



# U.S. Aerospace Manufacturing: Industry Overview and Prospects

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## Summary

Aircraft and automobile manufacturing are considered by many to be the technological backbones of the U.S. manufacturing base. As the Obama Administration and Congress debate how to strengthen American manufacturing, aerospace is likely to receive considerable attention. Like other manufacturing industries, the worldwide recession has affected aerospace manufacturing, with both the defense and commercial sides of the industry facing difficult business conditions for the near and medium term. This report primarily provides a snapshot of the U.S. commercial (non-defense, non-space) aerospace manufacturing industry and a discussion of major trends affecting the future of this industry.

The large commercial jet aviation market is a duopoly shared by the U.S. aircraft manufacturer Boeing and the European aircraft maker Airbus, with fierce competition between these two companies. The regional jet market is dominated by two non-U.S. headquartered manufacturers, Brazil's Embraer and Canada's Bombardier, both of which utilize a high level of U.S.-produced content in their products. The general aviation market includes companies such as Cessna and Gulfstream.

Aerospace manufacturing is an important part of the U.S. manufacturing base. It comprised 2.8% of the nation's manufacturing workforce in 2008 and employed over 500,000 Americans in high-skilled and high-wage jobs. More than half (61%) of the nation's aerospace industry jobs are located in six states: Washington state, California, Texas, Kansas, Connecticut, and Arizona. Several smaller aerospace manufacturing clusters are found in states such as Florida, Georgia, Ohio, Missouri, and Alabama. Other aerospace centers are beginning to emerge in southern states, such as South Carolina, where Boeing is now building a second production line to produce the 787 Dreamliner. Aerospace manufacturing contributes significantly to the U.S. economy, with total sales by aerospace manufacturers (including defense and space) comprising 1.4% of the U.S. gross domestic product in 2008.

U.S. aircraft manufacturers depend heavily on the international market for their sales. The aerospace industry sold more than \$95 billion in aerospace vehicles and equipment (including defense and space) to overseas customers in markets such as Japan, France, Germany, and the United Kingdom, and imported over \$37 billion in aerospace products from abroad, providing a significant positive contribution of \$57.7 billion to the U.S. trade balance in 2008. Increasingly, other markets are becoming important as an opportunity to increase U.S. sales, but also because of the potential for future competitors to challenge the U.S. aerospace industry's competitive position. U.S. aerospace exports to China have increased since 2003, totaling \$5.5 billion in 2008. At the same time, some analysts maintain that China could become a global competitor in the commercial aerospace market. Already, China is working to develop airplanes that could become globally competitive in both the regional jet and large commercial jet aviation market. Russia has stated that it wants to become the world's third-largest aircraft manufacturer by 2015.

Congress has been discussing issues affecting the competitiveness of the U.S. aerospace manufacturing industry for most of this decade. Among the concerns and issues affecting the future of the commercial sector of the industry are export control policies, environmental concerns, and an aging aerospace workforce. Additionally, the United States and the European Union are engaged in a long-running trade dispute over subsidies, with each side claiming the other subsidizes its domestic companies.

## **Contents**

Introduction .....	1
Aerospace Manufacturing Industry Overview .....	1
Aerospace Manufacturing Workforce .....	1
Economic Impact of Aerospace Manufacturing .....	2
Aerospace Trade .....	3
The Commercial Jet Aircraft Market .....	4
The Regional Jet Market .....	6
The General Aviation (GA) Aircraft Market .....	7
Potential Future Competition in the Aircraft Manufacturing Sector .....	8
Public Policy Issues .....	8
Export Controls .....	9
Environmental Concerns .....	9
Aerospace Workforce Issues .....	9

## **Tables**

Table 1. Boeing and Airbus Net Orders and Deliveries, 2000-2009 .....	5
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## **Contacts**

Author Contact Information .....	10
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## Introduction

Like other manufacturing industries, the worldwide recession is weighing heavily on aerospace manufacturing. This is especially true for commercial aerospace companies and their suppliers, which are being buffeted by the significant decline in global air travel, resulting in a sharp drop in new orders for aircraft and parts. The aerospace industry's commercial side anticipates difficult business conditions for the near and medium term, but long-term projections by Boeing, for instance, are positive, with airlines expected to need 29,000 new planes valued at \$3.2 trillion between 2009 and 2028.<sup>1</sup> For now, the defense segment of the aerospace sector has offset the downward trend because it still benefits from continuing government expenditures for military aircraft. Aerospace industry analysts nonetheless predict that there could be tough times ahead for producers of military aircraft. The international market for aerospace manufacturing is also rapidly changing, and it raises the question of what impact nascent competitors in countries such as China and Russia will possibly have on the future competitiveness of U.S. aircraft manufacturers.

