NextGen) online, the USG is working to develop and implement policy and technology improvements that will support up to a tripling of air traffic by 2025. Privately owned airports and aviation infrastructure manufacturers are participating in this effort, both independently and in partnership with the JPDO through the NextGen Institute.⁷⁴

Airport Infrastructure

Large numbers of new airports throughout Europe and Asia are either planned or under construction to accommodate [current and future] global air traffic, with some analysts expecting China alone to build up to 50 new airports in the next decade.⁷⁵ According to Airports Council International (ACI), the global economic recession caused a number of projects at airports around the world to be delayed, staggered, or put on hold.⁷⁶ Even so, the large majority of projects already underway continue as planned, given that existing airports will have to renovate and expand in order to handle future increases in passenger and cargo traffic as well as larger aircraft such as the Airbus A380.⁷⁷ The JPDO and U.S. airports continue to develop plans for new construction, airport expansion, and modernization initiatives that will create numerous opportunities for manufacturers of airport infrastructure equipment and technologies. From landside passenger services (e.g., check-in and baggage handling) to cargo operations (such as inter-modal transfers and just-in-time delivery to runways) to basic infrastructure (passenger terminal facilities, access control, information displays, and boarding bridges), the global business of building and maintaining airports already represents significant economic activity (approximately \$200 billion in 2008).⁷⁸

The need for new and/or expanded airport capacity as well as current and potential job growth have been tempered by the effects of the global economic downturn. The steep declines in both global air passenger traffic and global air freight shipments in 2008 into early 2009 have reversed in 2010. Passenger traffic rose by 6 percent in January 2010 compared to January 2009, and freight rose by 25 percent in the same period.⁷⁹ Although employment levels at airports declined in relation to traffic, airports continue to be significant centers of job creation. Even with the downturn in passenger and freight traffic in 2008, according to ACI, 3.975 million persons were employed on airport sites worldwide.⁸⁰ Furthermore, the Air Transport Action

⁷³ The JPDO was established through the enactment of the 2003 VISION 100 — Century of Aviation Reauthorization Act [P.L. 108-176] in order to oversee the development of NextGen. The JPDO coordinates the specialized efforts of the Departments of Transportation, Commerce, Homeland Security, Defense, FAA, NASA, and the White House Office of Science and Technology Policy.

⁷⁴ The NextGen Institute is the mechanism through which the JPDO accesses private sector expertise, tools, and facilities for application to NextGen activities and tasks (including planning, research, analysis, assessment, architecture, functional requirements setting, prototyping, simulation, and demonstrating future system attributes).

⁷⁵ Kevin Brass. "Dubai turns focus to airports." *International Herald Tribune*. March 29, 2006.

⁷⁶ Airports Council International. "New Release: ACI Airport Economics Report 2009." Press Release. December 22, 2009.

⁷⁷ *Ibid.*

⁷⁸ *Ibid.*

⁷⁹ Airports Council International. "January traffic shows strong start for the year." Press Release. March 4, 2010.

⁸⁰ Airports Council International. "New Airport Economics 2008 Report." Press Release. December 23, 2008.

Group estimates that around 8 million jobs worldwide are dependent on airport activity.⁸¹ This effect is further multiplied by the evolution of the “aerotropolis” in which international airports increasingly serve as magnets for commercial development and combine office, retail, entertainment facilities, and even some housing with airports to create “airport cities”.⁸² In fact, many of the largest airports derive up to 50 percent of their revenue from non-aviation sources, such as shopping areas, restaurants, and parking facilities.⁸³

Figures 1 and 2 provide breakdowns, by region, of airport employment in 2007.

Figure 1: 2007 Direct Airport Employment⁸⁴



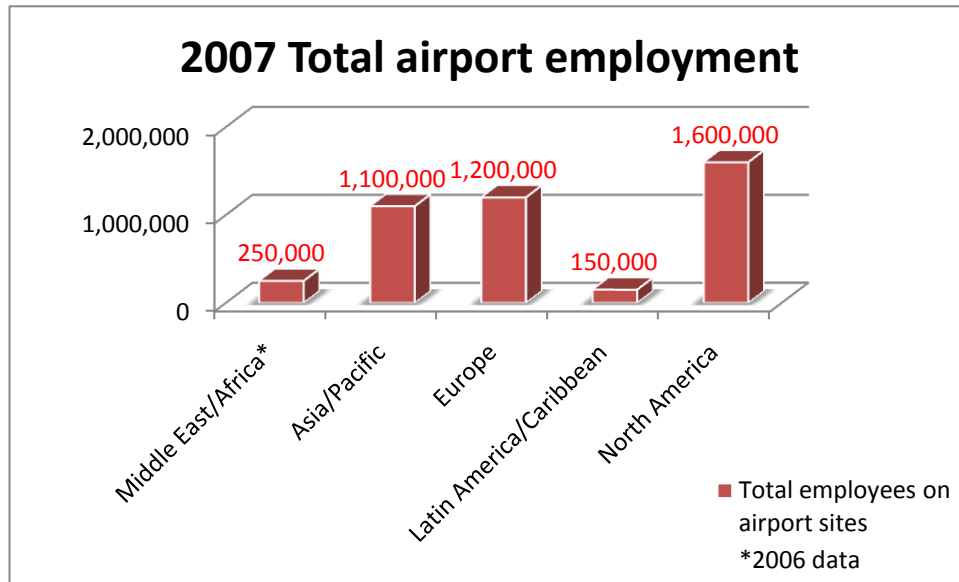
⁸¹ *Ibid.*

⁸² Urban Land Institute. “Will the ‘Aerotropolis’ Replace the Metropolis? In Today’s Real Estate Environment, Easy In-Easy Out is Key Factor.” November 7, 2002. Available on the web at <http://www.uli.org/AM/Template.cfm?Section=Home&CONTENTID=21387&TEMPLATE=/CM/ContentDisplay.cfm>

⁸³ Kevin Brass. “Dubai turns focus to airports.” *International Herald Tribune*. March 29, 2006.

⁸⁴ Airports Council International. *ACI Airport Economics Survey 2008*. December 2008. 2007 airport employment figures are provided for clarity and historical purposes only. More current data was not available as of this date.

Figure 2: 2007 Total Airport Employment⁸⁵



Existing airports will need to build new capacity both to meet the expected growth in passenger and cargo traffic and to maintain economic momentum. To do so, airports, airport infrastructure manufacturers, and government entities such as the JPDO are working to remove regulatory and political obstacles to building new capacity. This effort is necessary to avoid severe congestion that could restrict the economic dynamism of airports by suppressing trade, investment, and traffic flows.⁸⁶

Aviation Security

Security concerns have become an essential part of airport and aviation operations. The Transportation Security Administration produced a number of plans to address various aspects of transportation security, culminating in the drafting of the National Strategy for Aviation Security (NSAS).⁸⁷ Within the NSAS, a supporting plan regarding the Aviation Transportation Security System was created to help manage the development and implementation of new and improved security measures throughout U.S. airports and the National Air Space (NAS). The Airports and Aviation Security Working Groups of the JPDO partnered with industry and the governmental agencies involved in crafting the NSAS to ensure that costs, efficiencies, economic impact, and the changing nature of air transportation (e.g., the expected increases in air traffic) were considered and reflected in the Strategy. The NextGen aviation security model calls for a layered, adaptive security system that utilizes risk assessment and management to identify, prioritize, and assess homeland security needs and that adjusts resources to defeat evolving

⁸⁵ *Ibid.*

⁸⁶ Airports Council International. "Airports Stimulate Employment and Economic Growth." Press Release. April 11, 2006.

⁸⁷ National Security Presidential Directive 47/Homeland Security Presidential Directive 16 (NSPD-47/HSPD-16). Available on the web at http://www.dhs.gov/xprevprot/laws/gc_1173113497603.shtm

threats without unduly limiting mobility or making unwarranted intrusions on civil liberties while minimizing impacts to airline operations or aviation economics.⁸⁸

Further, NextGen and Department of Homeland Security (DHS)/Transportation Security Administration (TSA) planning acknowledges that aviation security is a global issue that requires a high level of cooperation among trading partners. Along with collaborative policies and procedures, NextGen technologies must be interoperable to ensure that critical information reaches appropriate security and air traffic management authorities.⁸⁹

The aviation security industry has moved forward with a number of possible solutions and technologies. The market for these technologies has significantly expanded; indeed, the global airport security equipment market is projected to reach \$131.7 billion by the end of 2010.⁹⁰ These new technologies will address both security concerns and the need to reduce congestion (and thus not interfere with the business of airports and aviation transportation). The constantly evolving array of threats has forced airport operators and security technology manufacturers to test and deploy various identification and screening technologies, such as biometrics, radio frequency identification (RFID), and prototype explosives/baggage screening devices. The attempted Christmas Day 2009 bombing, for instance, prompted DHS to request \$433 million to purchase and install hundreds of advanced body-scanning machines at airport checkpoints across the U.S. and an additional \$60 million for several hundred portable explosives detectors for the Department's 2011 budget.⁹¹

Future Market

The market for airport infrastructure and aviation security products will continue to expand in the foreseeable future as plans for implementing the Next Generation Air Transportation System and enhancing aviation security go forward; in fact, the 2011 FAA budget proposal includes \$1.14 billion for [NextGen] – a 32 percent increase from fiscal year 2010.⁹² ACI World forecasts a 3 to 4 percent upturn in global air traffic in 2010.⁹³ The expected growth in air traffic, the economic catalyst effect of large airports, and the demands of air travelers will pressure airports and vendors of infrastructure and security technologies to pursue greater efficiency.

⁸⁸ FAQ: What are NextGen's key capabilities? Available on the web at <http://www.jpdo.gov/faq.asp>

⁸⁹ JPDO "Snap Shot" Series: Securing America's Air Transportation System". Available on the web at http://www.jpdo.gov/library/snapshot/JPDO%20Snap%20Shot_Securing.pdf

⁹⁰ Cui Shiyang. "China: China Airport Security Development." September 15, 2009. Available on the web at http://www.buyusainfo.net/docs/x_833741.pdf

⁹¹ Bruce Kennedy. "Flying High: U.S. Aviation Security Costs Keep Rising." *Daily Finance*. April 11, 2010. Available on the web at <http://www.dailyfinance.com/story/when-the-cost-of-flying-safely-keeps-rising-who-pays/19433821/>

⁹² "2011 Budget Proposes \$3.515 Billion for AIP." *Airport Magazine*. February/March 2010. Available on the web at <http://airportmagazine.net/>

⁹³ Airports Council International. "Airports assess the industry's financial outlook, ACI World and ACI Europe host annual economics and finance conference." Press Release. February 23, 2010.

While many of the world's airports have historically been government-owned enterprises, the model is shifting towards commercially operated businesses, as is the case in the U.S.⁹⁴ Current and planned new airports and expansion projects will therefore provide numerous opportunities for providers of airport infrastructure products. The shift towards commercial operation as well as current government-to-government negotiations regarding wider access to procurement indicate that opportunities for airport infrastructure providers will continue to expand.

U.S. providers of aviation security technology hold a leading position in the market. Almost all U.S. aviation security technologies are used internationally. DHS laboratories such as the Transportation Security Laboratory (TSL) located at the William J. Hughes Technical Center within the Atlantic City International Airport in New Jersey continue to be primary centers of security research, testing, and certification for products and technologies. The TSL is internationally recognized for its role in the development of standards, protocols and test articles necessary for detection technology assessments.⁹⁵

The next generation of technologies will be smaller, faster, cheaper, and lighter and will be able to detect a greater array of threats. These new systems will be more user-friendly and have less impact on civil liberties. These new systems and technologies also will be more adaptable to the airports in which they will be placed. Harmonized security requirements will allow cohesive systems of passenger management, baggage handling, and cargo shipments to be built around available and future technologies, such as backscatter and millimeter wave technologies that are capable of both full body passenger screening as well as mobile cargo scanning applications.

⁹⁴ Kevin Brass. "Dubai turns focus to airports." *International Herald Tribune*. March 29, 2006.

⁹⁵ Available on the web at http://www.dhs.gov/files/labs/editorial_0903.shtm.

Commercial Space

The commercial space market is dominated by a small number of large companies that provide launch services and manufacture commercial communications satellites. Commercial remote sensing satellites are emerging within this market, but have seen limited growth internationally. The companies comprising this market are also major suppliers to U.S. Government (USG) programs, where demand has remained stable during the commercial aerospace downturn and global economic downturn that have occurred since 2001.

Table 1: Major U.S. and Foreign Commercial Launch Providers

Launch Company	Vehicles/Products	2009 Commercial Launches	2009 Total Launches
Boeing	Delta II, Delta IV, Sea Launch Zenit-3SL, Land Launch Zenit-3SL	3	14
Lockheed Martin	Atlas V	1	1
Arianespace	Ariane 5	5	7
International Launch Services (ILS)	Proton	7	7
Orbital Sciences Corporation	Pegasus, Taurus (light-weight), Minotaur	0	2
SpaceX	Falcon 1	1	1

Source: “2009 Year in Review”, Federal Aviation Administration, Office of Commercial Space Transportation, January, 2010.

Four major companies dominate the commercial launch market: Boeing, Lockheed Martin, Arianespace (Europe) and International Launch Services (Russia). Boeing and Lockheed Martin also provide launch services to USG customers on their Delta and Atlas rockets through the United Launch Alliance (ULA), a 50-50 joint venture. ULA uses the same Atlas 5 rockets that are marketed commercially, as well as the Delta 4 rockets that could re-enter the commercial market if commercial launch prices rise globally. 2009 saw a decrease in U.S. commercial launches from 2008 (24 vs. 28).

