United States International Trade Commission

Business Jet Aircraft Industry: Structure and Factors Affecting Competitiveness

Investigation No. 332-526
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U.S. International Trade Commission

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In Chapter 3, page 3-27 the original publication reported “Embraer invested $52 billion in Melbourne, Florida…” The correct information is “Embraer invested $52 million in Melbourne, Florida…”

Abstract

This report describes and analyzes factors shaping the competitiveness of the U.S. business jet industry during 2006–11, as well as the industry's structure worldwide. The United States has been the leading player in the industry since its inception in the 1960s. Three of the six global business jet producers are headquartered in the United States, while the other producers maintain at least one U.S.-based production activity. However, competition is strong, frequent cutting-edge updates are necessary, and demand is cyclical. During the recent economic downturn, deliveries dropped 57 percent, from a peak of 1,121 aircraft in 2008 to a preliminary total of 485 in 2011. This decline largely reflected customers' lower profits and the scarcity of credit, which especially weighed on potential buyers in two segments—very light and light business jets—in which deliveries of two U.S.-owned firms are concentrated. At least seven additional U.S. and foreign companies have expressed their intent to enter this industry. U.S. industry officials also indicated that sales and development of business jets were affected by the availability of financing, continued investment in research and development to maintain innovation capability, and the timely certification of business jets to provide state-of-the-art aircraft to the market. Finally, as demand for business jets softened in traditional markets, such as the United States and Europe, it rose in emerging economies, which were less affected by the downturn. This study, prepared by the U.S. International Trade Commission at the request of the U.S. House of Representatives Committee on Ways and Means, focuses on business jets at or below 50,000 pounds maximum takeoff weight.

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Acronyms

ADS	alternative depreciation system
ADS-B	Automatic Dependent Surveillance—Broadcast
ANAC	Agência Nacional de Aviação Civil (National Civil Aviation Agency, Brazil)
ASU	Aircraft Sector Understanding
AVIC	Aviation Industry Corporation of China
BASA	bilateral aviation safety agreement
BNDES	Banco Nacional de Desenvolvimento Econômico e Social (Brazilian development bank)
BNDESPAR	BNDES Participações S.A.
CAD/CAM	computer-aided design/computer-aided manufacturing
CAETRM	Canadian Aerospace Environmental Technology Road Map
CATIA	Computer Aided Three-Dimensional Interactive Application
CECAM	Center of Excellence for Composites and Advanced Materials
CEDBR	Center for Economic Development and Business Research (Wichita State University)
CLEEN	Continuous Lower Emissions, Energy, and Noise (FAA program)
CNC	computer numerical control
CTA	Departamento de Ciência e Tecnologia Aeroespacial (aerospace research center, Brazil)
COE	Center of Excellence (FAA)
COFACE	Compagnie Française d'Assurance pour le Commerce Extérieur (France's export credit agency)
CRIAQ	Consortium for Research and Innovation in Aerospace in Quebec
DER	designated engineering representative
EADS	European Aeronautic Defence and Space Company N.V.

Acronyms—*Continued*

EASA	European Aviation Safety Agency
EASy	Enhanced Avionics System
ECAs	export credit agencies
ECGD	Export Credits Guarantee Department (United Kingdom)
EDC	Export Development Canada
ENAC	Ecole Nationale de l'Aviation Civile (French civil aviation university)
ERJ	Embraer regional jJet
ERRA	Economic Revitalization Recovery Act of 1977, Kansas
EU	European Union
EX-IM	U.S. Export-Import Bank
FAA	Federal Aviation Administration
FINEP	Financiadora de Estudos e Projetos (Research and Projects Financing Agency)
FP	Framework Program
GAMA	General Aviation Manufacturers Association
GARDN	Green Aviation Research and Development Network
GIFAS	Groupement des Industries Françaises Aéronautiques et Spatiales (French aerospace industries group)
HBC	Hawker Beechcraft Corporation
HNWIs	high net worth individuals
IAM	International Association of Machinists and Aerospace Workers
IFI	Instituto de Fomento e Coordenação Industrial (Institute for Industrial Fostering and Coordination, Brazil)
IMPACT	Investments in Major Projects and Comprehensive Training Skills
IP	intellectual property

Acronyms—*Continued*

ISAE	Institut Supérieur de l'Aéronautique et de l'Espace (the French aerospace engineering school)
ITA	Instituto Tecnológico de Aeronáutica (Aeronautical Technical Institute, Brazil)
MACRS	Modified Accelerated Cost Recovery System
MTOW	maximum takeoff weight
NAS	National Private Air Transport Services Company Limited (Saudi Arabia)
NASA	National Aeronautic and Space Administration
NBAA	National Business Aviation Association
NCAT	National Center for Aviation Training
NIAR	National Institutute for Aviation Research
NextGen	Next Generation Air Transportation System
ODA	Organization Designation Authorization (NASA)
OECD	Organisation for Economic Co-operation and Development
OEM	original equipment manufacturer
ONERA	Office National d'Etudes et de Recherches Aérospatiales (French national aerospace research center)
PLMV6	Product Lifecycle Management version 6
R&D	research and development
RDT&E	research, development, test, and evaluation
SADI	Strategic Aerospace and Defence Initiative (Canada)
SBCE	Seguradora Brasileira de Crédito à Exportação (Brazilian export credit insurer)
SESAR	Single European Sky Air Traffic Management Research Program
SMEs	small and medium-sized enterprises
TRL	technology readiness level
TJLP	Taxa de Juros de Longo Prazo

Acronyms—*Continued*

VHNWIs	very high net worth individuals

Glossary

Avionics: The electronic systems and equipment that are part of an aircraft, including those in both the cockpit and the cabin (e.g., radios, navigation systems, wireless access systems).

Block point change: Changes to an aircraft's design that are bundled together and incorporated into a newly manufactured aircraft that is part of an existing aircraft model, or series (e.g., the Challenger series). Block point changes typically involve the addition of new engine and avionics systems to an aircraft, as well as the refurbishing of the aircraft's interior cabin and exterior paint.

Build to print/build to spec: The manufacturing of an aircraft or aircraft component to the design and materials specifications of the customer.

Certification: The approval of an aircraft provided by a national aviation authority. The certification may confirm that an aircraft design meets relevant airworthiness standards (a "type certificate," in the United States); that the manufacturer is able to build the aircraft in conformance with an approved design (production certification); or that a specific product conforms to the approved design and is in a condition to be operated safely (airworthiness certification).

Clean sheet aircraft: An aircraft that is newly designed, i.e., one that starts from a "clean sheet" of paper. By contrast, a derivative design is a variant of, or derives from, an existing product.

Composite: A material or structure made of physically distinct components that are mechanically, adhesively, or metallurgically bonded.

Computer Aided Three-Dimensional Interactive Application (CATIA): Originally developed by France-based Dassault Systèmes for the aerospace industry, CATIA is a software program designed to enhance product development and engineering by using digital mockups instead of physical models.

Derivative aircraft: An aircraft model created from an existing aircraft by using some of the aircraft's core elements but that also incorporates significant changes, such as new wings and/or engines.

Economies of scale: Economies of scale refer to the decrease in unit production costs that typically occur as a result of increasing production volume.

Export credit agency (ECA): An entity, either government affiliated or private sector, which arranges financing for the sale of goods by domestic exporters to foreign customers. Such financing must be governed by the Organisation for Economic Co-operation and Development's "Arrangement on Guidelines for Officially Supported Export Credits" or any of the subsidiary "Aircraft Sector Understanding" agreements.

Glossary—*Continued*

Fly-by-wire systems: Systems in which flight control movements are converted to electronic signals and then transmitted by wires to flight control computers that help guide the aircraft's movement. Fly-by-wire systems replace mechanical flight control mechanisms on an aircraft.

Fractional ownership: An arrangement in which a business jet customer is able to purchase a share of a business jet entitling the customer to use the aircraft for a specified time period each year, usually denominated in hours.

Homogenous oligopoly: An industry in which a few firms manufacture an identical product and where there is little variation among the prices charged by firms for their products. See entries for "oligopoly" and "product-differentiated oligopoly."

Innovation: In general, innovation refers to four types of activity: *product innovation*, which is the development of new or significantly improved goods or services; *process innovation*, which are changes in production or delivery methods; *organizational innovation*, which are changes in business practices; and *marketing innovation*, which are changes in product design or promotion.

Installed base: The number of aircraft operating within a country.

Lean manufacturing: A management approach that focuses on adding value and flexibility by cutting waste and streamlining operations, in turn decreasing a company's spending on activities that do not result in value added. Lean principles apply to all aspects of production, from conceptualizing the right products to product design, engineering, manufacturing, and after sales support.

Light business jet: For the purposes of this report, light jets are those with an MTOW between 12,501 and 30,000 lbs.