## Aerospace Manufacturing Industry Overview

### Aerospace Manufacturing Workforce

As an industry, aerospace manufacturing in 2008 directly supported over 500,000 high-skilled and relatively well-paid private sector manufacturing jobs nationwide.<sup>2</sup> The private sector aerospace manufacturing workforce in 2008 earned an average wage of \$79,700, or about 47% more than the annual average manufacturing wage of \$54,400. Many jobs in aerospace manufacturing require at least a bachelor's degree in a specialized technical field such as engineering, which largely explains the significant wage differential. As a result of collective bargaining agreements negotiated by major aerospace unions, including the International Association of Machinists and Aerospace Workers and the Society of Professional Engineering Employees in Aerospace, 21% of aerospace workers were union members or covered by union contracts in 2006, compared with 13% of all workers throughout private industry.<sup>3</sup>

The U.S. aircraft manufacturing industry is composed of major firms such as Boeing, United Technologies, Northrop Grumman, Gulfstream Aerospace, and Textron, among others. Established aerospace manufacturing centers are located in Washington state, California, Texas, Kansas, Connecticut, and Arizona (with a combined workforce of more than 305,000 in 2008, comprising over 60% of the aerospace workforce nationwide). Aerospace manufacturing clusters are also present in Florida, Georgia, Ohio, Missouri, and Alabama.

Other states, such as South Carolina, are also seeking to increase their aircraft manufacturing production base. In October 2009, Boeing announced it would locate a second final production

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<sup>1</sup> Boeing, *Current Market Outlook 2009-2028*, 2008, <http://www.boeing.com/commercial/cmo/>.

<sup>2</sup> These statistics are from the Bureau of Labor Statistics Quarterly Census of Employment and Wages, and cover private sector aerospace products and parts manufacturing employment based on NAICS code 3364 (aerospace products and parts manufacturing). <http://www.bls.gov/cew/>.

<sup>3</sup> Bureau of Labor Statistics, *Aerospace Product and Parts Manufacturing*, Career Guide to Industries, 2008-09 Edition, <http://www.bls.gov/oco/cg/home.htm>.

assembly line in North Charleston, South Carolina,<sup>4</sup> to produce its new 787 mid-sized aircraft, dubbed the Dreamliner. Ground was broken on the Boeing Charleston plant in November 2009, with the production line expected to be operational in July 2011 and delivery of the first plane scheduled for the first quarter of 2012.<sup>5</sup> Boeing anticipates the South Carolina facility will add over 3,800 new jobs within seven years.<sup>6</sup> This would be a significant jump for the state's aerospace manufacturing industry, which currently accounts for less than 1% of South Carolina's manufacturing workforce.<sup>7</sup>

## Economic Impact of Aerospace Manufacturing

For the most part, the ongoing contraction in aerospace manufacturing does not appear in the 2008 data used predominately in this report since the full impact of the economic downturn did not hit the U.S. economy until late 2008. However, the effects have been felt strongly on the commercial side of the industry, and the end of production of key aircraft platforms such as the F-22 and C-17 bodes ill for defense aircraft manufacturing.

The aerospace industry by its very nature is cyclical—with industry-specific cycles seemingly occurring approximately every 10 years—and highly susceptible to changing international situations and market forces that are often beyond its control. Commercial aircraft manufacturing sales are directly tied to the health of the airline industry, and a host of factors can influence demand for air travel, including increased economic activity, regional conflicts, terrorism, and disease outbreaks.

Full-year 2009 aerospace industry sales statistics are presently unavailable from the aerospace industry trade group, the Aerospace Industries Association (AIA),<sup>8</sup> or from government sources, but many believe considerable evidence indicates a weakening aircraft market, which most likely will reverse the strong market upturn and the lucrative period for aerospace manufacturing that extended back to 2003. Aerospace manufacturing, unlike other industries, entered the current recessionary period from a strong starting position, with limited debt and a strong backlog of orders, according to AIA.

AIA in its 2008 Year End Review and 2009 Forecast reported an increase in industry-wide estimated sales of \$204.4 billion in 2008, compared to \$200.3 billion in 2007 (in current U.S. dollars). As of 2008, aerospace manufacturing by sales accounted for 1.4% of U.S. gross domestic product (GDP). This was down from 1.5% in 2000 and 1.7% in the late 1990s.<sup>9</sup>

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<sup>4</sup> Boeing, "Boeing to Place Second 787 Assembly Line in North Charleston, South Carolina," press release, October 28, 2009, <http://boeing.mediaroom.com/index.php?s=43&item=906>.

<sup>5</sup> Gates, Dominic, "Boeing Re-Creating Local Plants in S.C.," *The Seattle Times*, October 29, 2009, [http://seattletimes.nwsourc.com/html/boeingaerospace/2010156801\\_boeing29.html](http://seattletimes.nwsourc.com/html/boeingaerospace/2010156801_boeing29.html)

<sup>6</sup> Sanders, Peter, "Boeing Breaks Ground on Dreamliner Plant," *Wall Street Journal*, November 20, 2009.