Since Lockheed Martin’s 2006 sale of its interests in International Launch Services (ILS) to Space Transport, Inc., ILS no longer offers marketing or technical assistance for U.S.-built Atlas launch vehicles. ILS now offers assistance only with Russian-built Proton launches. Space Transport is seeking to return some of its stake in the venture to Russia’s Khrunichev, the manufacturer of the Proton launch vehicle. In June 2009 Sea Launch filed for bankruptcy. At the time of this writing, Sea Launch was finalizing its Plan of Reorganization and working toward emerging from its Chapter 11 Bankruptcy status in Q2 2010.⁹⁶

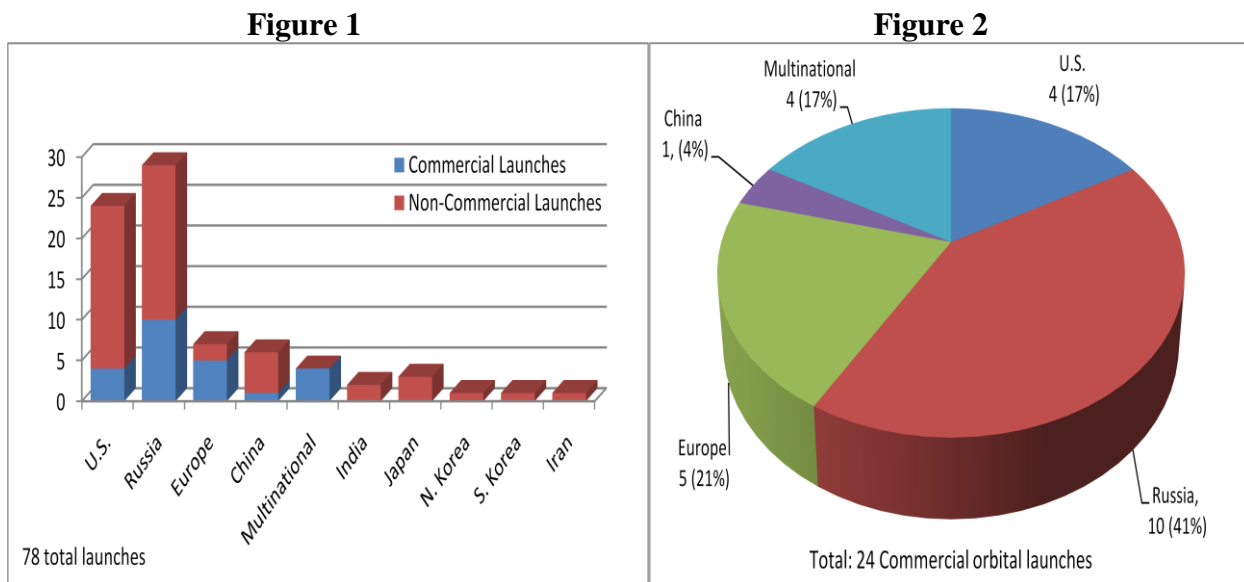
In addition to providing light-weight launch vehicles, Orbital Sciences has carved out a niche in the small to medium-sized communications satellite sector and attracts mid-range customers who

⁹⁶ <http://www.boeing.com/special/sea-launch/>

do not require the power and capability of a large, state-of-the-art satellite. It is likely that this market niche will continue to grow over the next few years. In April 2010, Orbital Sciences acquired the satellite manufacturing business of General Dynamics for \$55 million, adding advanced medium-class defense and scientific spacecraft to the company’s existing satellite product lines.

Entrepreneurial companies such as SpaceX are developing new launch vehicles and satellites intended to lower launch costs and support NASA’s Space Exploration Program. Since most entrepreneurial ventures have only minimal financing and have been unable to move beyond the initial program design stage, numerous entrepreneurial firms have exited this market in the past two years. However, SpaceX is an American entrepreneurial firm that is experiencing growing success through its privately developed Falcon family of launch vehicles. SpaceX currently has contracts or options for up to 27 launches.⁹⁷ The President’s 2011 budget proposal is continuing to encourage this trend toward NASA use of commercial services as is the new National Space Policy.

Figure 1: 2009 Total Worldwide Launch Activity
Figure 2: 2009 Worldwide Commercial Market Share



Source: FAA Commercial Space Transportation 2009 Year In Review
 Note: a “commercial launch” here is defined as an FAA-licensed launch

Market Trends

In 2009, 78 total orbital launches took place globally, of which 24 were commercial launches.⁹⁸ Five of the commercial launches were performed by U.S. ventures: Boeing’s Russian-built Sea Launch, Boeing’s U.S.-built Delta II and Delta IV, Lockheed Martin Commercial Launch Services’ Atlas V rocket and Space X’s Falcon 1 each conducted one launch. Arianespace

⁹⁷ <http://www.spacex.com/>

⁹⁸ “2009 Year in Review”, Federal Aviation Administration, Office of Commercial Space Transportation, January, 2010.

launched 8 satellites on 5 commercial launches.⁹⁹ Russia launched 12 commercial satellites on 10 launch vehicles, of which seven were Proton M vehicles, one was a Dnepr rocket and two were Rockot vehicles. These figures demonstrate the stiff competition between European- and Russian-manufactured rockets in the commercial market and the recent focus on U.S. government launches for U.S.-built rockets. Data have begun to indicate that recent increases in Russian and European commercial launch prices are nearly high enough to make U.S. commercial launch prices competitive again internationally. Worldwide revenues from the 24 commercial launch events in 2009 are estimated at \$2.49 billion, an increase of \$520 million (26 percent) from 2008.¹⁰⁰

The 78 total global launches carried 111 spacecraft into orbit in 2009. Of those 111 spacecraft, 26 provide commercial broadcast and communications services, while the remaining spacecraft were used for non-commercial civil government, military or non-profit services.¹⁰¹

In the commercial communications satellite manufacturing sector, U.S. companies have regularly maintained more than 50 percent of the commercial market over the past five years, with the exception of 2007 (42 percent).¹⁰² Boeing, Lockheed Martin, Orbital Sciences, Alcatel Espace, Astrium, and Loral Space and Communications dominate the market, with European companies continuing to strive for additional market share. U.S. market share could decline due to export control concerns and European technological advancements. In response to export control concerns, Europe's Thales has developed a satellite that contains no U.S. components, thereby avoiding U.S. export control regulations, and allowing it to be launched from China at a price lower than current Western market prices. While the United States maintains a small production cost advantage, aided in part by a weak dollar, this advantage has been shrinking as Europe produces a greater number of satellites and gains more technological expertise. Several factors will impact the demand for telecommunications services over the next 5-10 years including overall economic conditions, new market applications, competition with other non-space-based services (such as cable television), data compression technology, regulatory barriers, emerging competitors and the new trend towards investment firms' ownership of services companies.¹⁰³

In the commercial remote sensing satellite sector, the major communications satellite manufacturers listed above as well as Ball Aerospace and Northrop Grumman have the capability to build state-of-the-art imaging satellites. Even though the 2004 national policy on remote sensing encourages trade in this sector, no U.S. company has sold one of these satellites to an international customer. Export control concerns and/or a lack of funding from foreign customers are the main reasons for the slow emergence of this market.

Domestically, two U.S. companies--GeoEye and Digital Globe--own and operate imaging satellite systems and sell their data commercially. The companies' success, however, still hinges on purchases from their main customer, the USG. This government-customer focus will not

⁹⁹ Ibid.

¹⁰⁰ Ibid.

¹⁰¹ Ibid.

¹⁰² Satellite Industry Association.

¹⁰³ "2009 Year in Review", Federal Aviation Administration, Office of Commercial Space Transportation, January, 2010.

change in the near term, but it will slowly diminish as new applications are developed for commercial use, such as commercial mapping, mineral exploration, insurance appraisals, journalism/news media, and agriculture.

The satellite radio sector saw steady growth over the past few years, but the global economic downturn and competition from other sources has slowed subscriptions and weakened this sector. Satellite radio revenue decreased to an estimated \$2.46 billion in 2009 compared to \$2.50 billion in 2008.¹⁰⁴ Market growth is closely tied to U.S. economic growth, especially to declining auto sales in the U.S. Sirius XM is the global leader in satellite radio and launched its SIRIUS FM-5 satellite in June 2009. Bankruptcy rumors in early 2009 were followed by the March 2009 purchase of a 40% stake in Sirius XM by media conglomerate Liberty Media. Industry analysts now highlight Liberty Media's desire to increase take a controlling interest in the company.

China conducted six orbital launches in 2009, one of which was commercial (this is a decrease from 2008 when China conducted a record high 11 orbital launches, all of which were for the Chinese government).¹⁰⁵ China's one commercial launch, the Indonesian Palapa D communications satellite, was only partially successful since the satellite was not inserted into the proper orbit. Due to Tiananmen Square sanctions, U.S. satellites shipped to China for launch must receive a waiver from the President before shipment. When faced with such a difficult requirement, satellite customers have typically chosen other launch providers instead. New "ITAR-free" European satellites are allowing China to re-enter the commercial market, and several contracts have already been signed. With the appearance of these satellites, China likely will link low-cost launches with its satellite sales in Asia. Given the continued strong competition in the satellite market, China will only win these contracts with extremely low prices, thus negatively impacting U.S. manufacturers. China has also worked with Brazil and Europe to develop advanced satellite technology and is expected to begin offering low-cost, mid-size satellites on the international market within five years.

India continues its strong interest in entering the commercial launch services market. In 2009, India performed two successful launches for the Indian Government on its Polar Satellite Launch Vehicle (PSLV), which carried an ocean research satellite, a radar imaging satellite and a group of small experimental Swiss satellites.¹⁰⁶ In the commercial market, India is likely to win an average of one launch per year for a few years, mainly through promotional pricing, package deals, partnership programs with Europe, etc. Because of Indian launch vehicles' limited capabilities and size, India likely will not gain a significant portion of the market in the short term. India also intends to enter the commercial communications satellite market.

Japan conducted three launches in 2009 for the Japanese government, one of which marked the debut of the H-2B rocket. Reliability problems with the H-2A rocket and high costs of production have kept Japan from being competitive in this market to date, but Japan hopes to commercialize its H-2B rocket in the future.

¹⁰⁴ The Space Foundation, *The Space Report 2010: The Authoritative Guide to Global Space Activity*.
<http://www.thespacereport.org>.

¹⁰⁵ *Ibid.*

¹⁰⁶ "2009 Year in Review," Federal Aviation Administration, Office of Commercial Space Transportation, January 2010.

A few U.S. states continue to explore building commercial “spaceports”, for commercial launches and space tourism flights. The FAA is currently reviewing safety factors impacting such facilities. States that are interested include New Mexico, California, Florida, Virginia and Oklahoma, among others.

Trends

Satellite manufacturers are benefiting from a sudden turnaround in the market, which has included a return to historic satellite order levels. To meet customers’ increasing demand for all types of satellite services, satellites are being built larger and heavier in order to provide greater capability and longer satellite lifetime. In turn, these satellites require larger, heavier launch vehicles. Greater size reduces the likelihood of launching two satellites on one launch vehicle, a practice that was more common in the 1990s. However, the greater size has initiated a resurgence of demand for heavy launch vehicles—which are now developing backlogs and increased prices. Prices for intermediate to heavy class launches on several recent competitions have increased from approximately \$50 million to nearly \$100 million in the last three years. On the other hand, Orbital Sciences has carved out a niche market providing small- to medium-sized satellites to customers requiring a smaller amount of capacity.

Even though the commercial market is recovering, USG satellite and launch purchases will remain very important for U.S. companies who rely upon government business to balance the highs and lows of the commercial sector. However, the unreliable schedule associated with government launches and the 2006 move from “lot buy” purchases to annual awards for launches will negatively impact second and third-tier suppliers. The result is that the overall price associated with those launch vehicles will be higher because of an inability to take full advantage of rate and quantity discounts from critical suppliers. Additionally, the merger between Pratt & Whitney and Rocketdyne, the country’s major suppliers of rocket engines, limits the ability of U.S. launch vehicle manufacturers to negotiate better prices for propulsion unless a lot buy is arranged.

There are several factors that may stimulate growth in the launch market. For instance, NASA’s decision to rely mainly upon the use of commercial suppliers to deliver cargo and supplies to the International Space Station should supply a significant annual boost. The recently signed National Space Policy (April 2010) instructs NASA and all U.S. government departments and agencies to rely upon commercial providers to a much greater extent than in the past. This direction, if fully supported through Congressional appropriations, should lead to a more competitive commercial space industry, which is built upon new and more efficient technologies.

During the early to mid 1990s, the telecommunications boom encouraged a large number of entities around the globe to enter the market, but the late 1990s downturn created large oversupplies in the launch and satellite sectors which in turn eliminated normal profit margins through 2005 and resulted in reduced launch prices. Over the past four years, those prices have nearly returned to the mid-1990s prices due to a resurgence of demand for satellite telecommunications services. Prices are expected to continue to rise slightly before stabilizing. Prices could continue to increase sharply if another launch failure were to occur and/or Russia limits access to its vehicles (Proton, Zenit for Sea Launch and Land Launch, and Soyuz).

Oversupply and extremely low launch prices also pushed some U.S. manufactured launch vehicles out of the commercial launch business. As launch prices returned to higher levels, U.S.-built rockets have again become more competitive internationally. This may provide Boeing an opportunity to offer its Delta 4 rocket in commercial competitions. Following the telecom market crash, only two telecommunications behemoths (composed of many entities) remained: SES Astra-GE Americom-New Skies and Intelsat-PanAmSat-Loral Satellite Services. Moreover, this sector continues to compete with non-space based solutions which can meet the same high-technology needs, such as cellular phones, cable television and other information technologies.

Investors generally remain leery of space due in part to the sector's high risk and low returns on investment. However, investments in telecommunications satellite systems in 2009 pointed towards a return in investor confidence in this sector, and investment in some systems is increasing. As demand for these services increases, emerging launch providers such as India, China and small entrepreneurial ventures may find opportunities to enter the launch and satellite markets.