Maximum takeoff weight (MTOW): The weight at which the pilot of the aircraft is allowed to attempt to take off, due to structural or other limits.

Medium business jet: For the purposes of this report, medium jets are those with an MTOW between 30,001 and 50,000 lbs.

Mission: For an aircraft, the combination of range (i.e., the distance it can fly), speed, and passenger capacity.

Next Generation Air Transportation System (NextGen): A new air traffic control system scheduled for phased implementation in the United States between 2012 and 2025. NextGen represents a shift away from ground-based air traffic control systems to a satellite-based system that is expected to better manage the traffic demands associated with a significant increase in U.S. air travel forecast over the next decades.

Glossary—*Continued*

Oligopoly: An industry or market structure with high barriers to entry and dominated by a small number of interdependent sellers. Products in an oligopoly can be either differentiated or homogenous. See entries for "homogenous oligopoly" and "product-differentiated oligopoly."

Product-differentiated oligopoly: An industry in which only a few firms produce a similar, but not identical, product. See entries for "homogenous oligopoly" and "oligopoly."

Product differentiation: A manufacturer's practice of distinguishing its product or service from those of its competitors: often based on the product's price, quality, or aftermarket servicing**,** in order to capture market share.

Production efficiency: The use of resources so as to yield the most output from the least amount of inputs.

Product lifecycle management: A comprehensive software-based information system that coordinates all aspects of a product's lifecycle from conceptualization to retirement. Sometimes called the "digital backbone" of a product, it includes the product's requirements phase, analysis and design stages, manufacturing, product launch, distribution, quality assurance, and in-service maintenance.

Research and development (R&D): R&D covers three general activities: *basic research*, which refers to experimental or theoretical work to acquire new knowledge of the underlying foundation of phenomena, without any particular application in view; *applied research*, which is an original investigation to acquire new knowledge directed towards a specific practical aim; and *development*, which is systematic work directed toward producing new or improved materials, products, and/or processes.

Risk sharing: An arrangement in which a supplier funds the development of its part of an aircraft for an original equipment manufacturer (OEM) or for another supplier, coordinating the necessary components and raw materials. The subordinate supplier recoups its investment through sales of the finished aircraft.

Super midsize: A business jet in the medium weight class (with an MTOW between 30,001–50,000 lbs) built with a larger cabin interior than those of a similar weight.

Synthetic vision system: A technology that provides a pilot with increased situational awareness by displaying an artificial image of the outside world using computer-based topographical information.

Systems integrators: A company that consolidates several technologies and/or subsystems into a single system for an OEM.

Glossary—*Continued*

Technology readiness level (TRL): A measure used by government and industry to assess the maturity of an evolving technology. “TRL 1” represents the lowest (most general) level of scientific research that can be translated into applied R&D, whereas “TRL 9” refers to a technology whose application and usefulness have already been proven.

Tier 1 supplier: Suppliers that interact directly with an OEM and that may procure parts from or manage the activities of other suppliers located farther down the supply chain (i.e., tier 2 and 3 suppliers). For example, in the business jet industry, an engine manufacturer would typically be considered a tier 1 supplier, whereas a manufacturer of component parts for an aircraft engine would be considered a tier 2 or tier 3 supplier.

Very light business jet: For the purposes of this report, very light jets are those with an MTOW up to 12,500 lbs.

Executive Summary

The global business jet industry[1] consists of six principal producers that accounted for nearly all production worldwide during 2006–11. Deliveries of business jets reached an all-time high in 2008, and then fell significantly in 2009–11 in response to the economic downturn. The U.S. industry and market are the world's largest. Nonetheless, the share of global production and market held by the United States declined during the period under examination as the economic downturn cut the profitability of small and medium-sized enterprises, which are leading purchasers of business jet aircraft, and created an ongoing uncertain investment environment for producers and purchasers.

Major Findings and Observations

Industry Characteristics

Potential new entrants to the business jet industry face formidable barriers.

Potential barriers to firms considering entering the business jet industry include access to capital, the technical capacity to design, certify, and produce the aircraft, and the resources to provide aftersales service and support of their global aircraft fleet. Substantial capital is necessary to fund aircraft development and certification and regular improvements to stay current with the latest innovations and technologies. Business jet firms must maintain global support and service for their customers, who expect and require around-the-clock availability. Brand loyalty also presents a barrier to entry, as only an estimated 20–30 percent of business jet customers switch brands when buying a new aircraft.

Industry Structure and Deliveries

The world's six leading producers are headquartered in the United States, Canada, France, and Brazil, with the majority of production occurring in the United States. All six firms are part of larger corporations, most of which have diversified interests, varied manufacturing experience, and a broader resource base.

Three firms—Cessna, Hawker Beechcraft Corporation (HBC), and Gulfstream—are headquartered in the United States. Learjet, another U.S. producer, is owned by Bombardier (Canada). Dassault (France) and Embraer (Brazil) are the remaining two business jet producers; each has some U.S. operations. These original equipment manufacturers (OEMs) have different approaches to the market that determine their product range, often with the goal of providing business jets across market niches to retain their customers as they their needs shift into different aircraft categories. Cessna, HBC, and Embraer largely produce for the very light and light market segments, while Bombardier, with its Learjet models, competes in the light to medium/super midsize market segments (table ES.1). Gulfstream competes in the same segments as Bombardier, but most of Gulfstream's business jet production is heavier aircraft that falls outside of the scope of this investigation. Dassault also produces mostly heavier aircraft, although certain of its business jets compete in the

[1]As identified in the request letter from the House Ways and Means Committee, the focus of this investigation is on business jets at or below 50,000 pounds MTOW.

medium to super midsize segment of the industry, which is the only segment in which all six producers participate.

TABLE ES.1 Business jet market segments, by company

Company	Very light	Light	Medium to super midsize
Bombardier			x
Bombardier (Learjet)		x	
Cessna	x	x	x
Dassault			x
Embraer	x	x	x
Gulfstream		x	x
HBC	x	x	x

Source: Compiled by USITC staff.

Although the United States is believed to be the world's leading destination for foreign direct investment in this sector, U.S. business jet OEMs have increased their investment abroad as part of a competitive strategy to focus on their core competencies and to outsource non-core manufacturing activities.

Business jet companies from Brazil, Canada, France, and Japan have invested in the United States to produce or finish business jets for delivery to U.S. and foreign customers. This investment includes new facilities in North Carolina (Honda) and Florida (Embraer). The United States is an attractive investment site in part because of its market size and large, experienced supplier base and workforce. With respect to outbound foreign direct investment, HBC, Cessna, and Learjet have begun to source more parts and components from their facilities in Mexico as part of their competitive strategies. Their Mexican plants, located in Chihuahua (Learjet) and Querétaro (Cessna and HBC), conduct labor-intensive manufacturing, such as sheet metal fabrication and the assembly of wiring harnesses. Mexico is an attractive investment location because of its low labor costs, relatively good infrastructure, and the relative proximity of the plants to Wichita, Kansas, where three U.S. producers' final assembly plants are located.

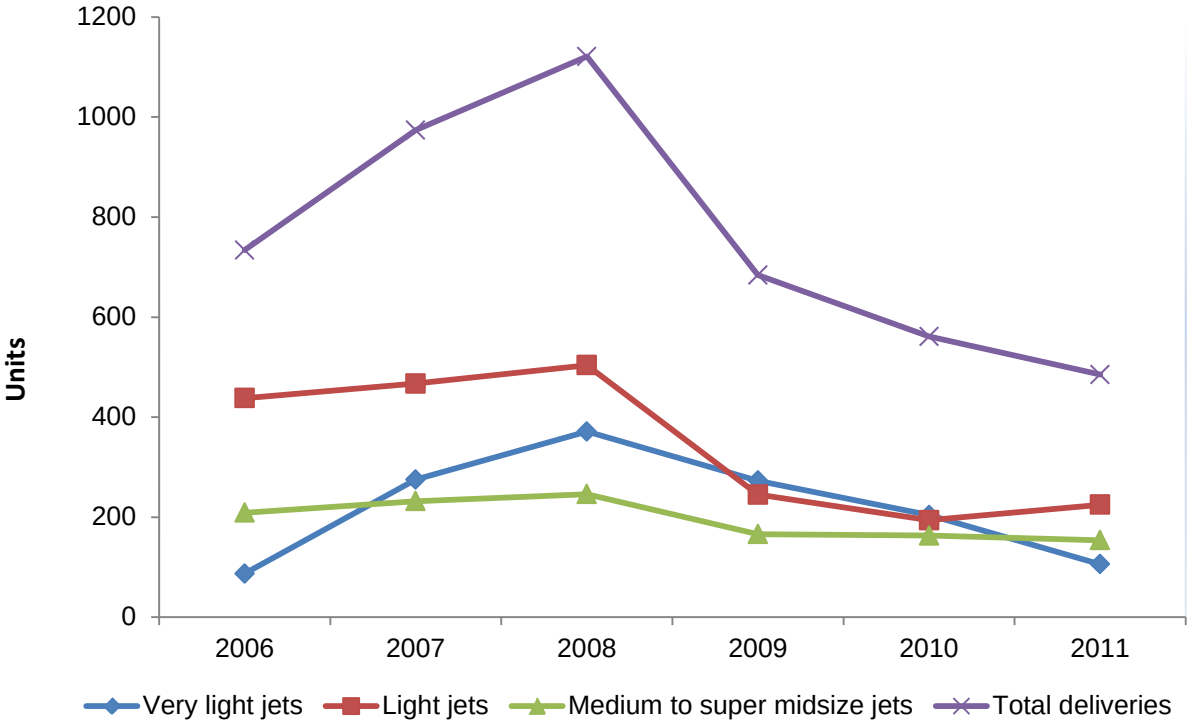
Despite the challenges to entry, several companies have announced their intentions to enter or reenter the business jet industry, and China has indicated its interest in developing an industry to serve this market.