<sup>7</sup> The statistics for South Carolina are from the Bureau of Labor Statistics Quarterly Census of Employment and Wages, and cover private sector aerospace products and parts manufacturing employment based on NAICS code 3364 (aerospace products and parts manufacturing). <http://www.bls.gov/cew/>.

<sup>8</sup> The Aerospace Industries Association is the industry trade group representing more than 100 aerospace and defense companies. <http://www.aia-aerospace.org/>.

<sup>9</sup> "Aerospace Summary," in *Aerospace Facts & Figures*, 56<sup>th</sup> ed. (Washington, DC: Aerospace Industries Association, 2009), p. 14.

The commercial market and defense market are the two major industry segments that comprise aerospace manufacturing. Commercial aircraft and parts shipments totaled \$96.6 billion in 2008, comprising 63% of total industry shipments, down 4% over 2007, which was a change in direction from the positive growth recorded in commercial aerospace manufacturing shipments dating back to 2003.<sup>10</sup> At the same time, new orders in 2008 for civil aircraft and parts fell for the first time since 2003, dropping from \$184.5 billion to \$124.1 billion between 2007 and 2008, down by 33%.

Defense is the smaller of the two, and this segment depends on the U.S. government for a significant share of its sales. Government agencies including the Department of Defense (DOD) and the National Aerospace and Space Administration (NASA) are the aerospace industry's single largest customers. Defense aircraft and parts accounted for 37% of total aircraft and parts shipments of \$152.4 billion in 2008.<sup>11</sup> These shipments were up 40% year-over-year between 2007 and 2008, rising from \$39.7 billion to \$55.8 billion. The strength of this segment is an important offset during downturns because aerospace companies can often rely upon government business to buoy the commercial sector through its cyclical highs and lows.

Aerospace products and parts, including aircraft engines made by firms such as General Electric and United Technologies, are manufactured at large production facilities and hundreds of smaller, but not necessarily small, manufacturers, which are suppliers of parts and components to U.S. and overseas aerospace manufacturers.<sup>12</sup> Main suppliers include the privately held Vought Aircraft Industries, a major subcontracting partner on many commercial and military aircraft programs.<sup>13</sup> Other supplier firms would include Spirit AeroSystems, a major supplier of commercial assemblies and components,<sup>14</sup> and Crane Corporation, a designer and manufacturer of critical systems and components to the aerospace and defense markets.<sup>15</sup>

## Aerospace Trade

For many decades, the U.S. large commercial jet manufacturing industry was dominant worldwide. Today, the world market has evolved into the highly competitive duopoly of Airbus and Boeing. At the same time, the U.S. aircraft industry now depends on many non-U.S. firms for contributions to their own products. Parts of Boeing's newest aircraft, the 787 Dreamliner, have been outsourced to a global supplier network including firms in Australia, Canada, China, Italy, and Japan. Of concern to many lawmakers in the large commercial aircraft market segment is the current dispute pending before the World Trade Organization (WTO) between Airbus and Boeing. The unfair subsidization case, which dates back to a May 30, 2005, WTO filing by the United States, alleges that member states of the European Union (EU) provided Airbus with illegal subsidies from 1970 to 2004, thus giving the European aircraft manufacturer an unfair advantage

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<sup>10</sup> U.S. Census Bureau, *Manufacturers' Shipments, Inventories, & Orders*, Washington, DC, [http://www.census.gov/manufacturing/m3/historical\\_data/index.html](http://www.census.gov/manufacturing/m3/historical_data/index.html). The Manufacturers Shipments, Inventories, & Orders (M3) survey is based on approximately 4,300 reporting units and provides an indication of the business activity in various manufacturing sectors, including the aerospace manufacturing sector.

<sup>11</sup> Ibid. These figures are not adjusted for inflation.

<sup>12</sup> AIA claims that there are over 30,000 aerospace suppliers in the United States.

<sup>13</sup> Vought Aircraft Industries, Inc., *Vought Aircraft Industries, Inc—At a Glance*, 2009, <http://www.voughtaircraft.com/newsFactGallery/factsheets/company/atGlance.htm>.

<sup>14</sup> Spirit AeroSystems, *About Us*, [http://www.spiritaero.com/about\\_us.aspx](http://www.spiritaero.com/about_us.aspx).

<sup>15</sup> Crane Aerospace & Electronics, *About Us*, <http://www.craneae.com/>.

in the large commercial aircraft market.<sup>16</sup> The counterclaim by the EU is that Boeing received billions of dollars in industrial subsidies by way of research and development programs dating back to the 1980s through U.S. military and space programs, along with state-level tax breaks.