Another trend having an impact on the market is the increased interest from entrepreneurial manufacturers to develop low-cost alternatives to the established launch providers and/or opportunities for space tourism. This sector has been reenergized as a result of the successful flight of Virgin Galactic's Space Ship One and its 2008 release of Space Ship Two (which made its first captive-carry flight test on March 22, 2010), and the ongoing competitions sponsored by the FAA and private organizations to develop new technologies. However, huge investments are still required to turn these demonstration launches into successful suborbital and/or orbital space tourism operations. The sector will also require the development of new safety and operational guidelines and the ability to use new technologies regularly and at a reasonable cost. With Virgin Galactic's space tourism flights currently priced at \$200,000 per person per flight, space tourism is quickly becoming accessible to more than just millionaires.¹⁰⁷ This market will remain small for several years, but advances in innovation will spur further research and development.

The more stringent enforcement of U.S. export control policies in the late 1990s and the international perception that U.S. export licensing laws would negatively impact a customer's ability to acquire a U.S. satellite appears to have hurt the ability of U.S. satellite manufacturers to compete internationally. This is mainly due to export control concerns and the development of satellites that contain no U.S. components. Even though larger companies have learned to manage export control requirements, they remain a heavy burden for smaller companies and entrepreneurial ventures that lack expertise in this area. As mentioned above, Europe's response to U.S. export control policies has been to develop communications satellites that do not contain any U.S. components. Several of these satellites have been sold, highlighting international concern about buying from the United States. Europe's response has probably had the greatest impact on second- and third-tier suppliers who are no longer supplying to European customers while simultaneously watching U.S. market share decline.

¹⁰⁷ <http://www.virgingalactic.com/overview/space-tickets/>

Another factor influencing the industry is the desire for national security spacecraft to have the ability to be launched “on demand”. The Department of Defense and the commercial industry are working together to develop guidelines that would encourage “operationally responsive launch”. Given that manufacturing a launch vehicle and/or a satellite requires 12-18 months, this goal will not be achieved for at least 10 years and will take substantial investments in inventories and production lines, which is unlikely in the near term given the current limited investment climate.

In 2009, President Obama signed a directive calling for a review of the existing Bush Administration federal space policies, which were signed in 2003-2006. Those policies aimed to improve the health of the U.S. space industry. Four sector-focused policies addressed the satellite remote sensing industry, global navigation satellite services, space exploration, and the space transportation industry. Those policies were followed by an “umbrella” National Space Policy (NSP) that addressed overarching issues impacting all commercial space sectors. Signed in April 2010, the Obama Administration’s new National Space Policy aims to improve the competitiveness of U.S. industry, increase U.S. jobs and address issues such as workforce training, standards and regulations and acquisition management. With the President’s 2011 budget proposal, the Administration is encouraging an increased reliance on use of commercial space services by the U.S. government. Policy direction will become clearer with approval of the budget in late 2010.

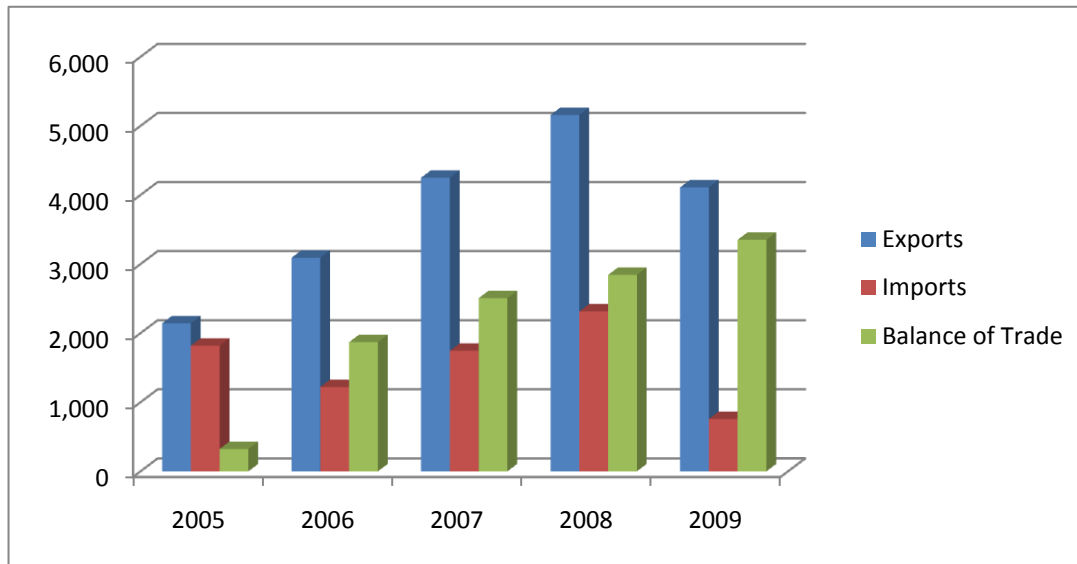
Outlook

Due to the limited size of the launch market, and the small nature of contracts, there are no ongoing competitions that would have a fundamental impact upon the international commercial market. However, within the civil space sector, NASA plans to use the commercial providers to resupply the International Space Station with cargo and possibly people, following the planned 2010 retirement of the Space Shuttle. Depending upon how NASA decides to work with U.S. and foreign industry partners on this and other aspects of its Space Exploration program, U.S. companies could receive a large amount of work, which would have a substantial impact on the health of the sector, though not the “commercial” market.

Arianespace is expected to remain the leader in the commercial launch services sector, due to competitive pricing and a reliable service. In 2009, Arianespace began conducting launches of the medium-lift Russian Soyuz rocket. In 2010, Arianespace has seven planned launches for its heavy-lift Ariane 5 vehicle, three with its medium-lift Russian Soyuz rocket and the maiden flight of its light-weight Vega rocket from its spaceport in French Guiana.¹⁰⁸ The Soyuz project is co-funded by the European Space Agency, the European Union, Arianespace and Russia.

¹⁰⁸ <http://www.nasaspaceflight.com/2010/04/live-ariane-5-eca-launch-with-astra-3b-comsatbw-2-satellites>

Country Studies: Brazil



U.S. aerospace trade with Brazil in millions of dollars

Brazil is a strong competitor in aerospace manufacturing and produces a wide range of aerospace products. Perhaps best known for producing regional jets, Brazilian manufacturers also make turboprops, military aircraft, agricultural aircraft, business aircraft, helicopters, and other general aviation aircraft. The most well-known Brazilian manufacturer is Embraer, which has delivered more regional jets than its only competitor (Canada's Bombardier) each year since 2006. Brazilian firms are highly integrated into the global aerospace supply chain and have embarked on risk-sharing projects and joint ventures with foreign firms both in Brazil and abroad.

Brazil is a major supplier to the United States' market, though it competes more in sales of final aircraft than in sales of parts and components. In 2008, the Aerospace Industries Association of Brazil estimated that its members earned \$7.5 billion in revenue¹⁰⁹; according to company information, Embraer's portion of that total was around \$6.3 billion¹¹⁰. Indeed, Brazilian manufacturers claim to import a significant amount of parts and components from non-Brazilian suppliers, including suppliers in the United States. However, it was only in the 2000s that Brazil consistently became one of the top ten U.S. export markets for aerospace equipment, likely due to the increasing success of Embraer's regional jet and business aircraft programs. In 2008, U.S. firms exported \$5.76 billion worth of aerospace products to Brazil, \$2.07 billion of which was complete aircraft and \$3.69 billion of which were parts and components.¹¹¹

¹⁰⁹ On the web at: http://www.aiab.org.br/english/index.php?option=com_content&task=view&id=17&Itemid=31

¹¹⁰ Embraer in Numbers. On the web at:

http://www.embraer.com/english/content/imprensa/docs/Embraer_Numbers.pdf

¹¹¹ ITA analysis of Census Bureau data.

Embraer was established in 1969 as a state-owned enterprise and though it was privatized in 1994, there is some government investment by BNDES, the Brazilian Development Bank (5.5% of shares).¹¹² It has been producing commercial aircraft since it was launched, starting with turboprops and moving to jets in the 1990s. Though its initial commercial aircraft were in the 20-30 seat range, today Embraer's largest aircraft can seat up to 122 passengers in a single-class configuration (additional discussion of regional jets can be found earlier in this report). Embraer has also become a serious competitor in the business jet market, particularly after the introduction of the Phenom 100 very light jet in 2008.

There are a significant number of foreign suppliers on Embraer's regional jet programs. Components and major segments of the airframe are subcontracted to non-Brazilian firms. For example, the wings for the ERJ-135/40/45 family were designed and manufactured by a Spanish firm (Gamesa, now called Aernnova) and the wings for the ERJ-170/75/90/95 families were initially made by Kawasaki Heavy Industries of Japan. Initially, many of the items supplied by foreign firms were manufactured abroad and imported; however, as Embraer became more successful, some companies set up facilities in Brazil in order to better serve their client. Embraer has also moved some production, such as the ERJ-170 wings, in house.

Although Embraer has a long history of making general aviation aircraft, it is just starting to become a major player in business jets. Its first business jet, the Legacy 600, is a modified ERJ-145. Two smaller variants are expected to come to market by 2013. Embraer has also introduced a business aircraft variant of the ERJ-190 and a very light jet, called the Phenom. The Phenom's entry into service was well-timed to take advantage of the void left when U.S.-based Eclipse ceased production of its VLJ in 2008. In addition to business jets, Embraer continues to be a player in the piston and turboprop market through its subsidiary, Neiva.

Nearly 95 percent of Embraer's 16,853 direct employees are located in Brazil¹¹³, but Embraer does have facilities and joint ventures in other countries. There is an ERJ assembly plant in Harbin, China, which manufactures ERJ-145s from kits; Embraer announced that it is considering adding an ERJ-190 assembly line to that facility as ERJ-145 sales have waned in China.¹¹⁴ Embraer has also invested in OGMA, a maintenance, repair, and overhaul provider in Portugal that had previously been owned by the Portuguese government. Embraer expects to open an assembly facility for the Phenom in Melbourne, Florida, in 2011.

¹¹²Embraer Capital Ownership. On the web at: http://ri.embraer.com.br/Embraer/Show.aspx?id_canal=LxvuWZRvW6bFtiTxHCpt6w==

¹¹³ Embraer Company Profile. On the web at: <http://www.embraer.com.br/english/content/empresa/profile.asp>.

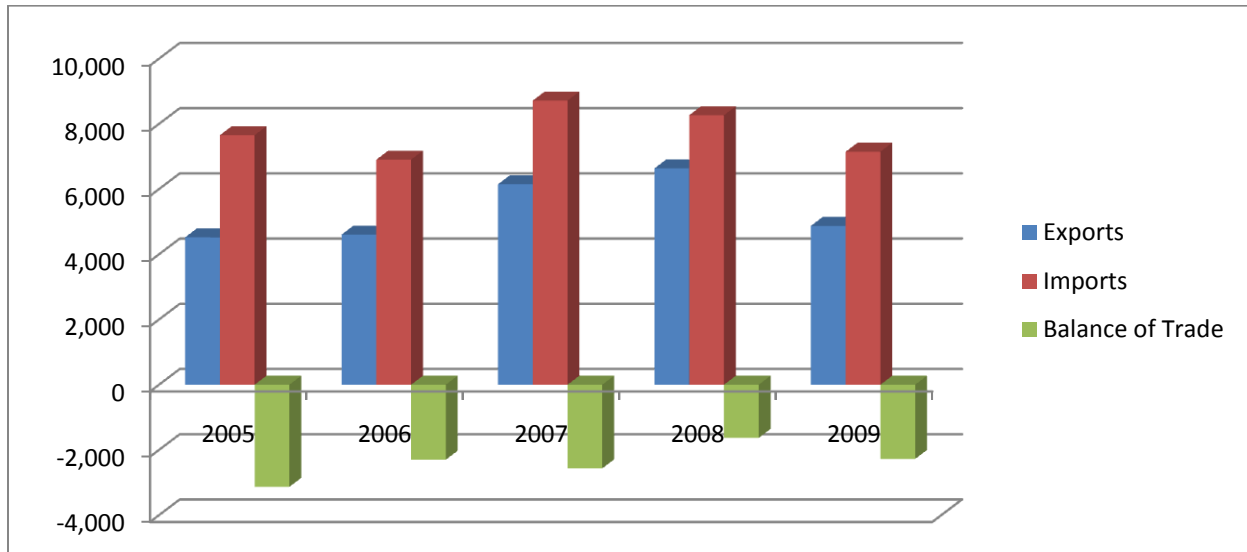
¹¹⁴ Siva Govindasamy. "SINGAPORE 2010: Embraer confirms E-190 an option for Harbin plant." *Flight Global*. February 2, 2010. On the web at: <http://www.flightglobal.com/articles/2010/02/01/337845/singapore-2010-embraer-confirms-e-190-an-option-for-harbin.html>.

Helibras, a subsidiary of EADS/Eurocopter, manufactures helicopters in Brazil for the Latin American market. Helibras has delivered about 500 units since 1978.¹¹⁵ UASs are being developed by the military and by private companies such as Embraer and Santos Lab.

There is significant foreign investment in the Brazilian maintenance, repair, and overhaul industry, with GE, Rolls-Royce, Pratt & Whitney Canada, and Goodrich among the manufacturers operating MRO facilities in-country. In addition, in 2005, Portugal-based TAP Maintenance and Engineering bought a controlling share of VEM Maintenance & Engineering. VEM was renamed TAP Brazil in 2009. Over the past several years, TAP has expanded its Brazil services to include a wider range of aircraft types.

¹¹⁵ Helibras. "A Empresa." On the web at: <http://www.helibras.com.br/historico.asp>.