At least five companies—Cirrus Aircraft, Diamond Aircraft Industries, Eclipse Aerospace, Honda Aircraft Co., and SyberJet Aircraft U.S.A.—have announced plans to offer a business jet in the very light or light segment of the market. Cirrus, Eclipse, Honda Aircraft (owned by Honda of Japan), and SyberJet are U.S.-based firms with established manufacturing operations. Eclipse and SyberJet (formerly Emivest) assembled business jets in the United States during the period under examination, but had shut down production by 2009. Cirrus, which merged with China Aviation Industry General Aircraft Company (AVIC) in June 2011, has announced plans to produce a very light business jet, and Honda is undergoing U.S. certification of its HondaJet. Diamond, headquartered in Austria, is undergoing flight testing and certification of its D-Jet in Canada, where the aircraft is produced. Two additional firms, U.S.-based Spectrum Aeronautical and Stratos Aircraft, Inc., are considering entering the industry. A potential newcomer to the industry in the long term is China, which has identified the general aviation sector as part of one of seven strategic industries for which the Chinese government will provide priority support during 2011–15. China currently does not produce any business jets.

Global deliveries of business jets fell sharply during the economic downturn, with the largest decline occurring in the very light business jet segment, where two U.S.-based producers compete.

Overall business jet deliveries were down by 57 percent in 2011 from the peak of 1,121 aircraft in 2008, falling to a preliminary total of 485 aircraft. Deliveries in the very light business jet market segment, where HBC and Cessna were principal players until Embraer's entry in 2007, fell by 71 percent from the 2008 peak of 371 aircraft to a preliminary total of 106 aircraft in 2011 (figure ES.1). In the light jet segment, deliveries fell by 45 percent from the 2008 high of 427 aircraft to 204 aircraft in 2010, but turned around in 2011 and grew by 26 percent to a preliminary total of 225 aircraft. The very light and light market segments represented 78 percent of HBC's deliveries and 89 percent of Cessna's deliveries of the subject business jets in 2010, the latest available full-year data. In the medium to super midsize category, where Bombardier and Dassault are the principal players, deliveries fell by 52 percent from 323 aircraft to a preliminary total of 154 aircraft in 2011.

FIGURE ES.1 Global deliveries of business jets, by segment, 2006—11[a]



Source: General Aviation Manufacturers Association.

[a]2011 data are preliminary.

Despite these trends, Embraer introduced a new business jet in the very light segment during the economic downturn.

Embraer entered the very light business jet market segment in late 2008 with the Phenom 100, a new aircraft that accounted for nearly one-half of segment deliveries by 2010. Embraer's market entry is attributable in part to its ability to leverage its extensive regional jet resources and to introduce to the market a newly designed (clean sheet) business jet incorporating new technologies and innovations. In 2010, Embraer entered the light jet segment with the Phenom 300. Approximately one-quarter of global deliveries of these aircraft were to customers in Brazil, where the brand is highly valued and where domestic financing is available from the Banco Nacional de Desenvolvimento Econômico e Social (BNDES), an export credit agency and national development bank.

In contrast to the decline in deliveries of the three business jet segments included in the scope of this study, deliveries of heavier business jets increased during the economic downturn. Business jet firms with a broad product offering in heavier business jets were consequently less affected by the global economic downturn.

The market for all business jets exhibited a marked bifurcation in deliveries over 2006–11, with jets outside the scope of this investigation experiencing a slight increase in deliveries during the economic downturn. Purchasers of these jets were more likely to have access to financing and/or the ability to pay with cash. Demand for these jets was also stronger in markets such as China, which were less impacted by the economic downturn, and where larger, longer-range business jets are preferred by purchasers. Dassault (France) and Gulfstream (United States), which primarily produce heavier business jets, had limited exposure to the business jet market subject to this investigation and were likewise less affected by the economic downturn than other business jet manufacturers.

The U.S. business jet supplier industry forms the basis of most global OEM supply chains. Many of these suppliers have formed risk-sharing partnerships with business jet OEMs and other suppliers to reduce costs and share the risk of product development.

The United States is the principal source of key parts and systems for all of the world's business jet manufacturers. For example, U.S. suppliers provide avionics, engines, wheels, and landing gear. OEMs work closely with their suppliers, increasingly in risk-sharing partnerships, to reduce costs and speed delivery of the latest innovations and technological advancements necessary to remain competitive in this industry. Many U.S. suppliers are considered to be global leaders in technical expertise and manufacturing know-how.

U.S. Workforce

Employment in the U.S. industry declined significantly during 2006–11 as U.S. OEMs retrenched during the economic downturn. While most U.S. OEMs are not currently experiencing a scarcity of qualified labor due to layoffs associated with the recession, replacement of an aging, but highly skilled and experienced, workforce is a cause for future concern.

As business jet orders fell and production was reduced, U.S. business jet producers made significant employment cuts, threatening their existing skills base and injecting uncertainty into the future workforce environment. A workforce with strong scientific and technological knowledge is critical for innovation and the sustained competitiveness in the U.S. business

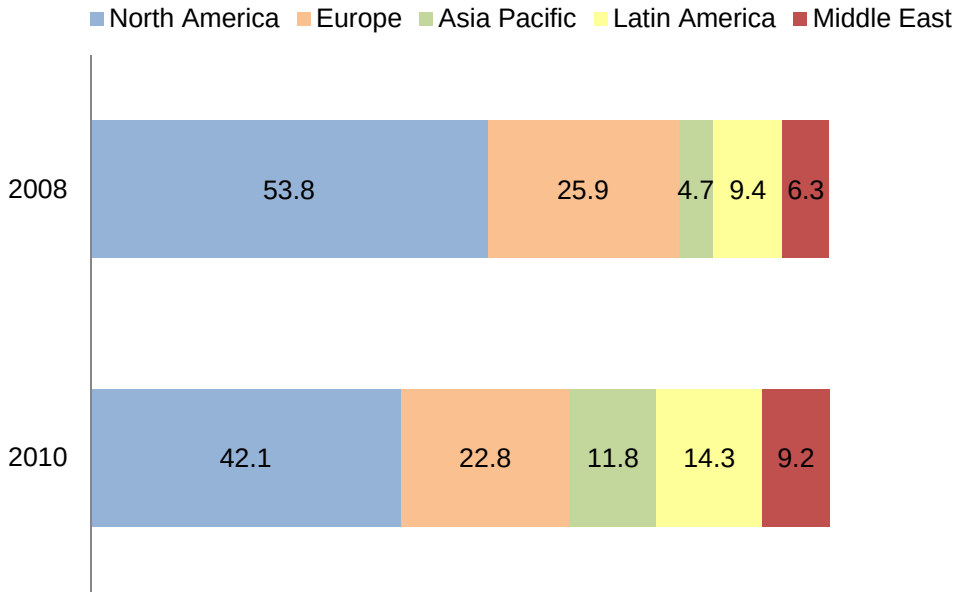
jet industry, which places great stress on retaining the existing workforce and planning for workforce succession.

Global Market

Despite declines in total business jet deliveries during 2008–10 to traditional markets, such as the United States and Europe, these economies remained the world's largest markets. While the share of global deliveries to emerging markets, such as China, India, and Russia, grew, prospects for their continued growth may be limited by inadequate airport infrastructure, burdensome regulations, and high tariffs.

During the economic downturn, deliveries of all business jets (including those outside the scope of this investigation) to emerging markets in Asia and Latin America grew faster than deliveries to the traditional leading markets of the United States and Europe (figure ES.2). The emerging markets were less affected by the economic downturn than the United States and Europe; in addition, emerging-market customers were more inclined to purchase larger, longer-range business jets. However, limited infrastructure hampers demand in many emerging markets, where few airports may be available to business jets. Access to these airports and airspace may also be heavily regulated by government authorities, as is the case in China, which only recently started to relax its airspace restrictions. High tariffs on imports of aircraft also reportedly hinder demand for business jets, with India's 25 percent tariff on imports of general aviation aircraft and aircraft parts and Russia's 20 percent tariff on certain imported business jets cited as examples.