Aerospace manufacturers like Boeing depend heavily on the international market for sales. For example, about 70% of Boeing's commercial airplane sales (by value) are sold to customers outside the United States.<sup>17</sup> Industry-wide exports (including defense and space products) by U.S. manufacturers of aerospace vehicles and equipment increased for five consecutive years, from \$53 billion in 2003 to \$97.4 billion in 2007. This growth was followed by a slight decrease in aerospace exports in 2008, dropping 2%, according to data compiled by the U.S. Department of Commerce.<sup>18</sup> Japan, France, the United Kingdom, Canada, and Germany were the top five export markets for U.S. aerospace products in 2008, accounting for 36.2% of total aerospace exports worldwide. Outside of these major markets, the United States increased its aerospace vehicle and equipment exports to emerging markets such as Brazil and China. U.S. aerospace exports to China more than doubled between 2003 and 2008, growing from \$2.7 billion to \$5.5 billion. U.S. aerospace exports to Brazil rose 320% during the same time period, to \$5.8 billion. France, Canada, the United Kingdom, Germany, and Japan were the leading aerospace suppliers to the United States in 2008, accounting for almost 75% of all aerospace imports, for a total of \$27.9 billion. U.S. aerospace exports made a contribution to reducing the U.S. merchandise trade deficit by offsetting deficits in other areas of trade. The U.S. aerospace industry trade balance stood at over \$57 billion in 2008.

## The Commercial Jet Aircraft Market

Boeing and Airbus entered the ongoing recessionary period with a considerable backlog of undelivered aircraft on their books (Airbus recorded a backlog of 3,715 and Boeing 3,714).<sup>19</sup> Both firms have continued to deliver significant numbers of new aircraft to their airline and/or leasing firm customers, and both are profitable. Boeing posted revenues of \$60.9 billion and Airbus recorded revenues of \$38.7 billion in 2008. Nonetheless, the recession is affecting both producers. In 2008, net orders fell for both Boeing and Airbus (see **Table 1**). For the first three quarters of 2008, Airbus and Boeing received total new orders of 785 airplanes and 625 airplanes, respectively.<sup>20</sup> For the same period in 2009, these numbers have dropped to 149 and 181. There are expectations both firms will have to significantly reduce their aircraft production rates at some point to correspond with this decrease in new orders. By one view, there is a growing supply of surplus aircraft in this market sector and it will take years for this surplus to be absorbed by a global airline industry currently operating at reduced capacity.<sup>21</sup>

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<sup>16</sup> On September 4, 2009, a WTO interim panel issued its findings, which were not made public, but which some industry observers believe found that the EU had engaged in some form of illegal subsidy of its industry.

<sup>17</sup> Boeing, *The Boeing Company Overview*, November 15, 2007, p. 5, <http://www.montana.edu/wwwcp/Virtual%20Library/Boeing.pdf>.

<sup>18</sup> Office of Transportation and Machinery, International Trade Administration, U.S. Department of Commerce, *Aerospace Statistics, Domestic Exports of Aerospace Vehicles and Equipment*, Washington, DC, [http://trade.gov/wcm/groups/internet/@trade/@mas/@man/@aai/documents/web\\_content/aero\\_stat\\_exp\\_1989.pdf](http://trade.gov/wcm/groups/internet/@trade/@mas/@man/@aai/documents/web_content/aero_stat_exp_1989.pdf).

<sup>19</sup> Lazzaro, Joseph, "Biggest Headwind Boeing, Airbus Face These Days is Recession," *BloggingStocks*, January 16, 2009, [http://www.bloggingstocks.com/2009/01/16/biggest-headwind-boeing-airbus-face-these-days-is-the-recession/?icid=sphere\\_blogsmith\\_inpage\\_bloggingstocks](http://www.bloggingstocks.com/2009/01/16/biggest-headwind-boeing-airbus-face-these-days-is-the-recession/?icid=sphere_blogsmith_inpage_bloggingstocks).

<sup>20</sup> SpeedNews, *SpeedNews Commercial Jet Aircraft Program Status: September 30, 2009*, <http://www.speednews.com>.

<sup>21</sup> Anselmo, Joseph C., "Analysis: Bloated Jet Capacity Seen Forcing Production Cuts," *Aviation Daily*, September 17, (continued...)

Another possible sign of trouble for commercial jet manufacturers could be the evolving economic and financial crisis in Dubai. Boeing and Airbus rely on the Middle Eastern market for sales of their aircraft, particularly to the region's large airlines such as Fly Emirates, the national airline of Dubai. Emirates is one of the largest customers for the Airbus A380, with 58 orders.<sup>22</sup> Less exposed is Boeing, but nonetheless it has 23 unfilled orders on its books with Emirates through October 2009 for its 777 aircraft.<sup>23</sup> It is too early to predict what the economic turmoil in Dubai could mean for the orders of these aircraft or for future orders.