Country Studies: Canada



U.S. aerospace trade with Canada in millions of dollars

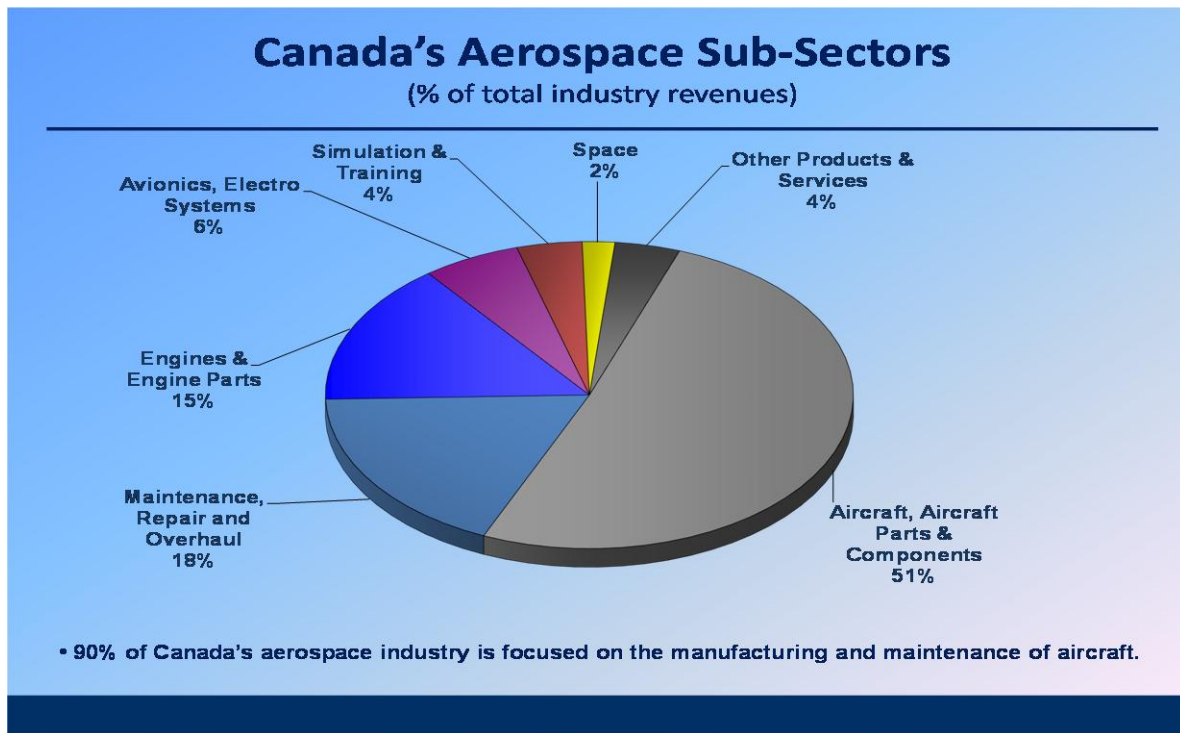
Overview

The Canadian aerospace manufacturing industry is comprised of about 400 companies, employing 80,000 workers, with sales of C\$23.6 billion in 2008 (the most recent year for which data is available).¹¹⁶ Manufacturers in Canada include Bombardier (with regional aircraft and business jets in production, and a jetliner in development), Bell Helicopter Canada (civil helicopters), Pratt & Whitney Canada (aircraft engines), CAE (flight simulators), and Thales Canada (avionics).

Measured by value of output, Canada's aerospace industry is the third largest in the world (behind the United States and the European Union). Canada's largest aerospace manufacturer, Bombardier, is the world's third largest civil airframe producer (after Airbus and Boeing).

Some 63% of Canadian aerospace output is produced in the province of Quebec, with a significant cluster in Montreal. Montreal is home of Canadian industry leaders Bombardier Aerospace, Pratt & Whitney Canada, Bell Helicopter Textron Canada, and CAE. Ontario also hosts significant aerospace manufacturing activity, accounting for an additional 22% of total national aerospace output.

¹¹⁶ Data concerning the Canadian aerospace industry is based on reports of the Aerospace Industries Association of Canada (AIAC), including as analyzed by the U.S. Commercial Service in Montreal. As of March 2010, the U.S. and the Canadian dollars were trading virtually at parity.



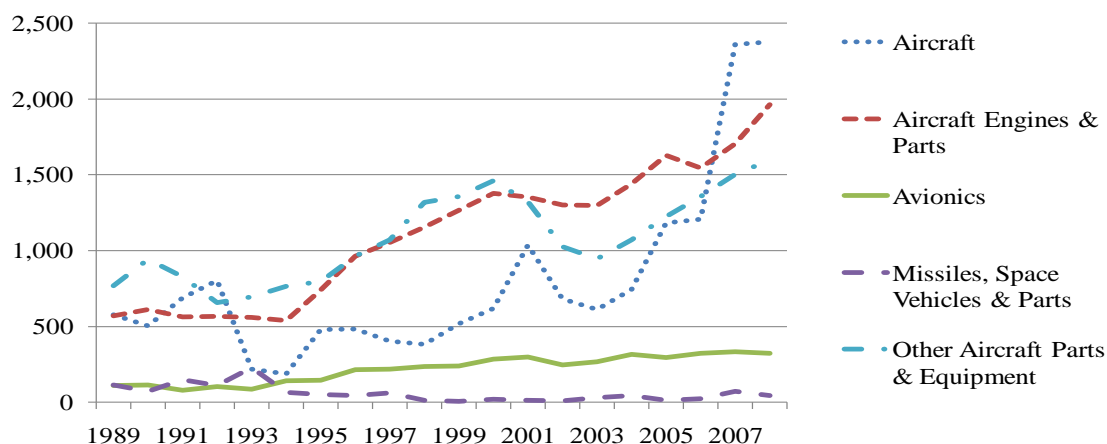
In contrast to the U.S. aerospace industry (in which output historically has been roughly half military and half civil), the Canadian aerospace industry is heavily oriented towards civil products. In 2008, 77% of Canadian aerospace output was accounted for by complete civil aircraft and related products (such as parts for civil aircraft).

Bilateral trade and investment

Canadian aerospace manufacturers are extremely dependent on access to foreign markets, especially the United States. Measured by value, about 80% of Canada's total aerospace output was exported in 2008. In that same year, exports to the United States accounted for 70% of total Canadian aerospace exports. This is not to say that the U.S.-Canada aerospace trading relationship is one-way—indeed, the U.S. and Canadian aerospace industries are highly interdependent. In 2008, Canada was the fourth largest U.S. aerospace export market. Complete aircraft and aircraft engines (including their parts) led the list of aerospace products exported from the United States to Canada. While complete aircraft and aircraft engines also dominate Canadian aerospace exports to the United States, over the last decade these two classes of products (and especially complete aircraft) have been relatively more important in the mix of Canadian exports than they have in the mix of U.S. aerospace exports to Canada.

The United States has run an aerospace trade deficit with Canada since 1990. In 2008, this deficit was US\$1.992 billion, due almost entirely to trade in complete aircraft. Canada is one of only two major U.S. trading partners that have an aerospace trade surplus with the United States. (The other is France.)

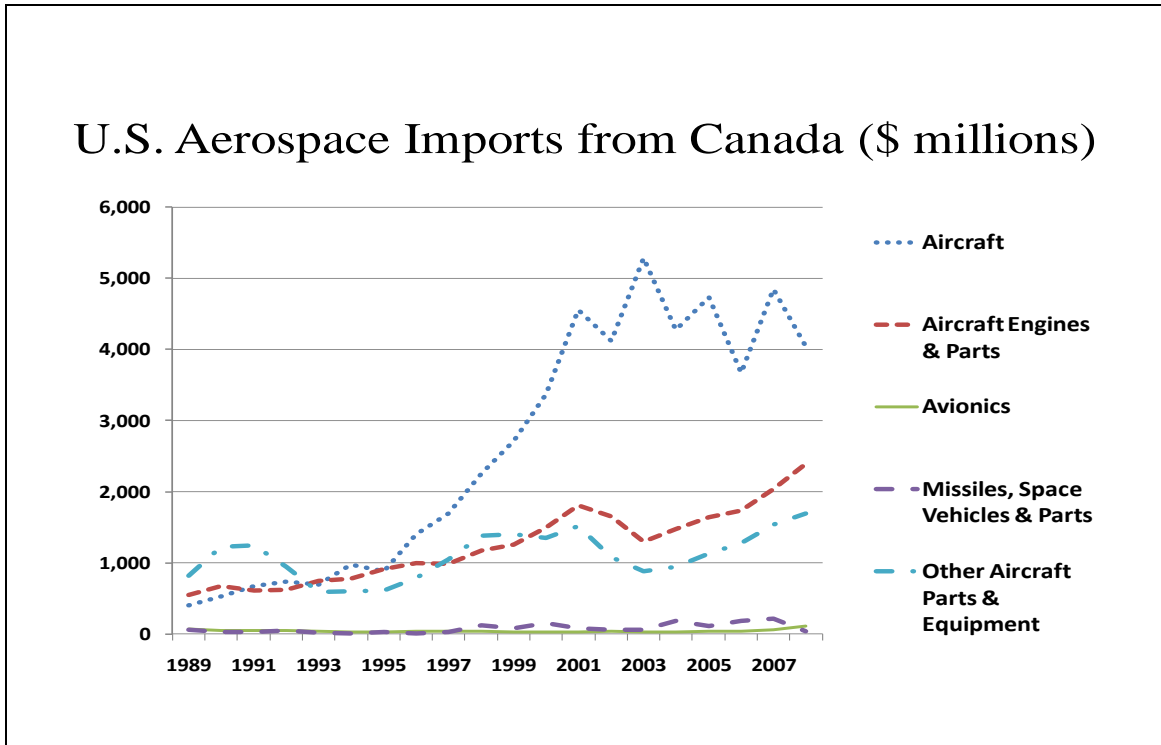
U.S. Aerospace Exports to Canada (\$ millions)



The United States and Canada are closely joined by robust investment in each others' aerospace industries. All of Bell Helicopter Textron's production of civil rotorcraft takes place in Canada. Pratt & Whitney Canada produces turboprop, turboprop, and turboshaft engines in its main Canadian manufacturing site outside of Montreal. According to the company, it is the "number one R&D investor in the Canadian aerospace sector", employs 6,200 Canadian workers, and contributes an average of over \$2 billion per year to Canada's Gross Domestic Product.¹¹⁷ Other major U.S. aerospace manufacturers with operations in Canada include Boeing, Goodrich, Honeywell, Raytheon, and Lockheed Martin.

Canada was the first major trading partner with which the United States concluded a bilateral free trade agreement, establishing a strong framework for free trade and investment in many products and service sectors, including aerospace. Further, as signatories to the World Trade Organization (WTO) Agreement on Trade in Civil Aircraft, both the United States and Canada have pledged adherence to trade principles aimed at optimizing the benefits to manufacturers and consumers that flow from free and fair trade in civil aircraft and aircraft components.

¹¹⁷ Source: Pratt & Whitney Canada web site, <http://www.pwc.ca/en/about/economic-impact>, accessed on March 31, 2010.



Canada enjoys unique treatment in regard to U.S. regulations that affect aerospace trade:

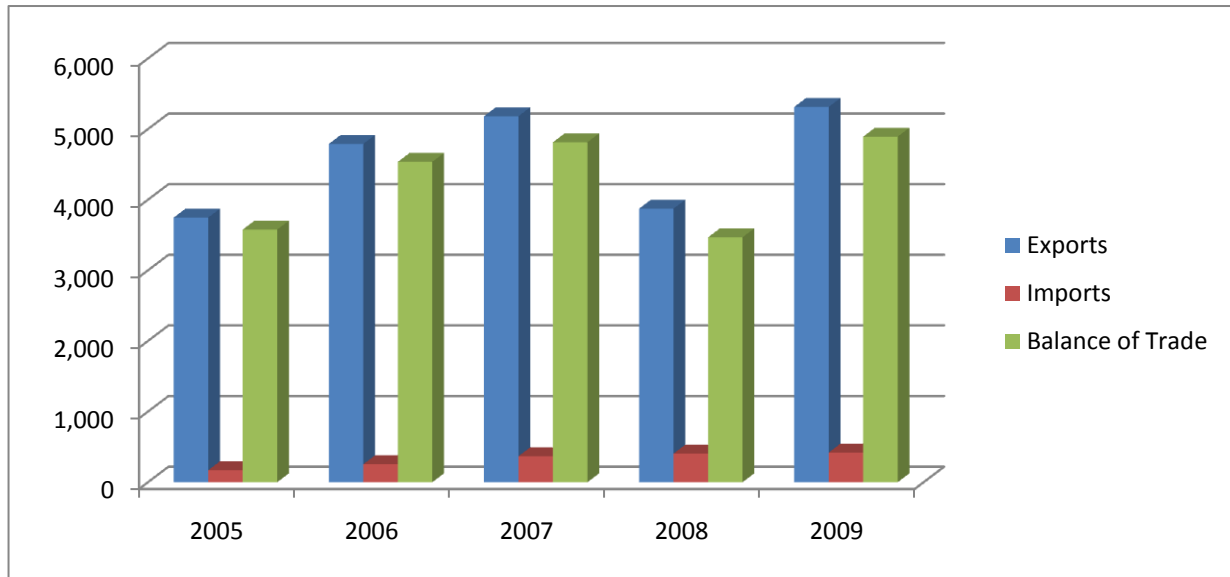
- As the only member besides the United States of the North American Technology and Industrial Base Organization (NATIBO), Canada is provided preferential access to U.S. Defense Department procurement, including with respect to military aircraft.
- Canada is exempted from a number of provisions in the U.S. International Traffic in Arms Regulations (ITAR), facilitating two-way bilateral trade in military aircraft products and military aerospace technology.¹¹⁸
- Canada is the only country designated in U.S. regulations for which its domestically-approved aircraft mechanics and aircraft repair facilities may perform maintenance or alteration of U.S.-registered aircraft without being approved by the Federal Aviation Administration.¹¹⁹

Aerospace manufacturers in Canada, including entities owned by U.S. and other non-Canadian companies, have received Canadian government financial support for decades. Among the most prominent support has been that of the Technology Partnerships Canada (TPC) program and its successor, the Strategic Aerospace and Defense Initiative (SADI). The TPC program was established in 1996 and terminated in 2006. While there are some differences between TPC and SADI, the underlying objectives and mechanics of the two programs are much the same.

¹¹⁸ See 22 CFR §126.5.

¹¹⁹ See 14 CFR §43.17.