FIGURE ES.2 Share of total business jet deliveries (including business jets above 50,000 pounds MTOW) by market, 2008 and 2010 (percent)



Source: General Aviation Manufacturers Association, *2010 General Aviation Statistical Databook & Industry Outlook,* n.d. (accessed January 11, 2012).

The decline in demand for business jets was related in part to tighter credit, which largely affected customers and aircraft sales in the very light and light business jet segments.

The customers for the very light and light business jets, the market segments in which U.S. producers are most active, were the hardest hit during the economic downturn because of decreased profitability and the credit crisis. These customers, which include small and medium-sized enterprises, small private companies, and charter companies, generally rely more on financing to purchase their business jets than other buyers. Their limited financing options during this period contributed to a significant decline in deliveries in these two aircraft segments.

Finance Mechanisms

Export credit agencies (ECAs), such as the U.S. Export-Import Bank, Canada's Export Development Canada, and Brazil's BNDES, are an important source of financing for export sales of business jets.

The U.S. Export-Import Bank (Ex-Im Bank) increased its assistance for U.S. export sales of business jets during the financial crisis and has continued to provide such support. The Ex-Im Bank is the most active ECA in the business jet market, despite local-content requirements not used by other ECAs and restrictions that limit financing to export sales only. Other ECAs, particularly those in countries with a national development bank or a budget for industrial policy spending, may offer financing of domestic sales as well. BNDES in Brazil, for example, has provided financing to Embraer's domestic business jet customers as part of its economic development objectives.

Research and Development

Research and development (R&D) investment and business and technological innovation are critical to success in this industry. In addition to corporate self-funding of R&D by OEMs and business jet suppliers, financial support for aeronautics R&D is provided by all governments to foster important national goals. The global business jet sector, however, reportedly has had the least government R&D participation among aerospace sectors.

Continual product innovation and R&D are key competitive factors for the business jet industry. Purchasers demand the latest technologies and advances in their business jets. To remain competitive, business jet producers must continually invest in new aircraft programs and/or upgrade existing aircraft to provide new features and systems. In the United States, funding for the Federal Aviation Administration (FAA) and National Aeronautics and Space Administration (NASA) forms the core of federal government R&D expenditures in aviation. However, support for R&D at both agencies has been inconsistent, with reductions at NASA and erratic funding at the FAA. This funding uncertainty has given rise to industry concerns about the government's commitment to long-term R&D programs. In contrast, aeronautics R&D in the European Union (EU) receives sustained support from governments at all levels and is targeted to strengthening the competitiveness of European firms. As the sole aircraft producer in Brazil, Embraer has benefited from government efforts by BNDES and the Financiadora de Estudos e Projetos (FINEP) to support aerospace innovation through R&D debt financing.

The R&D priorities of governments are not necessarily the same as those of industry, particularly in constrained budget environments.

Government R&D resources may be targeted to research on long-term projects to address broad, systemic issues rather than to develop discrete technologies at higher technology readiness levels (TRLs). U.S. business jet industry representatives report that the limited NASA research available to them generally is not at a high enough TRL to justify the follow-on investment necessary to bring a product incorporating the research to market. One area in which the United States, the EU, and Canada have invested in projects at higher TRLs is in improving the environmental efficiency of aircraft (increasing value while reducing resource use and environmental impact).

Business Innovation

Business jet producers have adopted a variety of business innovation strategies to improve competitiveness through balanced portfolios of products incorporating both large-scale and incremental innovations, lean management principles, design and manufacturing efficiencies, and cost reductions.

Although business innovation strategies are unique to individual companies, several common approaches were noted. With respect to product development, business jet OEMs typically seek to maintain a balanced portfolio of new (clean sheet), derivative, and incrementally improved products. OEMs are also increasingly partnering with their suppliers to share the costs and risks associated with new product development. In addition, business jet OEMs have adopted lean management principles to minimize waste and to improve responsiveness to change. Moreover, many OEMs have refocused on their core competencies (e.g., design, engineering, integration, and final assembly) in the aftermath of the economic downturn.

Certification

Constraints on FAA resources, including engineering and technical skills, coupled with fluctuating funding levels, have lengthened certification cycles for U.S.-assembled business jets, and reportedly undermine U.S. business jet industry competitiveness.

According to the FAA, the needs of the business jet industry are expanding at a rate that exceeds FAA resources. OEMs have stated that the most pressing problem is the timeliness of certification review. Resource constraints have led the FAA to institute a “sequencing policy” to prioritize which certification projects will be worked on and which will be delayed. According to the General Aviation Manufacturers Association, these constraints affect manufacturer and supplier decisions to invest in new projects, expand facilities, and increase employment. In addition, according to U.S. industry representatives, delays in FAA certification put U.S. manufacturers at a competitive disadvantage if foreign companies are able to obtain certification more quickly from their national authorities and get their products to market sooner. According to FAA data, the certification process in the United States averages 43 months for a business jet; thus, technologies that were new at the beginning of the project may be outdated by the time of certification. However, regulatory authorities in Brazil, France, and Canada also may take a long time to certify aircraft produced in their countries. The predictability and consistency of certification decisions both within the United States and across countries also is a substantial concern reported by OEMs. The FAA recognizes the problem of regulatory inconsistency and has in place internal mechanisms intended to promote harmonization.

Future Competitiveness

The future competitiveness of the U.S. business jet industry may be influenced by a number of factors that create uncertainty for U.S. OEMs.

Changes to factors affecting the U.S. competitive landscape for business jets occur over a long time period, often creating market uncertainty for U.S. OEMs seeking to expand their product portfolio and customer base. These factors include regional demand, new entrants in the industry, workforce characteristics, and government regulations affecting the environment, airspace, or fees/taxes. In some cases, the impact of these changes may benefit U.S. industry, such as the opening of airspace in China, whereas other changes may pose challenges, such as proposed fee increases in Europe.

CHAPTER 1
Introduction

The United States is the leading global producer of business jet aircraft ("business jets"). It is home to three producers and their business jet operations, as well as certain production activities by foreign-based producers. With the world's largest fleet of operating business jets, the United States is also the largest market. Despite historically strong demand for its products, the U.S. business jet industry is confronting several recent challenges, including the global economic recession; shifts in market demand from North America and Europe to rapidly growing economies elsewhere, particularly in Asia; and new producers entering the market, affecting the U.S. industry's future competitiveness worldwide.

Scope

Business jets are used by corporations, individuals, and leasing firms as tools to enhance business productivity by transporting employees, customers, suppliers, and, to a lesser extent, parts or other assets quickly, often to locations not easily accessible through commercial airline service.[1] Other reported advantages of business jet travel over commercial airlines include employee time savings, increased worker productivity, protection of intellectual property by permitting private communications en route, and improved customer interaction and support. To meet the specific needs of customers, business jets are designed and produced across an array of sizes, capacities, and capabilities, ranging from small-cabin jets designed for traveling short distances to much larger capacity jets with transoceanic capabilities.[2]

This report provides an overview of the global industry, supply chains, and market for business jets. It discusses government policies that affect the business jet industry in two distinct areas: (1) policies that promote innovation and research and development (R&D) activity, and (2) government financing mechanisms that support export sales and customer credit and more general corporate activities, including R&D, capital investment, employment, and workforce training. Factors that may affect the future competitiveness of the U.S. business jet industry are also discussed.

The report responds to a request by the House Committee on Ways and Means (Committee) for information and analysis regarding the structure and factors affecting the competitiveness of the U.S. business jet aircraft industry in the United States, Brazil, Canada, China, and Europe, focusing primarily on the 2006–11 time period.[3] The Committee requested that the U.S. International Trade Commission (Commission) provide a report to include the following:

- An overview of the structure of the global industry, including supply chain relationships and foreign direct investment;

[1] HBC, written submission to the USITC, October 5, 2011, 4.

[2] See chapter 3, "Global Industry," for further information on product segments and characteristics.

[3] A copy of the letter from the Committee requesting this factfinding investigation is provided in app. A of this report. As identified in the request letter from the House Ways and Means Committee, the focus of this investigation is on business jets at or below 50,000 pounds MTOW.

- An overview of the global market for business jet aircraft and of recent developments, such as the economic downturn, that may have affected demand;
- An examination of production, consumption, sales, financing mechanisms, R&D, and business innovation;
- Information on government policies and programs that focus on or otherwise involve the industry, including policies and programs affecting financing, aircraft R&D, and certification; and
- A discussion of factors that may affect the future competitiveness of the U.S. business jet aircraft industry, such as workforce characteristics, changes in regional demand, and new or growing entrants through 2028.