Boeing and Airbus both have substantial backlogs of orders on their books built up beginning in 2003. Industry analysts say that Boeing is working on a seven-year backlog and Airbus on a six-year backlog.<sup>24</sup> Both have slowed production lines for 2009, and the trend may continue through 2010 or 2011, but many analysts expect this hiatus to be temporary. Boeing's market projections indicate an average annual fleet growth of 3.2% and cargo growth rates of 5.4% from 2009 through 2028. The long-term trajectory for all aircraft manufacturers appears to be strong, with the global market absorbing 29,000 new commercial passenger and freight airplanes valued at \$3.2 trillion by 2028 due to such factors as volatile fuel prices, aging fleets, and environmental concerns.<sup>25</sup>

**Table 1. Boeing and Airbus Net Orders and Deliveries, 2000-2009**

	Net Orders		Deliveries	
	Boeing	Airbus	Boeing	Airbus
2000	588	520	491	311
2001	314	375	527	325
2002	251	300	381	303
2003	239	284	281	305
2004	272	370	285	320
2005	1,002	1,111	290	378
2006	1,044	824	398	434
2007	1,413	1,458	441	453
2008	662	900	375	483
2009 <sup>a</sup>	195	151	394	399

**Source:** Boeing, <http://active.boeing.com/commercial/orders/index.cfm>, and Airbus, [http://www.airbus.com/en/corporate/orders\\_and\\_deliveries/](http://www.airbus.com/en/corporate/orders_and_deliveries/).

a. 2009 data are through October 31, 2009.

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2009, p. 4.

<sup>22</sup> Airbus, *Summary of Orders & Deliveries*, October 2009, [http://www.airbus.com/en/corporate/orders\\_and\\_deliveries](http://www.airbus.com/en/corporate/orders_and_deliveries).

<sup>23</sup> Boeing, *Orders and Deliveries*, October 2009, <http://active.boeing.com/commercial/orders/index.cfm?content=displaystandardreport.cfm&pageid=m25066&RequestTimeout=20000>.

<sup>24</sup> Lagorce, Aude, "Aircraft Makers Plug their Ears. Crisis? What Crisis?," *MarketWatch*, June 14, 2009, <http://www.marketwatch.com/story/aircraft-makers-look-to-order-backlog-as-lifeline>.

<sup>25</sup> Boeing, *Current Market Outlook 2009-2028*, 2009, <http://www.boeing.com/commercial/cmo/index.html>.



For the near and medium term, however, both manufacturers have other issues that will affect their financial performance. The Boeing 787 program is now over two years behind its delivery schedule, originally slated for rollout on July 8, 2007. In part, the delay is viewed by many as being related to problems associated with the highly advanced composite technology that Boeing is incorporating into the aircraft. But many observers also believe the delays are due to the heightened level of outsourcing and concomitant international risk-sharing that Boeing built into the 787. Boeing has a large undelivered backorder of 840 of these planes valued at \$140 billion,<sup>26</sup> but until it starts delivering these aircraft in significant numbers the program will remain a drain on its profitability.

Airbus had a similar experience with its A380 aircraft program earlier in this decade. Although now in production (19 had been delivered as of October 2009), the world's largest commercial aircraft was delayed for years and it is unlikely that deliveries to date have come anywhere close to recouping the costs of developing that aircraft. Airbus is also in the process of developing a competitor aircraft for the 787 and 777, the A350 XWB, a long-range, mid-size, extra-wide-body airplane. Airbus is taking orders for the aircraft (reporting that it has more than 500 orders from 32 customers),<sup>27</sup> but deliveries are still well off, with the expectation that the first planes will be delivered in 2013, meaning that the A350 XWB program will also be a negative draw on the firm's finances for some years to come.

## **The Regional Jet Market**

Just like the large commercial aircraft market, the regional jet (RJ) market—typically considered to be commercial jet aircraft with up to 100 seats—depends on the recovery of the airline industry, and it is in a period of prolonged downturn. No U.S.-based firm produces RJs. Canada's Bombardier and Brazil's Embraer are the two major manufacturers of these aircraft, and they now control the market. More recently, deliveries of RJs have slowed. Save for one large order for the as-yet-to-be-built 100- to 130-seat Bombardier C Series aircraft (50 units), with an anticipated entry into service date of 2013,<sup>28</sup> neither manufacturer would have had more than 20 new orders for the first three quarters of 2009.<sup>29</sup> This is a major drop from the 2008 level for the same period of over 200 new orders. Some industry analysts believe the natural annual market for RJs is around 200 aircraft. Regardless of the non-U.S. manufacture of these airframes, RJs represent an important market for the U.S. aerospace manufacturing sector, which provides these manufacturers with engines, landing gear, avionics, and a wide range of other components. One research group, Forecast International, projects that between 2009 and 2018 a total of 3,754 regional aircraft will be produced at an estimated cost of \$115 billion.<sup>30</sup> Bombardier projects deliveries of 12,400 aircraft in the 20- to 149-seat segment over the next 20 years.<sup>31</sup> Forecast

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<sup>26</sup> Boeing, *787 Dreamliner*, <http://www.boeing.com/commercial/787family/background.html>.

<sup>27</sup> Airbus, *Aircraft Families A350 XWB*, <http://www.airbus.com/index.php?id=1555>.