Country Studies: China



U.S. aerospace trade with China in millions of dollars

The People's Republic of China is investing significant resources to become a competitor in the civil aircraft industry. With its regional jet program in the flight testing phase, the Chinese are embarking on a new program to develop a 150-seat narrow-body aircraft that would compete with aircraft currently sold by Boeing and Airbus. The effort to create a competitive civil aircraft production program in China is in part motivated by growth in domestic demand for air transportation, which should lead to orders for over 3,770 new aircraft by 2028.¹²⁰ Attempts to capitalize on this demand have led established manufacturers to engage Chinese suppliers in various joint ventures while simultaneously eyeing the Chinese as future competitors.

In 2008, China undertook a major reorganization of its aerospace manufacturing enterprises. In May 2008, China established the Commercial Aircraft Corporation of China (COMAC) to oversee the development and production of a large civil aircraft now called the C919. COMAC was given responsibility for most of China's commercial aircraft programs, including the ARJ-21 regional jet. In October 2008, the central government merged China's two large aerospace entities, AVIC I and AVIC II, creating one business unit with ten aerospace subsidiary companies.¹²¹ The new company, which took the name AVIC, was formed from various pieces of the former AVIC family. AVIC is a partial shareholder of COMAC. Since late 2008, enterprises dedicated to aircraft engines, helicopters, composites, and general aviation have been announced or rumored. A strategic agreement on specialized steel for large civil aircraft was

¹²⁰ Boeing Current Market Outlook. Viewed March 4, 2010. Available on the web at: <http://www.boeing.com/commercial/cmo/china.html>

¹²¹ enAvBuyer.com. "China's new aviation giant targets 1 trln yuan revenues by 2017 – official." November 13, 2008. Available on the web at: <http://www.avbuyer.com.cn/e/2008/30511.html>.

signed between Baosteel, China's largest steel producer and COMAC shareholder, and COMAC in January 2009.

The ARJ21 project has been delayed several times. The first ARJ21 rolled off of the assembly line in December 2007, but flight testing was delayed until November 2008. In early 2009, COMAC had estimated a 2010 delivery date, but delivery has now slipped to 2011. COMAC hopes to sell 500 regional jets in 20 years and is interested in FAA certification to facilitate exports.

The C919 was first mentioned in China's 11th 5-Year plan, released in March 2006. Initially, the goal was to produce the plane for military and civil purposes by 2015, with entry into commercial service in 2020.¹²² However, China has since moved up the later date to 2016. The aircraft will be assembled in Shanghai and, like the ARJ21, will have parts sourced globally. However, COMAC has indicated that many foreign suppliers will be required to participate in the project through joint ventures with Chinese manufacturers and to conduct a significant amount of the manufacturing in country. COMAC is still in the process of selecting suppliers for the C919.

Technological advancement of China's aviation industry has been directly related to cooperation and investment from international firms. On the one hand, western companies have sourced parts from China for several decades. Most major aerospace manufacturers outsource limited volumes of metalwork to Chinese machine tooling shops, due not only to lower labor rates but also to the wide availability of the latest tooling technology.

On the other hand, non-Chinese firms have played a significant historical role in the development of aircraft by Chinese firms, up to and including the ARJ21. Many of China's early aircraft were based on Russian designs, though that cooperation stalled with the downturn of Russia's aviation industry. Later, U.S. and other western companies partnered with Chinese companies to incorporate western engines and components on Chinese aircraft. For example, starting in the late 1980s and into the early 1990s, Pratt & Whitney established joint ventures with Chinese firms to manufacture turboprop engines for several of China's Y-series transport aircraft. More recently, at least 19 U.S. and European aerospace companies have supplied major components on the ARJ21, including the engines (GE), avionics (Rockwell Collins), flight control systems (Honeywell, Parker Aerospace), and the landing gear (Lieberherr Aerospace).¹²³

Western companies have also partnered with Chinese manufacturers to co-produce aircraft in China, though these programs have had mixed results. One of the most extensive U.S.–Chinese civil manufacturing partnerships was a program started in 1985 with McDonnell Douglas to

¹²² Peder Andersen. U.S. International Trade Commission. "China's Growing Market for Large Civil Aircraft." p. 12. http://www.usitc.gov/ind_econ_ana/research_ana/research_work_papers/documents/ChinaLCA2-14-2008final.pdf.

¹²³ Andersen. p.11.

assemble MD-82 aircraft in China. Thirty-five of these aircraft were produced, five of which were sold in the U.S. market.¹²⁴ In 1994, McDonnell Douglas finalized an agreement to coproduce MD-90s in China, but only three of the planned 40 aircraft were assembled before the project was cancelled in 1998.¹²⁵ Plans by Chinese and Airbus officials to jointly build a 100-seat “Asian Express” aircraft that would be added to the Airbus product line never came to fruition.¹²⁶ Despite this history, in October 2006, Airbus signed a “Framework Agreement” with a Chinese consortium to assemble A320 aircraft in Tianjin, China, with production designed to serve the Chinese market. That facility delivered 11 aircraft in 2009.¹²⁷

For coproduction of regional jets, Chinese companies have found a willing international partner in Embraer. AVIC owns 49 percent of a joint venture with Embraer to manufacture, assemble, sell, and provide after-sales support for the ERJ 135/140/145 family of aircraft in Harbin, China. The enterprise delivered its first plane in 2004; slow orders, however, placed some doubt on the long-term viability of the project.¹²⁸ In February 2010, Embraer announced it would consider adding an ERJ-190 assembly line in the Harbin facility.

China’s transition to a competitive producer of commercial jet aircraft and engines will be aided by its large and growing domestic aviation market, providing a ready market for new indigenous aircraft. China’s has the world’s fastest growing domestic aviation industry, with air traffic increasing at a rate of 7.9 percent per year.¹²⁹ Given that there are only about 1,325¹³⁰ commercial jets operating in China (compared to roughly 7,000 in the United States), industry analysts predict that Chinese airlines will need to add over 3000¹³¹ large- and medium-sized aircraft to their fleets over the next two decades to meet this demand.

Not surprisingly, Boeing and Airbus have identified China as the single most important market for sales over the next 20 years, and both companies are working hard to win orders from Chinese airlines. Traditionally, the Chinese government (through the China Aviation Supplies Corporation [CASC]) directs the purchase and distribution of imported aircraft among the various Chinese airlines. This practice has started to change as Chinese airlines become more independent. However, it is likely that the Chinese government will mandate that Chinese airlines purchase the ARJ21 and the C919.

¹²⁴ *The Changing Structure of the Global Large Civil Aircraft Industry and Market: Implications for the Competitiveness of the U.S. Industry*, ITC Publication 3143, Investigation No 332-384, November 1998.

¹²⁵ Andersen. p. 8.

¹²⁶ Diane Brady and Charles Goldsmith. “Airbus is Set to Help China Build Jetliner.” *The Wall Street Journal*. November 20, 1996.

¹²⁷ Airbus Press Release. December 16, 2009. Viewed on the web at:

http://www.airbus.com/en/presscentre/pressreleases/pressreleases_items/09_12_16_china_final_assembly_line.html

¹²⁸ Nicholas Ionides. “ERJ-145 deal earns reprieve for Chinese assembly line.” *Flight International*. Jan 24-30, 2006.

¹²⁹ Boeing Current Market Outlook 2008. p. 30.

¹³⁰ Boeing Current Market Outlook 2008. p. 30.

¹³¹ Consolidated estimate from Boeing, Airbus, CAAC, and industry analysts.

Business opportunities in China are not limited to sales of large aircraft. Fleet expansion has been accompanied by infrastructure improvements, with 24 new airports added and 50 airports upgraded between 2001 and 2005.¹³² CAAC expects the number of airports serving scheduled flights to increase from 147 in 2006 to 244 by 2020.¹³³ CAAC also expects to make improvements to its air traffic management system, including improving its meteorological services. In April 2006, CAAC and the U.S. Federal Aviation Administration established a Joint Next Generation Air Transportation Steering Group to collaborate on deploying new air traffic management technologies and procedures.

In the end, future U.S. and European export prospects may be dampened if Chinese companies are able to satisfy some of this growing demand with indigenously produced aircraft and other equipment. U.S. and European companies also may face new competition outside of China as Chinese manufacturers seek to expand their share of the global aircraft market. For now, aerospace companies are exercising cautious optimism while pursuing business opportunities in China.

¹³²Presentation by CAAC Deputy Director General Sha Hongjiang, at the U.S.-China Aviation Summit, Washington, D.C., September 18, 2006.

¹³³“97 Airports in 12 Years.” *The China Daily via People’s Daily Online*. March 25, 2008. On the web at: <http://english.peopledaily.com.cn/90001/6380001.html>.

Country/Regional Studies: Europe

The European Union (EU) is the largest regional export market for the United States aerospace industry¹³⁴ (although Japan is the largest individual country market). Combined exports of the U.S. aerospace industry to France, the United Kingdom, and Germany account for 20.9 percent of total U.S. aerospace exports.¹³⁵ European aerospace companies also produce the full range of aerospace products and services, from large civil aircraft, to satellites, to subassemblies and components. As a result, European firms are both important partners as well as competitors for U.S. firms. As is the case with the U.S. aerospace industry, the global economic downturn has affected the EU aerospace industry. However, economic fundamentals are in place for continued long-term growth. There is significant variety in the ownership structure of European major suppliers. Several major suppliers still have significant government ownership. The European Aeronautic Defense and Space Company (EADS), for example, benefits from partial French and Spanish state ownership as well as other public shareholders.

On June 30, 2010, a World Trade Organization (WTO) dispute settlement panel publicly released a decision finding that EU member state governments' provision of launch aid, and certain other kinds of financial support to Airbus (a subsidiary of EADS), was at odds with WTO subsidies rules. The panel found that the launch aid had the effect of displacing U.S. aircraft sales in Europe and certain third country markets and contributed to significant lost sales of U.S. aircraft in the U.S. market. In addition, the panel found that UK, German and French launch aid provided in connection with the Airbus A380 is a prohibited subsidy, in as much as it was contingent on export performance. The EU and the U.S. each filed appeals, seeking a reversal of certain aspects of the panel's decision (in the case of the U.S., it argued, among other things, that the panel erred in finding certain launch aid not be to *de facto* export contingent). In a separate WTO dispute, the EU charged the U.S. with providing subsidies to Boeing that are inconsistent with WTO rules. A WTO panel was expected to issue a confidential ruling by mid-September 2010 on EU claims leveled against \$20 billion in aid to Boeing.¹³⁶

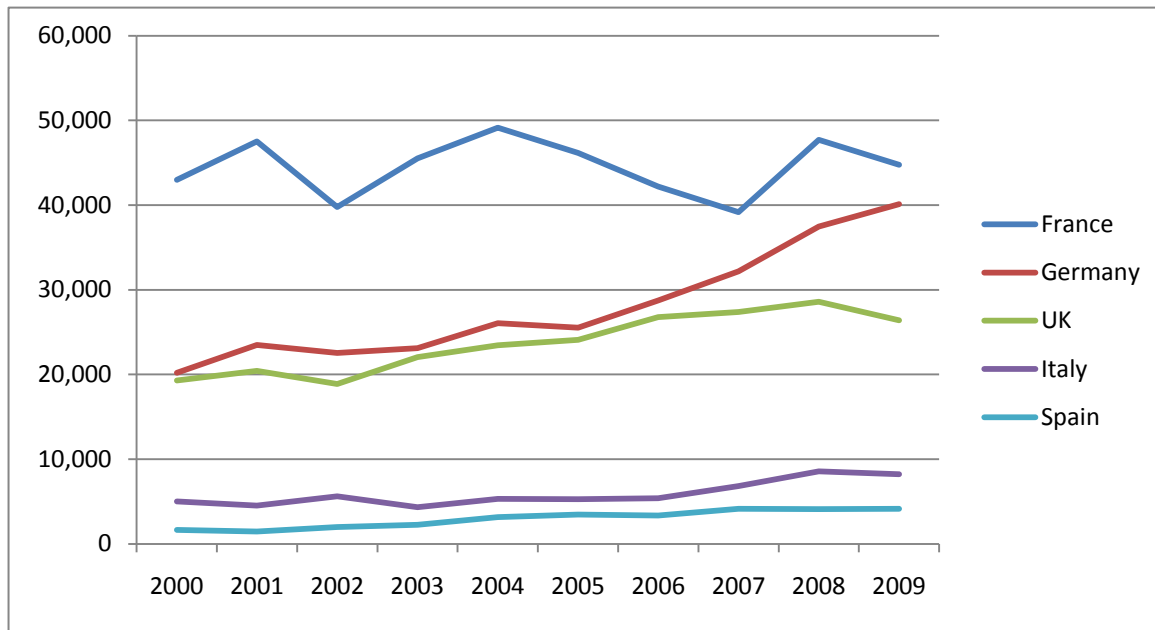
Individual member states of the European Union are free to shape their own aerospace policies. Recognizing the advantage of a unified aerospace policy that would facilitate enhanced competition, particularly with the United States, the EU has taken steps to strengthen the coherence of its regional aerospace market. In the July 2002 Strategic Aerospace Review for the 21st Century (STAR 21) report, the European Advisory Group on Aerospace developed several recommendations. They included: (1) coordinated efforts to increase access to world aerospace markets, particularly through advocacy for changes to Buy America practices and convergence in export control policies; (2) mobilization of region-wide public and private research funds to launch a coordinated, long-term civil aerospace research strategy; (3) a shift of authority from individual member state specific aerospace policy makers to a more unified structure, including wider roles for the European Aviation Safety Agency and advocating for membership of the EU in the International Civil Aviation Organization (ICAO) alongside member states; and (4) consolidation of aerospace defense research and acquisition policies among member states. The EU and its member states are continuing to implement these recommendations today.

¹³⁴ For purposes of this report, statistical comparisons of trade data were made using 2009 data, which is the most current available for all markets considered.

¹³⁵ http://trade.gov/wcm/groups/internet/@trade/@mas/@man/@aai/documents/web_content/aero_stat_top20exp.pdf

¹³⁶ *Flightplan* text was prepared in early September 2010.