The Committee requested that the Commission provide its report in 11 months and rely primarily on publicly available information. The business jets examined in this study fall into three generally recognized product segments: very light, light, and medium to super midsize jets.[4]

Organization of the Report

The remainder of this chapter describes the report approach and provides a brief overview of business jet development. Chapter 2 describes the structural characteristics and identifies the factors of competitiveness for the global business jet industry. Chapter 3 begins with information on the global business jet industry, identifying major producers, product segments, and other industry indicators and presenting data on aircraft deliveries. The industries in the United States, Brazil, Canada, China, and the European Union (France)[5] are examined relative to their respective deliveries, production facilities, supply chain relationships, workforce characteristics, and foreign direct investment, among other factors. Chapter 4 provides an overview of the global market for business jets, and identifies and describes leading markets and consumers, as well as key factors affecting global demand, including the impact of the economic recession. Chapter 5 examines technological and business innovation in the business jet industry, including innovations in product development and business processes, the role of risk-sharing suppliers in R&D, government R&D support in the United States, Brazil, Canada, and France, and the effect of government regulation, especially with regard to certification. Chapter 6 provides an overview of the types and role of financing mechanisms, both private and public, in the production and sale of business jets. The report concludes with a chapter outlining the factors affecting the long-term competitiveness of the U.S. business jet industry, including workforce characteristics, shifts in regional demand, new and emerging entrants, and government policies and regulations.

Appendices A and B reproduce the Committee's request letter and the *Federal Register* notice, respectively. Appendix C contains the calendar of witnesses

[4] For the purposes of this study, the very light segment includes business jets up to 12,500 pounds MTOW, the light segment includes business jets from 12,501 to 30,000 pounds MTOW, and the medium to super midsize segment includes business jets from 30,001 to 50,000 pounds MTOW.

[5] There is one major business jet producer in Europe—Dassault Aviation of France.

appearing at the Commission's public hearing, while appendix D summarizes the positions of the interested parties who appeared at the Commission's hearing and/or submitted written statements in conjunction with this investigation.

Approach

In responding to the Committee's request, the Commission gathered information from a variety of industry and public sources. Information on the global business jet industry and market for this investigation was obtained from written submissions received in response to the Commission's *Federal Register* notice announcing institution of the investigation;[6] testimony at the Commission's public hearing in this investigation, held on September 28, 2011; and extensive interviews during factfinding fieldwork with U.S. and foreign producers, suppliers, and regulatory officials both in the United States and in the major foreign producing countries of Brazil, Canada, and France.[7] Other key sources of information were academic papers; business and industry publications; company Web sites; and reports by U.S. and foreign government agencies.

To discuss and analyze the structure and factors affecting the competitiveness in the global business jet industry, as requested by the Committee, the Commission identified the structural characteristics of the industry. These characteristics include few firms, significant barriers to entry, and competition based on products that are differentiated by functionality, technological content, price or value, and other unique features. Other key characteristics of this industry include complex manufacturing processes, risk sharing with suppliers, globalized supply chains, and continuous innovation. The Commission used these characteristics to identify factors likely to affect the competitive positions of global business jet producers. Based on this framework, primary competitive factors in the global business jet industry include product differentiation and innovation, production costs and efficiency, access to skilled labor and capital, corporate aircraft manufacturing experience, marketing expertise, customer loyalty, provision of support services, and certification. These competitive factors relate directly to the structural characteristics of the industry and to the abilities of business jet producers to provide customer value, while at the same time strategically positioning themselves in the global business jet market.

[6] A copy of the *Federal Register* notice is provided in app. B of this report.

[7] As detailed in chapter 3, "Global Industry," the nascent business jet industry in China had not produced or sold any aircraft up to the time of this report's publication, although the industry is pursuing design, development, and financing for future business jet production. Information regarding the industry in China was gathered from public reports, hearing testimony, interviews with industry representatives, and other public sources.

Business Jet Development

The development of a new business jet is a costly and lengthy process from design to certification, and requires a very substantial financial commitment. The cost typically ranges between $500 million and $1 billion, depending on whether the aircraft is newly designed ("clean sheet") or created from an earlier model (derivative design).[8] Another option for producers is to perform "block point changes,"[9] such as an upgrade to a new engine, about five years after the initial introduction of the aircraft to attract and retain customers who are interested in the latest technologies. Innovation and product improvement are critical to the success of business jet original equipment manufacturers (OEMs), driving significant investment in R&D and the development and adoption of new technologies.

The principal stages of aircraft development are design, manufacturing, assembly, and testing and certification (figure 1.1), with varying complexities and time frames depending on product characteristics. The manufacturing process is highly capital intensive, with computer-aided design and manufacturing (CAD/CAM) technology widely employed in the design and assembly of business jets. The manufacturing facilities and production equipment of the producers are generally similar, and the basic assembly process has not changed in recent years. Business jets are assembled in large hangars on long assembly lines by teams of workers. In some cases, production lines for other types of aircraft run parallel to the business jet line. Production equipment is purchased, as necessary, to keep up with the latest technological developments. Business jets are typically made to order for particular customers, with little to no inventories of new aircraft held by OEMs.[10] Business jet OEMs have generally adopted lean manufacturing principles throughout their production processes to reduce costs and improve efficiencies. All OEMs have close relationships with their supply chains and source globally for the best cost/quality and most advanced systems and components. OEMs typically engage in risk-sharing partnerships with key suppliers to share production and development costs of business jet programs and important technologies. Because sales of business jets are denominated in U.S. dollars, OEMs with non-U.S. production facilities may be exposed to exchange rate risks.

Another critical step in the process of launching an aircraft is the certification process. All aircraft, including business jets, must be certified as meeting prescribed safety standards by the national aviation authority where production occurs, such as the Federal Aviation Administration (FAA) in the United States. This process is not only costly, but is often lengthy and complex, with business jet certification taking an average of 43 months in the United States.[11] These development challenges and factors of competitiveness will be discussed in greater detail in subsequent chapters in this study.

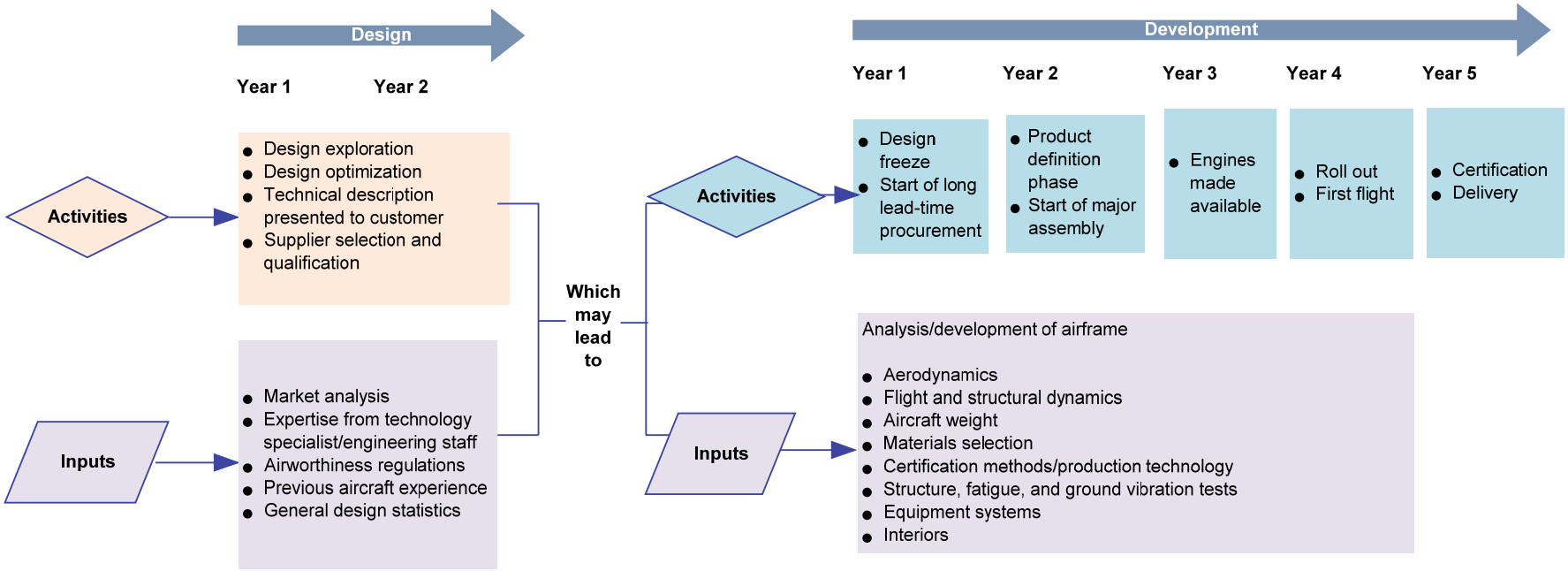
[8] USITC, hearing transcript, September 28, 2011, 83 (testimony of Bob Blouin, HBC); industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[9] Changes to an aircraft's design that are bundled together and incorporated into a newly manufactured aircraft that is part of an existing aircraft model or series. See the glossary for more information.