<sup>28</sup> Bombardier, "Lease Corporation International Group Orders 20 Bombardier CSeries Jetliners with Options to Purchase a Further 20," press release, March 30, 2009, [http://www2.bombardier.com/en/7\\_0/pdf/20090330\\_LCI\\_CSeries\\_Sale.pdf](http://www2.bombardier.com/en/7_0/pdf/20090330_LCI_CSeries_Sale.pdf).

<sup>29</sup> SpeedNews, *SpeedNews Commercial Jet Aircraft Program Status: September 30, 2009*, <http://www.speednews.com>.

<sup>30</sup> Aerospace and Defense News, "Regional Aircraft Market: Short-Term Chaos; Long-Term Growth," press release, November 10, 2009, [http://www.asdnews.com/news/24409/Regional\\_Aircraft\\_Market:\\_Short-Term\\_Chaos;\\_Long-Term\\_Growth.htm](http://www.asdnews.com/news/24409/Regional_Aircraft_Market:_Short-Term_Chaos;_Long-Term_Growth.htm).

<sup>31</sup> Bombardier, *Bombardier Commercial Aircraft Market Forecast 2009-2028 Future*, Paris, France, June 15, 2009, p. 21, [http://www2.bombardier.com/en/3\\_0/3\\_6/pdf/Paris2009/Paris\\_Forecast.pdf](http://www2.bombardier.com/en/3_0/3_6/pdf/Paris2009/Paris_Forecast.pdf).

International also points to increased potential competition from three new entrants into the regional jet market: the Chinese state-owned company, the Commercial Aircraft Corporation of China, Ltd. (COMAC), with its ARJ21; the Japanese firm Mitsubishi Heavy Industries, with the Mitsubishi Regional Jet (MRJ); and the Russian firm Sukhoi, with its Superjet 100.

## **The General Aviation (GA) Aircraft Market**

Much of the world's air traffic falls in the general aviation, or GA, category. This sector of aircraft manufacturing covers all aircraft that are not for military use or used for scheduled flights (private and commercial aircraft available for charter or cargo). A wide variety of aircraft types are included in the GA market, ranging from single engine piston aircraft to corporate jets. The General Aviation Manufacturers Association (GAMA)<sup>32</sup> reports that through the end of 2008, the general aviation market was booming. In 2007, deliveries of business jets exceeded 1,000 for the first time, and shipments of new business jets in 2008 reached 1,315 planes, up 15.6% over 2007. Before 2009, production of all but piston aircraft had been increasing steadily on an annualized basis.<sup>33</sup> U.S. production in the business jet classification segment reached 955 aircraft in 2008 (out of total world production of 1,315 units). Since the ongoing recession hit hardest in the fall of 2008, orders for new GA aircraft and especially business jets have fallen dramatically, with the use of corporate jets viewed unfavorably by some in the current economic climate. U.S. business jet production was off by almost 46.8% in the first nine months of 2009.<sup>34</sup> Industry analysts project a significant decline in orders for 2009. Overall, worldwide shipments of general aviation aircraft, including airplanes that are not business jets, fell 7.1% in 2008, to 3,969.

Kansas is one state, in particular, that is directly affected by the downturn in the general aviation market. Business jet producers Cessna, Hawker Beechcraft, and Bombardier's Learjet each have production facilities in Wichita, often referred to as the "Air Capital of the World." Kansas's aerospace and parts manufacturing industry employed 43,290 workers, representing 23% of the state's manufacturing workforce.<sup>35</sup> Already, Hawker Beechcraft has reduced production and shed jobs. In February 2009, the company announced that it would lay off 2,300 workers this year,<sup>36</sup> and most recently Hawker made public the closure of its factory in Salina, KS.<sup>37</sup> Additionally, Cessna Aircraft, the largest manufacturer of corporate jets in the United States, said earlier this year that it would lay off at least 4,600 in 2009, 4,000 of which will come from Wichita.<sup>38</sup>

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<sup>32</sup> GAMA is the trade group representing the interests of over 65 manufacturers of fixed-wing general aviation airplanes, engines, avionics, and components. <http://www.gama.aero/>.

<sup>33</sup> General Aviation Manufacturers Association. Statistical Data Book, 2008. [http://www.gama.aero/files/2008\\_general\\_aviation\\_statistical\\_databook\\_\\_indust\\_499b0dc37b.pdf](http://www.gama.aero/files/2008_general_aviation_statistical_databook__indust_499b0dc37b.pdf).

<sup>34</sup> General Aviation Manufacturers Association. <http://www.gama.aero/media-center/industry-facts-and-statistics/shipments-billings>.

<sup>35</sup> The statistics for Kansas are from the Bureau of Labor Statistics Quarterly Census of Employment and Wages, and cover private sector aerospace products and parts manufacturing employment based on NAICS code 3364 (aerospace products and parts manufacturing). <http://www.bls.gov/cew/>.