Figure 1: Aerospace Exports to World (Millions of U.S. dollars)



Source: Eurostat.

Country Profiles

France

The French aerospace industry is the largest in Europe, with 2009 exports of over \$44.7 billion (in 2009 dollars).¹³⁷ The French aerospace industry employed approximately 134,000 people in 2009.¹³⁸ Despite the 2009 economic crisis, the long-term outlook for the French aerospace industry remains generally positive, characterized by continued revenue growth, record orders, and a stable industry workforce.¹³⁹ In the civil aerospace sector, the Airbus A380 and Dassault Falcon 7X entered into service in 2007 and the A350XWB, Falcon SMS, and Falcon 2000 LX programs were launched.¹⁴⁰ There was also a significant rise in telecommunications satellite orders.

¹³⁷ Eurostat data. This data is also available from the World Trade Atlas, published by Global Trade Information Services, Inc. (WTA), which is a secondary electronic source based upon the Eurostat data. See <http://www.gtis.com/wta.htm>. Accessed March 22, 2010.

¹³⁸ Groupment des Industries Francaises Aeronautiques et Spatiales (GIFAS). 2008/2009 Annual Industry Report. || Accessed March 23, 2010. http://www.gifas.asso.fr/en/pages.php?tab=facts__figures&sub=4.

¹³⁹ Ibid.

¹⁴⁰ Groupment des Industries Francaises Aeronautiques et Spatiales (GIFAS). French Aerospace Industry Digest, 2009 Edition || Accessed March 25, 2010. http://www.gifas.asso.fr/en/pages.php?tab=publications__reports&sub=2.

Germany

The German aerospace industry is the second largest in Europe, with 2009 exports of \$40.1 billion¹⁴¹ and 2009 employment of 93,000.¹⁴² In general, the outlook for the German aerospace industry remains positive, with gains in the civil and military aviation sectors driving growth. Specifically, current Airbus A380 and Eurocopter helicopter production, coupled with future production of the Airbus A350XWB are driving strong civil aviation sales. In the military aviation sector, increased production of the Eurofighter and the Tiger and NH90 military helicopters are driving export sales growth. Aerospace revenue gains are sustained by Germany's continued emphasis on research and development expenditures, which are greater on a percentage of sales basis than in other EU member countries.¹⁴³ In 2008, civil aviation made up 67.2% of all German aerospace industry revenue (62,011 employees), defense and security accounted for 25.4% of revenues (20,267 employees) and the space industry accounted for 7.4% of revenues (6,136 employees).¹⁴⁴ Major challenges include the lack of consolidation among German aerospace suppliers, and the need for more qualified engineers to fill manufacturing jobs.¹⁴⁵

United Kingdom

The UK aerospace industry is the third largest in Europe, with 2009 exports of \$26.4 (in 2009 dollars).¹⁴⁶ UK aerospace sector growth is due primarily to the maintenance, repair and overhaul (MRO) market, which is driven by increasing demands for air travel.¹⁴⁷ The UK is home to several of the world's leading aerospace companies, including BAE Systems PLC and Rolls-Royce PLC. In addition, U.S. aerospace companies such as Boeing, Honeywell, Raytheon, Rockwell Collins, and Lockheed Martin also maintain a presence in the UK. According to the Society of British Aerospace Companies (SBAC), UK aerospace companies directly employ 112,585 people, plus 40,091 people located in the United States.¹⁴⁸

One of the primary challenges facing the UK aerospace industry is the impact of an appreciating British currency against the U.S. dollar which has compelled some UK aerospace producers, such as Rolls-Royce, to move production and other activities abroad to dollar-denominated locations. Further appreciation of the British pound will likely expand and accelerate the trend of outward

¹⁴¹ Eurostat data. This data is also available from the World Trade Atlas, published by Global Trade Information Services, Inc. (WTA), which is a secondary electronic source based upon the Eurostat data. See <http://www.gtis.com/wta.htm>. Accessed March 22, 2010.

¹⁴² German Aerospace Industries Association (BLDI) Homepage. || Accessed March 23, 2010. See <http://www.bdli.de/en/>.

¹⁴³ U.S. Commercial Service Market Research Library: May 2008 German Aerospace Industry Update. Available at: <http://www.export.gov/mrktresearch/index.asp>.

¹⁴⁴ German Aerospace Industries Association (BLDI), 2009 Aerospace Industry Report: Accessed March 24, 2010 (available only in German) http://www.bdli.de/images/stories/brochures/BDLI_Jahresbericht2009.pdf.

¹⁴⁵ U.S. Commercial Service Market Research Library: May 2008 German Aerospace Industry Update. Available at: <http://www.export.gov/mrktresearch/index.asp>.

¹⁴⁶ H.M Customs and Excise data for Harmonized Tariff System (HTS) 88 —Aircraft, Spacecraft. || This data is also available from the World Trade Atlas, published by Global Trade Information Services, Inc. (WTA), which is a secondary electronic source based upon the H.M. Customs and Excise data. See <http://www.gtis.com/wta.htm>.

¹⁴⁷ United Kingdom: An Overview of the Aerospace Market, U. S. Department of Commerce, April, 2006, available at http://www.buyusainfo.net/docs/x_7389140.pdf

¹⁴⁸ SABC UK Aerospace Industry Survey 2009 available at http://www.sbac.co.uk/pages/24059849.asp#aGroup_2

mobilization across the UK aerospace industry. Other challenges facing the UK aerospace industry include consolidation of SME manufacturers in order to enable them to better compete globally.

Italy

The Italian aerospace industry is the fourth largest in Europe, with 2009 worldwide exports of \$8.2 billion.¹⁴⁹ The Italian aerospace industry, which employed approximately 38,000 people as of 2008, is generally open to cooperation with the U.S. aerospace industry.¹⁵⁰ Major players in the Italian aerospace industry include Finmeccanica, which is the country's largest engineering and aerospace/defense group. Finmeccanica manufactures helicopters, military aircraft, defense systems, satellites, and is also an energy producer and builder of generation and transmission components, boilers, turbines, cogeneration plants, desalination plants, and nuclear power plants.¹⁵¹ Telespazio, a Finmeccanica joint venture, is involved in satellite management and navigation, and broadband multimedia telecommunications.¹⁵² Fiat Avio SpA is the country's major manufacturer of aircraft propulsion systems. Fiat Avio has partnerships with Pratt & Whitney, GE Aviation and Rolls-Royce for the production of aircraft engines.¹⁵³

Spain

Spain's aerospace industry is the fifth largest in Europe, with 2009 exports of \$4.1 billion¹⁵⁴ and 2009 employment of over 40,000 workers.¹⁵⁵ The Spanish aerospace industry is dominated by three manufacturers. Airbus Military (formerly called EADS CASA) is Spain's largest aerospace company and is a world leader in light and medium-sized military aircraft. Airbus Military is also a supplier of aerodynamic surface components for the Boeing 737, 757 and 777.¹⁵⁶ Aeronova (formerly called Gamesa Aeronautica) designs, develops, and manufactures major subassembly structures for a number of large civil aircraft.¹⁵⁷ Indra Sistemas S.A. is Spain's leading producer of electronic defense equipment.¹⁵⁸ Industria de Turbo Propulsores S.A. (ITP) designs, produces and provides maintenance repair and overhaul services for a variety of aircraft engines and gas turbine compressors.¹⁵⁹ The outlook for Spain's aerospace industry remains positive in the long term, as continued sales growth by EADS-affiliated aerospace companies carries over to the industry in general.

¹⁴⁹ Eurostat data. This data is also available from the World Trade Atlas, published by Global Trade Information Services, Inc. (WTA), which is a secondary electronic source based upon the Eurostat data. See <http://www.gtis.com/wta.htm>.

¹⁵⁰ <http://www.aerospacemeetings.com/the-aerospace-industry-in-piemont-and-italy.php>

¹⁵¹ Hoover's Company Records – In Depth Company Record Finmeccanica SpA.

¹⁵² Telespazio website: <http://www.telespazio.it/profile.html>

¹⁵³ Outline of the Italian Aerospace Industry, U.S. Department of Commerce, available at http://www.buyusainfo.net/docs/x_9518011.pdf.

¹⁵⁴ Eurostat data. This data is also available from the World Trade Atlas, published by Global Trade Information Services, Inc. (WTA), which is a secondary electronic source based upon the Eurostat data. See <http://www.gtis.com/wta.htm>.

¹⁵⁵ Spanish Association of Defense, Aeronautics and Space Companies:

<http://www.tedae.org/View/page/informacion-general>

¹⁵⁶ <http://www.eads.net/1024/en/casa/casa.html>

¹⁵⁷ <http://www.aernnova.com/user/en/index.php>.

¹⁵⁸ Hoover's Company Records – In Depth Company Record Indra Sistemas S.A.

¹⁵⁹ <http://www.itp.es/index.php>

Country Studies: India

Rapid population growth, a corresponding growing demand for civil aviation services and a need for adequate supporting infrastructure to support this growth, represent the primary challenges facing India's civil aviation industry. While growing demand for civil aviation services is certainly an opportunity for manufacturers and service providers, lack of a supporting infrastructure threatens to limit the growth potential in this sector.

India's civil aviation market is predicted to expand significantly over the next twenty years. Domestic passenger traffic is expected to grow at 12.5 percent per year as the country's large and growing middle class spends more money on air travel. To feed this growth, several new domestic airlines have been started in India over the past several years, most following the low-cost business model. These new startup airlines have helped fuel a buying surge that began in 2005, with Indian carriers ordering 327 new aircraft.¹⁶⁰ This trend is expected to continue; according to Boeing's Current Market Outlook 2009-2028, India will need an additional 1,180 aircraft worth \$120 billion over the next 20 years to satisfy demand.¹⁶¹

In addition to its civil aircraft acquisitions, India imports a majority of its aerospace products, with approximately 80 percent of aircraft and parts coming from foreign sources. Domestic production has largely centered on military aircraft, with the state-owned Hindustan Aeronautics Limited (HAL) anchoring the aerospace hub in Bangalore. Historically, most of India's aircraft have been derived from foreign technology, particularly from the former Soviet Union; the Light Combat Aircraft (LCA), which had its first flight in 2001, was the first indigenous fighter produced in India in nearly 40 years.¹⁶² India is attempting to grow its domestic industry by promoting it as a low-cost outsourcing site. In addition, the Indian government imposes a minimum 30 percent offset requirement on all defense and state-owned enterprise civil aviation acquisitions valued over 300 crores (\$64.7 million at current exchange rates).¹⁶³¹⁶⁴

In response to complaints over a lack of transparency in the defense acquisition process, the Indian Ministry of Defense published the Defense Procurement Procedure 2006 (DPP) regulations in June 2006. The DPP provides comprehensive policy guidelines for all capital acquisitions for the Indian Armed Forces (IAF) to include Requests for Proposal (RFP), a notional schedule for the acquisition cycle, offset requirements, a list of acceptable Indian defense vendors for fulfilling offset requirements and a schedule of penalties for noncompliance with offset arrangements. The DPP therefore codifies not only the offset policy but the overall acquisition process. While India possesses significant market opportunities in both civil and defense aviation sectors, capitalizing on these opportunities requires millions of dollars of investment by foreign companies and strict adherence to the government's procurement

¹⁶⁰ http://www.buyusainfo.net/docs/x_4342293.pdf

¹⁶¹ http://www.boeing.com/commercial/cmo/southwest_asia.html

¹⁶² Sukumar R. Iyer. "LCA: Impact on Indian Defense." Bharat Rakshak Monitor. Vol 3(5) March-April 2001. <http://www.bharat-rakshak.com/MONITOR/ISSUE3-5/sukumar.html>

¹⁶³ <http://mod.nic.in/dpm/dpp2006.pdf>

¹⁶⁴ At an exchange rate of \$1 = 46.40 rupees, which is the Federal Reserve Bank of New York spot exchange rate in effect on December 31, 2009 at 12:00 PM. Available at http://www.federalreserve.gov/releases/h10/Hist/dat00_in.txt

procedures. The DPP was revised in 2008 and is scheduled for a further revision in 2010. The goal of the 2010 DPP is indigenous production of the majority of India's defense acquisitions.¹⁶⁵

Perhaps the single most critical factor that could limit growth of the domestic aviation industry is inadequate infrastructure. Problems persist across the system—air traffic control equipment is old and unreliable, there is not enough space to park airplanes or store cargo, and there are not enough area control centers to provide complete coverage of the airspace. Indian government officials have launched several multibillion dollar programs over the last several years to address problems throughout the country. One of these programs, announced in 2004, provided \$4 billion to upgrade the facilities at India's two main hubs, Mumbai and New Delhi, along with \$5 billion for 23 other non-metro airports.¹⁶⁶ A second program announced in 2006 made available \$12.5 billion for regional airport improvements.¹⁶⁷ As a result of these programs, a third runway was installed at New Delhi's Indira Gandhi International Airport to ease chronic congestion due to weather and growing passenger traffic, and significant upgrades were made to the airport's international terminals.¹⁶⁸ In Mumbai, land and facility constraints have compelled India's civil aviation authorities to commission the construction of a completely new facility to be named Navi Mumbai International Airport.¹⁶⁹ The new airport construction was approved in 2008 but has been delayed due to land acquisition and ecological issues. In January, 2010, however, Civil Aviation Minister Patel announced that construction bids for the new facility would be accepted within the next six months.¹⁷⁰ In addition to ongoing improvements in New Delhi and Mumbai, Bangalore and Hyderabad already have completely new, "greenfield" airports, and plans are underway to construct an additional 100 airfields in the next five years

In addition to infrastructure development initiatives launched by the Indian civil aviation authorities, the United States is also actively involved in aviation related cooperative ventures with the GOI. In April, 2007, the U.S-India Aviation Cooperation Program (ACP), a public-private partnership between the U.S. Trade and Development Agency (USTDA), the FAA and U.S. aviation companies, was established to provide a forum for unified communication between the Government of India and U.S. public and private sector entities in India. The ACP is designed to work directly with the Indian Government to identify and support India's civil aviation sector modernization priorities, and the organization serves as a mechanism through which Indian aviation sector officials can work with U.S. civil aviation representatives to highlight specific areas for technical cooperation. The ACP currently has over 30 active corporate members. In March, 2010, the United States and India established a Civil Aviation Subcommittee under the umbrella of the U.S.-India High Technology Cooperation Group (HTCG). The Civil Aviation Subcommittee of the HTCG meets on a regular basis to identify areas for U.S.-Indian civil aviation cooperation in a manner complementary to the ACP. An Airport Infrastructure Working Group (AIWG) established by the joint recommendations of the

¹⁶⁵ "In defence, take your time but hurry", available at <http://www.financialexpress.com/news/In-defence--take-your-time-but-hurry/605904/>

¹⁶⁶ See U.S. Commercial Service Market Research. http://www.buyusainfo.net/docs/x_866852.pdf

¹⁶⁷ "India Pushes \$12.5 billion Overhaul of Secondary Airports." *Aviation Daily*. February 24, 2006.