[10] Inventories of used aircraft, however, are often a barometer of industry health and influence new aircraft demand. See chapter 4, "The Market for Business Jet Aircraft," for more information.

[11] FAA, written submission to the USITC, October 11, 2011.

FIGURE 1.1 Business jet development process



Source: Compiled by the staff of the U.S. International Trade Commission from information gathered from industry sources.

Note: Time frames are estimates.

CHAPTER 2
Industry Characteristics and Factors of Competition

Summary

The global business jet industry[13] currently consists of six major manufacturers, three of which are U.S.-headquartered. The remaining companies are headquartered in Canada, France, and Brazil, but each has some production activities in the United States. The companies compete globally in the business jet market on the basis of the functionality, unique characteristics, and price of their aircraft. Barriers to entry into the industry are high, so the number of OEMs is relatively low. Product differentiation, enabled by technological innovation, is a key structural feature of this industry. Through product differentiation, manufacturers have been able to expand sales by providing business jet options across a broad range of aircraft sizes, capabilities, and prices.[14] The most important competitive factors identified by the Commission for this industry include production cost and efficiency; access to capital and skilled labor; manufacturing infrastructure; marketing expertise; the ability to maintain customer loyalty through aftermarket support, product innovation, and company reputation; and experience in designing and producing business jets.[15] These factors are also significant barriers to entry for firms seeking to enter the market.

Structural Characteristics

The most important structural characteristics of the global business jet industry are the small number of firms, significant barriers to entry, and product differentiation. Other key characteristics of this industry include complex manufacturing processes, risk sharing with suppliers, globalized supply chains, and continuous innovation.[16]

Industry Competition

The business jet industry is characterized by a small number of firms and certain competitive factors that pose significant barriers for new firms to enter the industry.[17] In this type of market structure, pricing, production, and investment decisions are strategic choices. The outcomes or "payoffs" from these decisions depend not only on the choices that a particular company makes, but also on the decisions made by competitors, since only a few firms are competing in the market. In other words, industry participants must respond to a decision by

[13] As identified in the request letter from the House Ways and Means Committee, the focus of this investigation is on business jets at or below 50,000 pounds MTOW.

[14] Starry and Bernstein, "The Economics of Private Business Jet Travel," 2008, 38. For more information on business jet demand see chapter 4, "The Market for Business Jet Aircraft."

[15] According to Porter, a company's competitive advantage in any industry is achieved either through providing a product at the lowest cost, or providing a product in a unique way that creates more buyer value than its competitors. Porter, "Competition in Global Industries," 1986, 20.

[16] Demand factors are analyzed in chapter 4, "The Market for Business Jet Aircraft."

[17] Grant, *Contemporary Strategy Analysis*, 2007, 78.

any other firm to remain competitive. For these reasons, the structure of the business jet industry is considered to be an oligopoly.[18] Oligopolies can include either homogenous or differentiated products. In a product-differentiated market, the success of a company depends on the type of product that it offers. A study of price competition in an oligopoly framework found that competition is "tougher" when products are not differentiated.[19]

Competition in the global business jet industry largely occurs within the market structure of a product-differentiated oligopoly. Currently there are six global OEMs competing in the business jet segments that are within the scope of this investigation. Both academic and industry analysts have cited significant barriers to entry for new firms to the business jet industry that have kept the number of OEMs low, although several new companies are poised to enter the market. Business jet OEMs compete in the global market by strategically positioning themselves in various market segments and by offering similar but differentiated products within these segments. These products offer specific attributes to individual customers that may vary in terms of aircraft functionality, technological content, price, and brand reputation for customer service and safety.[20]

The importance of product differentiation and strategic market positioning in the global business jet industry is illustrated by the number of market segments and models in which the OEMs compete. Business jets range in size from small, four-passenger jets designed for short flights to large-cabin aircraft that can fly great distances nonstop.[21] Roughly 206 models of business jets are currently in production across all business jet segments, including those outside the scope of this study.[22] Manufacturers produce business jets for specific segments that are based on range, speed, cabin size, and price, with individual company success often depending on the market segment(s) in which they sell.[23] For example, industry sources report that larger business jets tend to be more profitable than the smaller aircraft, which have faced the largest declines in sales to price-sensitive customers since the downturn in the global economy.[24] The medium to super midsize category is the only segment in which all six manufacturers compete.[25]

Related to the role of product differentiation, the business jet market is also highly value oriented, with competition based on a firm's pricing strategies in each niche.[26] These

[18] Mustilli and Izzo concluded that the business jet industry tends toward oligopoly due to the presence of high barriers to entry. The barriers they cited included economies of scale; specialized complementary assets, such as brand loyalty and customer service networks; and corporate management ability. Mustilli and Izzo, "Competition, Technology Innovation, and Industrial Structure," 2009, 110. However, there is no single theory of oligopoly because the behavior of oligopolistic firms depends on the strategic decisions of these firms and how their rivals react. For a more complete discussion of competition within an oligopoly framework, see Pindyck and Rubinfeld, Microeconomics, 2005, 441–68.

[19] Mazzeo, "Competitive Outcomes in Product-Differentiated Oligopoly," 2002, 720.

[20] According to one industry source, for example, suppliers generally provide the same avionics to business jet OEMs. With such commonalities, OEMs must differentiate their aircraft either with the pilot or passenger experience in the cockpit or cabin. Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[21] Bunce, on behalf of the General Aviation Manufacturers Association (GAMA), written testimony to the USITC, September 9, 2011, 3.

[22] USITC, hearing transcript, September 28, 2011, 208 (testimony of Michael D. Chase, Chase & Associates). This industry participant noted that the spectrum of aircraft available has grown almost exponentially over the past 15 years. The 206 models of business jets include those of Airbus and Boeing, which are outside the scope of this investigation.

[23] USITC, hearing transcript, September 28, 2011, 157–58 (testimony of Robert Wilson, Honeywell Aerospace).

[24] USITC, hearing transcript, September 28, 2011, 44 (testimony of Robert Morin, Ex-Im Bank).

[25] Starry and Bernstein, "The Economics of Private Business Jet Travel," 2008, 39.

[26] USITC, hearing transcript, September 28, 2011, 228 (testimony of Richard Aboulafia, Teal Group Corporation).

strategies reflect a "price-performance" continuum that takes into account customer value or aircraft utility per dollar spent.[27] Therefore, cost pressures are important in the business jet industry, with each OEM competing on its ability to provide the most per dollar in innovation and customer satisfaction.[28]

Barriers to Entry and Potential for New Entrants

Barriers to entry in the global business jet industry cited by researchers and industry analysts include, among others, the high initial capital investment required to build a business jet, the organizational and technical ability to design, certify, and manufacture products requiring multiple and complex technologies, and the need to establish after sales support.[29] Industry sources indicate that it typically costs between $500 million and $1 billion to develop a new business jet program.[30] Moreover, much of this investment involves upfront costs, which tend to be highly risky due to the uncertainty of aircraft certification and the number of years required to recoup the investment.[31] Government certification[32] is a "multifaceted and highly technical" process that can be a significant barrier to entry in the global business jet industry due to the time and cost involved.[33] Barriers to entry provide advantages to established firms and determine the extent to which an industry can, in the long run, enjoy profits above the competitive level.[34] However, the extent to which such barriers are effective in deterring new entrants depends on the specific resources and capabilities that potential new entrants possess to meet the demands of the market.[35]

New entrants to the business jet industry may influence existing OEMs in two ways. They could either put downward pressure on the prices of existing aircraft models if the new entrant offered "more for less," or they could expand the existing market by drawing in new participants, such as owners of turbopropeller aircraft and used business jets. To illustrate one impact of new entrants on the business jet industry, figure 2.1 shows a simple microeconomic model of supply and demand for a business jet OEM that depicts the effect of an increase in the number of suppliers on quantity and price. As indicated in figure 2.1, an existing firm faces a potential loss of sales and downward pressure on its aircraft price when a new competitor comes into the market selling a business jet with higher technological content to the same customers that would likely buy jets from established manufacturers. This loss of sales could be limited if the new entrant creates a market niche that attracts

[27] USITC, hearing transcript, September 28, 2011, 158–59 (testimony of Robert Wilson, Honeywell Aerospace). Cho discusses business jet market niches as being identified by the price-performance continuum. Cho, "A Chain-Type Price Index for New Business Jet Aircraft," 2006, 46.

[28] USITC, hearing transcript, September 28, 2011, 158 (testimony of Robert Wilson, Honeywell Aerospace).