<sup>36</sup> Hegeman, Roxana, "Hawker Beechcraft Announces 2,300 Layoffs," *TheStreet.com*, February 3, 2009. [http://www.thestreet.com/story/10461763/1/hawker-beechcraft-announces-2300-layoffs.html?puc=\\_reuters&cm\\_ven=REUTERS&cm\\_cat=Free&cm\\_pla=Feed&cm\\_ite=Feed&puc=reuters&](http://www.thestreet.com/story/10461763/1/hawker-beechcraft-announces-2300-layoffs.html?puc=_reuters&cm_ven=REUTERS&cm_cat=Free&cm_pla=Feed&cm_ite=Feed&puc=reuters&).

<sup>37</sup> Swickard, James, "Hawker Beechcraft Will Close Salina Plant," *Aviation Week*, November 11, 2009. [http://www.aviationweek.com/aw/generic/story\\_generic.jsp?channel=busav&id=news/SALINA111009.xml&headline=Hawker%20Beechcraft%20Will%20Close%20Salina%20Plant](http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=busav&id=news/SALINA111009.xml&headline=Hawker%20Beechcraft%20Will%20Close%20Salina%20Plant).

<sup>38</sup> McCoy, Daniel, "Cessna: Layoff Total to Climb to 4,600 following 4Q Report," *Wichita Business Journal*, January (continued...)

## Potential Future Competition in the Aircraft Manufacturing Sector

One possible issue of interest to Members of Congress is increased competition to the domestic industry from low-cost competitors, including the emergence of possibly strong aerospace manufacturing centers in China and Russia. As the above discussion indicates, non-U.S. firms dominate the RJ market and participate in the GA market. The large commercial jet aircraft manufacturing sector is a Boeing and Airbus duopoly. Over the years, aerospace firms from several non-traditional aircraft manufacturing nations have attempted to enter various parts of the international commercial aircraft sector. With the exception of some GA products, these attempts have largely been commercial failures. As mentioned earlier, a number of new initiatives appear to be under way. While aerospace firms in Europe and Japan have long driven competition with the United States, Russia and China have not, until recently, been strong competitors in the international market. Nowadays, both nations appear to have plans to dominate a much larger share of their own domestic markets and, in turn, perhaps the global market.

Most notable is a new Chinese initiative to build an aircraft to compete in the same markets as the A320 series and the B737 series. COMAC was launched by the Chinese government in May 2008 for the express purpose of overseeing the development and production of large civil aircraft. The Comac C919, an approximately 156-seat aircraft with dimensions similar to the A320, is in development, though a production date has not yet been announced.<sup>39</sup> Slated for certification no later than 2016, that model would compete directly with Boeing and Airbus. Though still in early design, Chinese officials have said the C919 should have operating costs 10% below those of comparable Western jetliners.<sup>40</sup> Another competitor could be Russia's United Aircraft Corporation (UAC), a Russian government-owned joint stock company. UAC has stated it plans to become the third-largest aircraft manufacturer worldwide by 2015.<sup>41</sup> Both Chinese and Russian aircraft manufacturers face significant hurdles in building commercial aircraft, since neither has ever built such airplanes for the commercial market, which requires planes to be reliable, have low operating costs, and be easily maintained. Another outstanding barrier to their market entry is certification by U.S. and EU aviation authorities.

## Public Policy Issues

Congress has been discussing broad issues affecting the competitiveness of the nation's aerospace manufacturing industry for most of this decade. In the early 2000s, the Presidential Commission on the Future of the U.S. Aerospace Industry released its recommendations on how to maintain the competitiveness of the aerospace sector.<sup>42</sup> The Aerospace Commission called for a national

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29, 2009. <http://wichita.bizjournals.com/wichita/stories/2009/01/26/daily42.html>.

<sup>39</sup> Perrett, Brady. "Comac Begins Building C919 Narrowbody Structure." *Aviation Daily*. September 9, 2009, p. 5.

<sup>40</sup> <http://online.wsj.com/article/SB10001424052748704204304574544043310821078.html>.

<sup>41</sup> U.S. International Trade Administration, *Russia: Consolidation of the Aerospace Industry MAS/OAAI/Aerospace Team*, [http://www.trade.gov/static/aero\\_rpt\\_russian\\_industry\\_consolidation.pdf](http://www.trade.gov/static/aero_rpt_russian_industry_consolidation.pdf).

<sup>42</sup> Presidential Commission on the Future of the U.S. Aerospace Industry, *Final Report of the Commission on the Future of the United States Aerospace Industry*, December 2002, [http://trade.gov/static/aero\\_rpt\\_aero\\_commission.pdf](http://trade.gov/static/aero_rpt_aero_commission.pdf).

aerospace policy along with a government-wide framework to implement this policy, as well as the removal of prohibitive legal and regulatory barriers that impede the ability of the industry to grow. The Commission also advanced policies to maintain U.S. global aerospace leadership by proposing investments in America's industrial base, workforce, and research and development infrastructure.