¹⁶⁸ "Delhi Airport Gets Third, and India's Longest, Runway" available at <http://www.nerve.in/news:253500158879>

¹⁶⁹ "Govt approves Navi Mumbai Airport", available at <http://www.india-server.com/news/govt-approves-navi-mumbai-airport-1135.html>

¹⁷⁰ "Tenders for navi Mumbai Airport Likely In 6 Months", available at <http://business.rediff.com/report/2010/jan/11/tenders-for-navi-mumbai-airport-in-6-mnths.htm>

HTCG Civil Aviation Subcommittee is a joint effort to promote U.S. private sector interest and investment in this \$20 billion market.

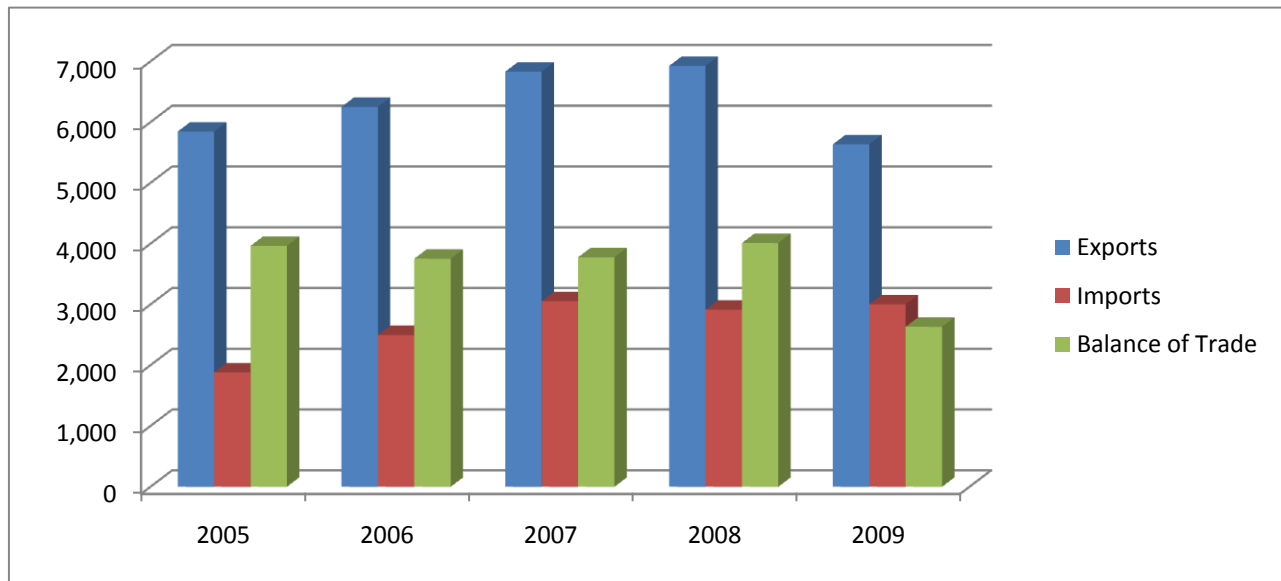
India has demonstrated a strong interest in the development of space technologies. The Indian Space Research Organization (ISRO) is the primary (government) vehicle for research and development, procurement and the provision of space-related services. ISRO built and operates the INSAT satellite system to provide television, meteorological, and telecommunications services. ISRO's Indian Remote Sensing (IRS) Satellite System provides satellite-imaging data for resource monitoring, infrastructure development, and exploration.

India has also developed two launch vehicles, the smaller PSLV rocket and the larger GSLV rocket, and is interested in partnering with foreign companies to expand its satellite technology. Once India enters the commercial launch market, India is likely to win an average of one launch per year, mainly through promotional pricing, package deals, and partnership programs with Europe.¹⁷¹ Because India's launch vehicles are limited in terms of capabilities and size, India likely will not gain a significant portion of the market in the short term. India will be able to launch U.S. commercial satellites once it has signed a commercial space launch trade agreement with the United States. By guaranteeing the protection of U.S. technology, these agreements will allow India to work with U.S. products, something that currently is prohibited.

India intends to expand its communications satellite production capabilities to capture some of the commercial market. The Indian Government has already manufactured several communications and remote sensing satellites for its own use. India is now actively seeking international customers. India is exploring joint ventures with U.S. and European companies to build communications satellites. The HTCG is exploring areas in which cooperation in the space sector can be increased between the two countries. Some areas likely to be considered in the future are space research and development, joint satellite production and launch services for U.S. satellites and/or components on Indian rockets.

¹⁷¹ "2007 Year in Review", Federal Aviation Administration, Office of Commercial Space Transportation, January, 2008.

Country Studies: Japan



U.S. aerospace trade with Japan in millions of dollars

Japanese aerospace companies have established themselves in the global aerospace industry as important manufacturers of a wide range of civil, military, and corporate aerospace products. They supply components and structures for a broad spectrum of commercial aircraft (especially Boeing and Airbus jet transports) and aircraft engines. Although they are respected as suppliers, Japanese firms have not been able to successfully produce a commercial transport aircraft. Despite its long history in aerospace manufacturing, Japan does not currently produce its own commercial aircraft and has never produced a commercial jet.

The last successful commercial aircraft produced in Japan was the YS-11 turbo-prop, which was discontinued in 1973.¹⁷² As a result, Japanese airlines import their aircraft, mostly from the United States.¹⁷³ Japan has been one of the top six markets for U.S. aerospace exports since 2001, and has accounted for \$36.94 billion in U.S. aerospace exports from 2004-2009.¹⁷⁴ In fact, Japan was the top U.S. aerospace export market in 2003, 2006, and 2008.¹⁷⁵ During the same period, Japan was one of the top six suppliers to the U.S. market of aerospace products, with sales of \$14.91 billion.¹⁷⁶

¹⁷² Kevin Done. "Mitsubishi to Market New Regional Jets." *The Financial Times*, October 9, 2007.

¹⁷³ Japanese customers have ordered 845 aircraft from Boeing compared to about 105 from Airbus. Data from Boeing and Airbus websites.

¹⁷⁴ International Trade Administration analysis of Census data. Available on the web at:

http://trade.gov/mas/manufacturing/OAAI/aero_stats.asp.

¹⁷⁵ *Ibid.*

¹⁷⁶ *Ibid.*

The Japanese aerospace industry is dominated by the four “heavies”: Mitsubishi Heavy Industries (MHI), Kawasaki Heavy Industries (KHI), Ishikawajima-Harima Heavy Industries (IHI), and Fuji Heavy Industries (FHI). These four companies, together with a wide range of smaller Japanese companies, employ around 30,967 aerospace workers.¹⁷⁷ While the “heavies” are widely diversified among strategic businesses such as industrial machinery, shipbuilding, electrical machinery, and automobiles, aerospace products make up a significant percentage of total sales for these companies. MHI, for example, derives 21 percent of its sales from its aircraft and defense component business.¹⁷⁸

The expansion into new civil aerospace markets has been aided significantly by financial support from the Japanese government, through groups like the International Aircraft Development Fund (IADF) made up of the four heavies and the Ministry of Economy, Trade, and Industry (METI).¹⁷⁹ For example, in 1996 the Japanese government provided ¥2.9 billion (\$24 million) to assist with Japanese participation in the Boeing 777 program, and ¥1.6 billion (\$13 million) for the International Aero Engines V2500 engine project.¹⁸⁰

For more than 50 years, Boeing has developed a uniquely close relationship with Japan as a customer, supplier and risk-sharing partner.¹⁸¹ Japan’s four “heavies,” for instance, produce components almost exclusively for Boeing.¹⁸² Furthermore, Japanese-manufactured parts and components make up significant portions of the Boeing 777, and Japanese companies have been identified as significant risk-sharing partners in Boeing’s new 787 program. Boeing also has extensive relationships with Japanese airlines. According to Boeing’s website, since 1958, Japan has ordered 901 Boeing airplanes.¹⁸³ Moreover, Boeing considers Japan’s airlines to be the company’s “largest wide-body customer,” views Japan overall as “one of [its] largest and most profitable commercial markets,” and claims an 85 percent share of the Japanese market.¹⁸⁴

Airbus has actively pursued partnerships with Japanese companies on new aircraft programs such as the A380, possibly in hopes of capturing a larger share of Japan’s large jet transport market. In 2002, seven Japanese suppliers, including MHI, FHI, and the Japan Aircraft Manufacturing Company, signed contracts to manufacture parts for the A380 over a period of 20

¹⁷⁷ “Aerospace Industry in Japan.” The Society of Japanese Aerospace Companies (SJAC). 2009.

¹⁷⁸ “Mitsubishi Heavy Industries, Ltd.” Available on the web at: <http://www.answers.com/topic/mitsubishi-heavy-industries-ltd>.

¹⁷⁹ The Japanese Ministry of International Trade and Industry (MITI) was the Japanese Government agency responsible for this activity prior to being reorganized into METI in 2001.

¹⁸⁰ The Society of Japanese Aerospace Companies (SJAC), 1998.

¹⁸¹ Mike Wiegand. “Toward a Common Benefit.” *Boeing Frontiers*, September 2008.

¹⁸² *Ibid.*

¹⁸³ Available on the web at:

<http://active.boeing.com/commercial/orders/index.cfm?content=displaystandardreport.cfm&pageid=m25062&RequestTimeout=100000>.

¹⁸⁴ Mike Wiegand. “A formula for success: What makes Japan important to Boeing—and vice versa?” *Boeing Frontiers*, September 2008.

years, for a total of \$850 million in components including cargo doors and parts of the tail.¹⁸⁵ By December 2008, the number of Japanese companies participating in the A380 program had increased to 21, with the components provided expanding to include parts of the airframe, engines, avionics, and landing equipment.¹⁸⁶

The Japanese aerospace industrial base is not limited to supplying other manufacturers. Japanese companies also produce complete small jet and turboprop aircraft and helicopters, military aircraft and trainers, and space launch vehicles. About 40 percent of Japanese-produced aircraft were sold to the Japanese Defense Agency in 2009 (compared to percent in 2008).¹⁸⁷ Often these aircraft are manufactured under technical license or in coordination with non-Japanese (mostly U.S.) companies. Many indigenous military aircraft programs have had relatively small production runs, in large part due to a 1967 Japanese government ban on military product exports. This continuing ban and shrinking domestic defense budgets have led Japanese companies to seek out new opportunities to participate in civil aircraft programs.

As an example of new opportunities in civil aircraft production, Japanese firms have been interested in entering the regional jet market, with firms expressing interest in the idea since at least 1991.¹⁸⁸ In the mid-1990s, a partnership between Mitsubishi and Bombardier to produce a 100 seat regional jet was discussed¹⁸⁹ but never came to fruition. In 2003, Mitsubishi launched a study, partly funded by the Japanese government, to explore the feasibility of a Japanese regional jet. Initially, the study focused on the 30-50 seat market, but by 2005 it had become clear that there was greater demand in the 70-90 seat market. By 2007, the Japanese government indicated that it would offer financial assistance totaling ¥40 billion for the aircraft's development, about 1/3 of the estimated cost.¹⁹⁰

MHI established Mitsubishi Aircraft Corporation (MAC) to undertake the design, type certification, procurement, sales and marketing and customer support. Mitsubishi began formally marketing the aircraft in October 2007 and by February 2008 had announced six partner suppliers.¹⁹¹ These supplies include U.S. manufacturers such as Parker Aerospace (hydraulic systems), Hamilton Sundstrand Corporation (electrical power system), and Rockwell Collins (flight control system) as well as the Japanese supplies Nabtesco Corporation (flight control

¹⁸⁵ "Airbus Picks Three More Suppliers from Japan for Its A380 Jet," *Wall Street Journal*, June 2002.

¹⁸⁶ "Aerospace Industry in Japan." SJAC, 2009.

¹⁸⁷ *Ibid.*

¹⁸⁸ Paul Proctor. "Japanese Firms Force Advanced Aircraft Industry." *Aviation Week and Space Technology*, July 29, 1991.

¹⁸⁹ Eiichiro Sekigawa and Michael Mecham. "Mitsubishi Sees 100-seater in Global Express' Wing," *Aviation Week and Space Technology*, August 26, 1996.

¹⁹⁰ Knight Ridder Tribune Business News. "Japan's First Jetliner to Get Financial Lift." June 1, 2007.

¹⁹¹ Joseph C. Anselmo. "Mitsubishi Nears Regional Jet Launch Decision." *Aviation Week and Space Technology*, February 14, 2007. Available on the web at:

http://www.aviationweek.com/aw/generic/story_channel.jsp?channel=comm&id=news/MRJ02148.xml&headline=Mitsubishi%20Nears%20Regional%20Jet%20Launch%20Decision.

system) and Sumitomo Precision Products Co., Ltd. (landing gear).¹⁹² In addition, Pratt & Whitney will supply the Geared Turbofan engines, a next-generation model that will help the aircraft achieve a 20-30 percent savings in fuel consumption over current regional jets while substantially lowering emissions and noise.¹⁹³ MAC also signed a deal with Boeing to receive assistance with aircraft development, sales and customer support.