[29] Mustilli and Izzo, "Competition, Technology Innovation, and Industrial Structure," 2009, 110; USITC, hearing transcript, September 28, 2011, 154–55 (testimony of Bob Blouin, HBC). The competitive factors discussed in the following section also serve as barriers to entry.

[30] USITC, hearing transcript, September 28, 2011, 83 (testimony of Bob Blouin, HBC); industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[31] According to one industry source, when a business jet manufacturer embarks on building a new aircraft, it is such an extensive risk and so costly that the manufacturer is "gambling the company." USITC, hearing transcript, September 28, 2011, 267 (testimony of Heidi Wood, Morgan Stanley).

[32] In the United States, the FAA is responsible for developing aircraft safety standards and for certifying that aircraft operated in the United States meet these safety standards. USITC, hearing transcript, September 28, 2011, 15–16 (testimony of Dorenda Baker, FAA). In addition to the FAA, airworthiness authorities in most other countries either follow the standards and requirements of the FAA or promulgate their own.

[33] USITC, hearing transcript, September 28, 2011, 154 (testimony of Bob Blouin, HBC); USITC, hearing transcript, September 28, 2011, 16 (testimony of Dorenda Baker, FAA).

[34] Grant, *Contemporary Strategy Analysis*, 2007, 76.

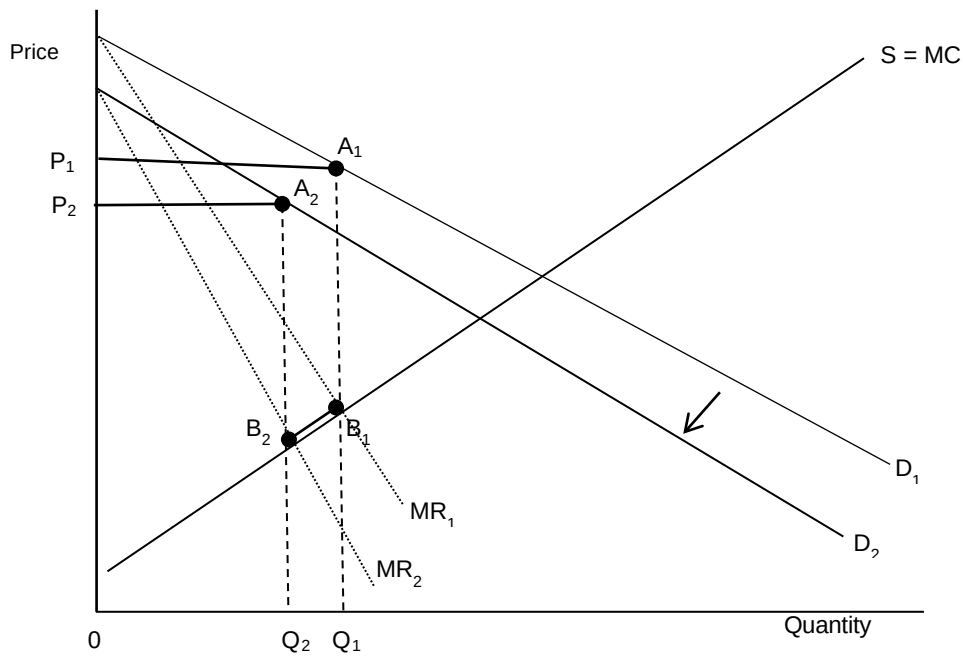
[35] Grant, *Contemporary Strategy Analysis*, 2007, 78. For example, Embraer was a strong participant in the regional jet market before entering the business jet market.

FIGURE 2.1 Effect of new entrant into a product differentiated oligopoly

The increased pricing pressures faced by existing business jet producers from new entrants into the market may be illustrated by an oligopoly model of a firm selling differentiated products in the market.[a] In this context, an OEM has control over the prices of its aircraft and faces a downward sloping, individual market demand curve for the particular jet aircraft that it produces, rather than an "industry-wide" demand curve. Thus, the demand curve (D_1) faced by an OEM is for a particular model of business jet. However, while OEMs produce differentiated products in this example, the products are still substitutes in the sense that if a customer buys a business jet from one OEM, this customer will not buy a similar business jet from another OEM. The OEM maximizes its profit by producing at Q_1 where marginal revenue (MR_1) equals marginal cost (MC) at point B_1. The OEM receives a price of P_1 for each jet sold. Total revenue is equal to the area 0 P_1 A_1 Q_1.

The entrance of a new firm into this specific market segment is illustrated by both the demand and the marginal revenue curves shifting inward to D_2 and MR_2, respectively, depending on the output of the new competitor. Sales for the existing OEM fall to Q_2 and the price falls to P_2. Overall revenue declines also, to 0 P_2 A_2Q_2.

While the graph suggests a decrease in quantity and price due to a new entrant in the market, a fuller model could leave the change in quantity and price ambiguous for any particular OEM. For example, a new entrant could come into this market with a new model that attracts new customers, with the result that the demand curve D_1 does not shift inward, or the shift is less. Similarly, business jet OEMs producing in different segments than the new entrant—for example, in medium or large-cabin aircraft versus light or very light jets—may experience little impact on sales, as demand is conditioned on the specific requirements for aircraft in these segments.



[a]Adapted from Wiens, "Differentiated Oligopoly," http://www.egwald.ca/economics/monopolistic.php (accessed November 10, 2011).

additional customers to the market. However, if business jets from new entrants substitute for existing models, existing producers will feel additional pressure to lower prices to regain market share and sales. In the longer term, a possible impact from a new entrant could be that the new entrant's customers will later upgrade to larger or different aircraft, expanding future sales for other companies and business jet models.

Complex Design and Manufacturing Processes

Business jets are complex product systems that integrate many interrelated components and subsystems using multiple technologies. Due to the number of technologies involved, business jets are typically built in collaboration with a sizable number of suppliers.[36] The industry is highly capital intensive, with CAD/CAM widely used in design and to integrate different components. Many new developments in business jet manufacturing involve computerized controls and automation designed to improve assembly, as well as to lower energy consumption and pollution. Innovative manufacturing techniques, including lean manufacturing, can also lead to significant productivity gains, cost savings, and better customer service.[37] The use of composite materials is also increasing.[38] Composite materials, which are structural materials made up of two or more contrasting components, are used to build aircraft that are lighter than aluminum models.[39]

Risk Sharing

Risk sharing is a common practice in which OEMs partner with a supplier in developing a new aircraft.[40] Partnering with specific suppliers is a risk-management strategy that allows OEMs to adopt the most advanced technologies suited to their individual jet aircraft while sharing the financial costs and risks associated with aircraft and system development.[41] Risk sharing also allows an OEM to lower its cost on a new aircraft, thus enabling a lower sales price.[42] Risk-sharing partners may be expected to devote time, labor, capital, and research and development (R&D) resources to design a specific part or system and ensure that the final aircraft product meets FAA certification and quality standards.[43] In exchange, these are assured of a guaranteed parts supply arrangement if the aircraft is produced.

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[36] Production of a business jet relies on the precise and accurate alignment and mating of six major subassemblies. These include the fuselage or body, empennage or tail assembly, wings, landing gear, engine, and flight control systems and instruments. See Madehow.com, "How Business Jets Are Made," n.d. (accessed November 10, 2011).

[37] Industry representatives, telephone interview by USITC staff, November 2011; industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011. See also chapter 5, "Technological and Business Innovation."

[38] Industry sources indicate that use of composite materials is increasing at an even faster rate in production of large commercial aircraft due to fuel efficiency concerns. Industry representatives, telephone interview by USITC staff, November 2011.

[39] Madehow.com, "How Business Jets Are Made," n.d. (accessed November 10, 2011).

[40] Risk-sharing partnerships can also occur among component suppliers.

[41] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011. According to one industry source, the typical job for a supplier used to be to "build to print," under which U.S. business jet producers typically designed an aircraft and certain parts, and their suppliers produced them to the specifications provided. The supplier would then charge its startup costs to the OEM as a one-time nonrecurring charge. With risk sharing, the supplier carries this charge, but receives a longer contract for sales and service. See also USITC, *Competitive Assessment of the U.S. Large Civil Aircraft Aerostructures Industry*, 2001, 2-8.

[42] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[43] USITC, *Competitive Assessment of the U.S. Large Civil Aircraft Aerostructures Industry*, 2001, 2-8.