## Export Controls

Many industry analysts argue that globalization helps the United States achieve its business objectives and enhances the competitiveness and vitality of aerospace exporters. But U.S. export licensing laws can negatively impact a customer's ability to acquire aerospace products and parts from the United States. While larger firms have learned to manage export control requirements, they remain a heavy burden for smaller companies, which in some cases inhibits the ability of second- and third-tier suppliers to compete in the international marketplace.<sup>43</sup> The response by some overseas competitors to U.S. export control policies has been to develop products that do not contain any U.S. components.

## Environmental Concerns

Like all other sectors of the U.S. economy, environmental concerns impact the aerospace industry. As the world debates the possible implications of climate change, it appears that the aerospace industry will have to contribute to reduction of carbon emissions. How to limit the environmental impact of aviation is a hotly debated topic in the United States and many foreign countries. Concerns include the possibility that some countries could establish unilateral measures to limit greenhouse gas emissions (GHG) for aviation. For instance, the EU's Emissions Trading Scheme (ETS)<sup>44</sup>—a cap-and-trade system—wants the aviation industry to take responsibility for the emissions it contributes to the atmosphere, and all intra-EU and international flights are set to be included under the ETS beginning on January 1, 2012.<sup>45</sup>

## Aerospace Workforce Issues

The aerospace industry confronts a considerable workforce challenge, which is part of an overall problem in the U.S. science and technology workforce. The industry claims that the United States is not producing enough qualified workers to meet the needs of aerospace companies, and not enough students are opting for science and engineering careers. The number of students receiving engineering bachelor's degrees dropped by 11% between 1986 and 2006, but more recent data indicate a change in this trend, with engineering degrees conferred to undergraduates up 14%

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<sup>43</sup> Center for Strategic & International Studies, *Briefing of the Working Group on the Health of the U.S. Space Industrial Base and the Impact of Export Controls*, February 2008, p. 33 and 55, [http://csis.org/files/media/csis/pubs/021908\\_csis\\_spaceindustryitar\\_final.pdf](http://csis.org/files/media/csis/pubs/021908_csis_spaceindustryitar_final.pdf).

<sup>44</sup> For a complete discussion on the EU's Emissions Trading Scheme, see CRS Report RL34150, *Climate Change and the EU Emissions Trading Scheme (ETS): Kyoto and Beyond*, by (name redacted).

<sup>45</sup> A discussion on aviation and climate change can be found in CRS Report R40090, *Aviation and Climate Change*, by (name redacted).

since 2000.<sup>46</sup> In addition, the current aerospace industry workforce is aging, with an increase in retirements projected in coming years.

According to Aviation Week's 2009 Workforce Study, the average age of the broad U.S. aerospace and defense industry workforce is 45, with an average age of 43 among engineers.<sup>47</sup> Boeing reports the average age of today's aerospace engineer at 54 years, which is even older.<sup>48</sup> A 2008 report by the American Institute of Aeronautics and Astronautics found that

26% of aerospace professionals will be eligible to retire this year, and potential additional retirements of "baby-boom" personnel will create a virtual "silver tsunami" of skilled workforce reduction.<sup>49</sup>

As a consequence, there is concern among aerospace companies that they are rapidly losing their institutional knowledge base. At the same time, the industry is finding it difficult to replenish its workforce with a younger engineering base. Significant competition for the small pool of technically trained aerospace talent comes from other industries, such as information technology and financial services, and increasingly other countries.

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<sup>46</sup> National Science Foundation, *S&E Degrees: 1996-2006*, Arlington, VA, October 2008, p. 8, <http://www.nsf.gov/statistics/nsf08321/pdf/nsf08321.pdf>.

<sup>47</sup> Aviation Week, *Aviation Week 2009 Workforce Study*, July 20, 2009, p. 12, [http://www.ndia.org/Divisions/Divisions/STEM/Documents/ArticlesOfInterest/Aviation\\_Week\\_Workforce\\_Study\\_09.pdf](http://www.ndia.org/Divisions/Divisions/STEM/Documents/ArticlesOfInterest/Aviation_Week_Workforce_Study_09.pdf).

<sup>48</sup> Albaugh, Jim, "National Space Symposium," Colorado Springs, Colorado, April 8, 2008, [http://www.boeing.com/news/speeches/2008/albaugh\\_080408.html](http://www.boeing.com/news/speeches/2008/albaugh_080408.html).

<sup>49</sup> American Institute of Aeronautics and Astronautics, *Working Together to Build the Aerospace Workforce of Tomorrow*, Arlington, VA, May 13, 2008, p. 3, [http://www.aiaa.org/pdf/public/Inside\\_Aero08\\_Report\\_and\\_Recommendations.pdf](http://www.aiaa.org/pdf/public/Inside_Aero08_Report_and_Recommendations.pdf).

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