The program was officially launched on March 28, 2008.¹⁹⁴ All Nippon Airways (ANA) placed orders for 25 aircraft (15 firm, 10 options), and Trans States Holding (an airline holding company based in St. Louis, Missouri) ordered 100 aircraft (50 firm, 50 options). To accommodate design changes for the cabin and the wing box, the first flight of the MRJ has been delayed until the second quarter of 2012, and the first delivery has been delayed until the first quarter of 2014.¹⁹⁵

Mitsubishi had hoped that the expertise it gained in composites while working on the Boeing 787 would help distinguish its planned regional jet from its competitors' offerings (primarily Brazil's Embraer and Canada's Bombardier), which are already on the market or are nearing flight-testing phase. Mitsubishi's jet would have been the first regional jet "to adopt composite materials for its wings and vertical fins on [a] significant scale."¹⁹⁶ Instead, the MRJ will have aluminum instead of carbon fiber composites for the aircraft's wings, resulting in only 10 to 15 percent of the total airframe (empennage, horizontal tail, and vertical tail) being made from composite materials.¹⁹⁷ MAC claims that aluminum wings will allow for faster and less difficult structural changes as well as easier optimization (such as through weight reduction and larger winglets).¹⁹⁸

¹⁹² *Ibid.*

¹⁹³ *Ibid.*

¹⁹⁴ "MHI Officially Launches Mitsubishi Regional Jet Program." Available on the web at: <http://www.mhi.co.jp/en/news/story/200803281230.html>.

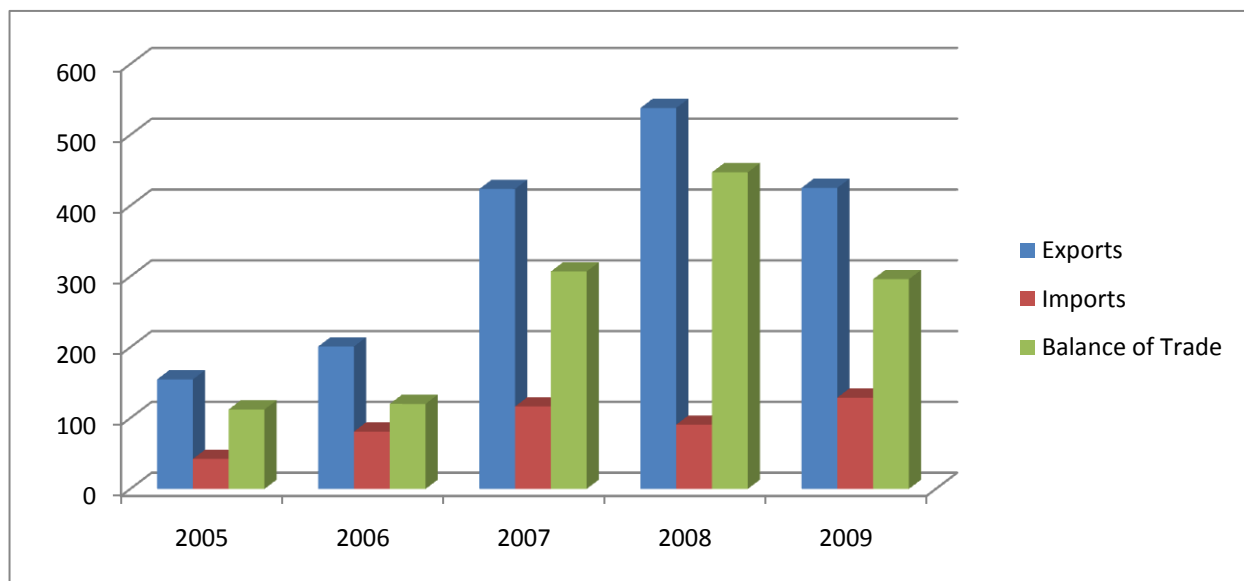
¹⁹⁵ Gregory Polek. "Mitsubishi To Delay MRJ First Flight." *Aviation International News*, September 9, 2009. Available on the web at: <http://www.ainonline.com/news/single-news-page/article/mitsubishi-to-delay-mrj-first-flight-22023/>

¹⁹⁶ *Ibid.*

¹⁹⁷ Siva Govindasamy. "AA09: Mitsubishi unveils major changes to MRJ programme." *Flight Daily News*, September 9, 2009. Available on the web at: <http://www.flightglobal.com/articles/2009/09/09/332045/aa09-mitsubishi-unveils-major-changes-to-mrj-programme.html>

¹⁹⁸ *Ibid.*

Country Studies: Russia



U.S. aerospace trade with Russia in millions of dollars

The Russian aviation industry has undergone a dramatic transformation designed to position it as a formidable competitor to the aviation industries of the United States and the EU. As recently as 2005, the Russian aviation industry could be characterized as a post-USSR era industry comprised of separate state and privately held manufacturers and design bureaus with limited cooperation in research and development, design, manufacture, sales and marketing. In 2006, however, the Government of Russia began a program to consolidate the majority of the industry's aerospace companies under a central, state owned joint stock company, the United Aircraft Corporation (UAC). The outlook for the Russian aviation industry is for continued consolidation under the UAC enterprise, increased cooperation with U.S. and EU aviation companies through parts and materials supply agreements, engineering and design services, and joint production through licensing agreements and joint ventures. Russia is also a key supplier of raw materials—especially titanium—used in Western aerospace production.

In the immediate post-USSR era, the Russian aviation industry found itself unable to compete with U.S. and European companies for market share. Both domestically and abroad, Russian aircraft makers were constrained with a product line that was non-competitive in comparison to aircraft produced by established competitors like Boeing and Airbus. By 2005, Russia's entire civil aviation industry was building on average a total of 10 aircraft per year. In comparison, in 2005 Boeing and Airbus booked over 1,000 orders each for new aircraft.¹⁹⁹ At the same time, Russian domestic demand for civil aircraft was quite high and growing. According to the Russian Transport Ministry, by 2005, of 2,528 total civil aircraft currently in service, more than one-half had passed their legal operational limits and needed to be replaced. In addition, industry experts forecast that Russian airlines would need at least 620 long- and medium-haul aircraft in the next 20 years.

¹⁹⁹ http://www.businessweek.com/bwdaily/dnflash/jan2006/nf20060117_9445_db039.htm

Faced with the reality of a rapidly aging civil aircraft fleet and no viable domestic industry to fulfill demand, Russia was faced with two choices: they could fill the country's aircraft needs with western sourced aircraft or attempt to ramp up Russian domestic production to meet their own needs, while also becoming a player in the international civil aircraft market. Rather than cede this vital sector to the West, President Putin decided on the latter option. In 2005, President Putin directed the formation of the Government Commission for Integration of Aircraft Building Enterprises in the Russian Federation. The Commission was charged with the responsibility of developing a plan to revitalize the Russian aviation industry and concluded that the best and most effective road to global competitiveness would be to consolidate the country's mostly state-owned aviation companies. On November 2, 2006, the Commission announced its decision to establish an open joint stock company that would consolidate many of the state-owned aerospace companies under a single entity, the United Aircraft Corporation (UAC).

The UAC Board of Directors is chaired by Deputy Chairman of the Government of the Russian Federation Sergei Ivanov. Ivanov has functioned as a "troubleshooter" for former President (now Prime Minister) Putin on a number of high-profile tasks to include oversight and improvement of the country's aviation safety system. UAC's supervisory board selected Alexei Fedorov, former general director of jet manufacturer RSK MiG, as the company's President and General Director.²⁰⁰ In this capacity, Fedorov is responsible for day-to-day operations of the consolidated entity. In addition to the two top spots, UAC's board includes representatives from the various consolidated companies, government and non-aviation industrial members, particularly from the financial sector.

UAC Director Fedorov has stated that he expects UAC to become the world's third largest aircraft manufacturer by 2015.²⁰¹ To accomplish this goal, UAC has entered into a variety of cooperation agreements with its direct competitors and suppliers.²⁰² Specifically, UAC has signed agreements with Boeing and EADS for design, manufacturing and sales/marketing cooperation, Alenia Aeronautica of Italy for sales and marketing of UAC products, and Hindustan Aeronautics Limited of India for joint design and production of civil and military aircraft.

Russia has also brought the country's helicopter industry under a single, majority state-owned entity. In November 2004, President Putin issued a decree directing the assets of Russia's helicopter industry to be consolidated under OPK Oboronprom's Helicopter Group. A diverse corporation with multi-sector investments in high technology and defense, OPK Oboronprom assumed the assets of the various member companies under its newly established Helicopter

²⁰⁰ On October 1, 2007, Alexei Fedorov resigned from his post as general director and general designer of RSK MIG. He was replaced on an interim basis by Sergei Tsivilev, first deputy director general of the company. Tsivilev was investigated by Russia's Prosecutor General for fraud in conjunction with an alleged sale to Poland of counterfeit parts for MiG-29 aircraft but was not ultimately charged. <http://www.themoscowtimes.com/stories/2007/10/02/061.html>; http://www.kommersant.com/p731704/MiG_director_criminal_case/. Tsivilev was succeeded by Mikhail Pogosyan, who also retained his position as general director of JSC Sukhoi. <http://www.migavia.ru/eng/news/?page=1&tid=4&id=40>

²⁰¹ Moscow International Aviation and Space Salon 2007 Show Program interview with Alexei Fedorov, President of United Aircraft Corporation

²⁰² "Alcoa, United Aircraft Corporation Sign Technology Cooperation Agreement" available at http://www.alcoa.com/global/en/news/news_detail.asp?newsYear=2007&pageID=20070822005466en

Group. OPK Oboronprom is majority owned by the government (51 percent) and its members include all major Russian helicopter manufacturers. OPK Oboronprom is headed by Andrey Reus, former Deputy Minister of Industry and Energy.²⁰³

Russian aviation companies have aggressively pursued agreements to supply materials, parts, and engineering services for Western commercial aircraft and engine manufacturers.²⁰⁴ Boeing has invested more than \$1.3 billion²⁰⁵ into Russian joint ventures since the early 1990s and plans to bring that total to \$2.5-\$3 billion by the end of 2010.²⁰⁶ This investment has enabled Boeing to tap into the vastly underutilized expertise of Russian aerospace experts who have extensive experience. The Boeing Design Center in Moscow employs Russian engineers to work in research, materials, design, information technology, and modification work on the 777, the 787, and other commercial aircraft models.

The European aviation industry has also been active in Russia. In July 2001, Airbus's parent company, EADS, signed a cooperation agreement with the Russian Aerospace Agency and agreed to invest more than \$2 billion in the Russian aerospace industry over a ten-year period.²⁰⁷ The agreement calls for a broad range of cooperative projects, including Russian participation in the A320, A380, and other Airbus projects.

Russian manufacturers are also seeking partnerships and cooperative ventures with Western manufacturers to help them develop new aircraft. For example, Pratt & Whitney entered into a strategic partnership with Perm Motors Joint Stock Company, which is developing an internationally compliant upgrade to the widely used PS-90A engine in Russia.²⁰⁸ In 2004, Boeing entered into a contract with Russian manufacturer Sukhoi to help develop and market the Superjet 100, which is designed to replace aging Russian aircraft and is intended to compete worldwide with regional jet aircraft from Bombardier and Embraer.²⁰⁹ Although the capability of Russia's aviation industry in the areas of design and manufacturing is not in doubt, the country's ability to deliver the level of marketing and customer support needed to successfully export civil aircraft is more uncertain. To that end, Sukhoi Civil Aircraft and Alenia Aeronautica, a part of Italy's Finmeccanica group, formed the Superjet International joint venture to provide marketing and customer support in Western Europe, North America and South America. Snecma Moteurs of France is developing the engine in a 50/50 joint venture with NPO Saturn JSC, with French government assistance worth €250 million.²¹⁰ After numerous delays, commercial delivery of the first Superjet is scheduled for the end of 2010 to launch customers Aeroflot and Armavia.²¹¹

²⁰³ <http://www.oboronprom.com/en/show.cgi?/corporation/about.htm>

²⁰⁴ http://www.boeing.com/commercial/777family/pf/pf_background.html

²⁰⁵ http://www.boeing.com/news/releases/2002/q3/nr_020805a.html

²⁰⁶ "Boeing to invest \$2.5-\$3 billion in Russian Aircraft Industry." Russian News and Information Agency. <http://en.rian.ru/business/20050427/39749807.html> April 27, 2005.

²⁰⁷ "Negotiations between EADS and Russian Aerospace Agency Rosaviakosmos Finalised," EADS press archives, July 2, 2001, <http://www.eads.net>

²⁰⁸ "Pratt & Whitney in Russian Gas Turbine Accord," Dow Jones Newswires, August 9, 2000.

²⁰⁹ "Sukhoi picks up pace on RRJ," *Concise B2B Aerospace*, June 17, 2003.

²¹⁰ "Paris Breathes New Life into Jet Project", *The Moscow Times*, September 20, 2004.

²¹¹ "Sukhoi Superjet 100 Completes Cold-soak Trials", available at <http://www.ainonline.com/news/single-news-page/article/sukhoi-superjet-100-completes-cold-soak-trials-24210/>

UAC's newest aircraft is the MS-21, a twin-engine, single-aisle, medium-range family of passenger aircraft currently in development and intended to directly compete with third generation Boeing 737 aircraft and the second generation of Airbus A320 aircraft families beginning in 2016. This new aircraft family is intended to transport passengers and cargo over national and international routes. UAC is actively pursuing international suppliers for the MS-21, with U.S. manufacturers Goodrich, Hamilton-Sundstrand, Pratt & Whitney, Rockwell Collins, Eaton Aerospace and Kidde Aerospace & Defense all providing components for the aircraft.²¹²

²¹² http://www.airframer.com/aircraft_detail.html?model=MS-21