Supply Chains and Globalization

Business jet OEMs source their products worldwide to obtain the most appropriate and highest-quality technology for a given aircraft program. For example, Brazilian-based Embraer has indicated that it has suppliers in a number of U.S. states and its aircraft include 50–70 percent U.S. content.[44]

In addition to appropriate technology, the global supply chain for business jets is motivated by a number of other factors. First, some aircraft parts have become "commoditized" over time, thus allowing manufacturers to source these parts globally at lower cost.[45] Second, manufacturers can also save costs by relocating labor-intensive operations to lower-cost labor destinations. For example, both Cessna and HBC have component manufacturing facilities in Mexico; Cessna estimates that its operations in Mexico could grow to account for 10 to 15 percent of all production hours over the next several years.[46] Third, by locating manufacturing or assembly facilities in the United States, foreign-owned manufacturers, such as Dassault, Embraer, and Bombardier, are able to reduce their exposure to foreign exchange risk, since business jets are typically priced in dollars.[47] For example, it has been suggested that Embraer has moved production to the United States in part to take advantage of the dollar's weakening value over the past few years[48] and reduce its exposure to exchange rate risk.

Innovation and R&D

Continuous innovation in aircraft design and performance are important structural features of the business jet industry.[49] Global business jet producers innovate through newly designed business jets that start from a "clean sheet" of paper, or through jets with updated electronics systems (avionics), engines, and interiors that are variants or derivatives of existing models. The innovations in the derivative models may be incremental, whereas more radical innovation occurs with the introduction of a new clean sheet model.[50] Both clean sheet and derivative business jet design and production involve significant investments in R&D.

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[44] Industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

[45] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[46] Bunce, on behalf of GAMA, written submission to the USITC, September 9, 2011, 3.

[47] USITC, hearing transcript, September 28, 2011, 217–18 (testimony of David Strauss, UBS Investment Research); industry representatives, interviews by USITC staff, France, October 2011.

[48] The dollar has declined relative to the Brazilian *real*, the euro, and the Canadian dollar over the last few years. One analyst has suggested that the appreciation in the *real* and high real-wage inflation in Brazil are at least partially responsible for Embraer's recent move to establish a new production line in Florida rather than expand capacity in Brazil. USITC, hearing transcript, September 28, 2011, 250 (testimony of David Strauss, UBS Investment Research).

[49] A study of industry structure and innovation suggests that convergence to an industry's "technological frontier," i.e., the eventual adoption of the innovations that are available to, and feasible for, a particular industry, is a necessary condition for firm survival in a highly competitive oligopolistic industry. See, for example, Bonaccorsi, Giuri, and Pierotti, "Technological Frontiers and Competition in Multi-technology Sectors," 2005, 39.

[50] Industry representatives, interviews by USITC staff, Paris, France, October 2011. A "clean sheet" aircraft is newly designed.

While innovation is a key market driver affecting firm behavior, the pace of its introduction into specific business jet models may be uneven for several reasons. For example, consumer preferences for specific business jet characteristics can result in tradeoffs and variations in overall technological efficiency among business jet models.[51] Consumers' brand loyalty and the costs they would incur in switching to a new product, as well as an OEM's ability to continue strong sales from a particularly robust technological platform, can also result in delays in introducing more innovative product features.[52] For these reasons, along with the regulatory requirements and costs associated with business jet improvements, strategies for introducing technological innovation are key competitive factors for OEMs.

More stringent regulations also drive innovation in the business jet industry. For example, industry sources have noted that the European Union (EU) Emissions Trading Scheme (ETS), designed to reduce greenhouse gas emissions, went into effect in January 2012 for flights going into and out of the EU. The ETS requires manufacturers of aircraft, including business jets, to focus on the jets' carbon footprint, which may provide an incentive for future engine and aerodynamic development.[53]

Competitive Factors

Various factors affect the ability of a business jet producer to provide customer value and to position itself strategically in the global business jet market.[54] These competitive factors include (1) production factors (production efficiency, access to skilled labor and capital), (2) manufacturing infrastructure, (3) marketing expertise, (4) brand loyalty, (5) support services, (6) OEM core capabilities, strategy, and experience, and (7) certification (table 2.1). As noted in the following discussion, these competitive factors also serve as barriers to entry: for example, they may give existing OEMs significant cost advantages over potential entrants. Also, in a product-differentiated market such as business jets, it is not only costly for potential new entrants to develop new, niche products with high technological content, it is also difficult for them to overcome brand loyalty to existing OEMs and their aircraft.

[51] For example, in the business jet market, some customers seek the newest and latest technology, such as composite manufacturing, while others are interested in upgrades to existing models, such as increased fuel efficiency or aerodynamics, and/or interior modifications. Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[52] Bonaccorsi, Giuri, and Pierotti, "Technological Frontiers and Competition in Multi-technology Sectors," 2005, 39.

[53] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[54] Some of these factors were also discussed in the Commission's studies on competitiveness in the global large civil aircraft industry. See USITC, *Competitive Assessment of the U.S. Large Civil Aircraft Aerostructures Industry*, 2001, chapter 2, and USITC, *The Changing Structure of the Global Large Civil Aircraft Industry and Market: Implications for the Competitiveness of the U.S. Industry*, 1998, chapter 2.

TABLE 2.1 Competitive factors in the business jet industry

Production costs
- Production efficiency, lean manufacturing
- Labor productivity, access to skilled labor
- Global supply chains, sourcing from lower-cost producers
- Access to capital
- Economies of scale and learning curve
Manufacturing infrastructure
- Access to R&D facilities, land, and materials
- Competitive supplier base
- Aerospace research clusters
Marketing expertise
- Ability to predict and respond to changing market demand
Brand loyalty
- Brand strength/loyalty
- Company reputation
- Market positioning
Service, global support network
- Customer service and support, including aftermarket service
Corporate structure, experience, and strategy
- Access to capital and other resources
- Leverage experience
- Core competencies to design and manufacture aircraft
- Risk-sharing, R&D, and global supply strategies
- Managing supplier networks
Certification
- Time needed to certify design and production in home market
- Ability to certify aircraft use in consuming countries

Source: Compiled by USITC staff.

Production Factors

Production Efficiency

OEMs, as well as their suppliers, are under increasing pressure to improve productivity and to incorporate the latest efficiency-enhancing manufacturing techniques. Such improvements not only help to save on costs, but also increase customer value.[55] The ability of OEMs to increase productivity and efficiency is often a function of their technological capabilities and financial resources. "Lean manufacturing" techniques, which reduce company spending on activities that do not add value, can increase production efficiency—for example, by shortening the amount of time that it takes to assemble an aircraft.[56] Building risk-sharing partnerships, or outsourcing low-valued activities, can increase production efficiency for business jet OEMs by allowing them to focus on the activities and skill sets that add the most value to the company.

[55] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[56] Industry representatives, telephone interview by USITC staff, November 2011; industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

Labor Cost and Productivity

Although business jet manufacturing is relatively capital-intensive, labor productivity and cost are important competitive factors.[57] Improving employee efficiency at all skill levels not only reduces labor cost, but also fosters innovation at the manufacturing level.[58]

U.S. industry officials have cited the need to increase U.S. workers' productivity to compete with lower wages in foreign countries.[59] Some business jet OEMs cut costs by outsourcing labor-intensive tasks to countries such as Mexico.[60] However, moving work offshore may also entail higher logistics costs, as parts may need to be transported from overseas locations back to U.S. assembly facilities.[61] Sourcing or moving to a low-cost country that has not had an aerospace industry in the past also entails a significant learning curve, since production experience, worker skills, and quality must be developed over time.[62]

The role labor costs play in business jet manufacturing competitiveness depends on the company, its market niche, and its business strategy.[63] France-based Dassault, for example, successfully differentiates its aircraft through its deployment of advanced technology in the super midsize and heavier business jet segments while reportedly using relatively high-wage labor in France.[64] On the other hand, it may be advantageous for producers of light jets, which serve a different market, to reduce labor costs.[65] In addition, the dynamics of labor costs may change over time. Although Embraer's labor costs have risen in recent years,[66] analysts suggest that Embraer has been able to employ lean manufacturing and supply chain management strategies, for example, to control its overall manufacturing costs,[67] including labor.

Skilled Workforce

The scientific and technological knowledge base that fosters innovation and is essential to sustained competitiveness in the business jet industry is housed largely in the industry's workforce. The industry must be capable of developing new products with superior features and by increasing productivity. To accomplish these goals, the industry must maintain the technological competence of its existing workforce and ensure that new talent is in the pipeline to secure future competitiveness.

Business jet manufacturers must have access to a pool of labor with skills in science, engineering, mathematics, and comprehensive reading.[68] An important success factor, for both U.S. and foreign-owned OEMs, is access to certified aircraft workers and engineers.[69]

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[57] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[58] Ibid.

[59] Ibid.

[60] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011. For example, Bombardier (Learjet), HBC, and Cessna all have assembly operations in Mexico.

[61] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[62] Ibid.

[63] USITC, hearing transcript, September 28, 2011, 236–37 (testimony of Richard Aboulafia, Teal Group Corporation).

[64] USITC, hearing transcript, September 28, 2011, 237 (testimony of Richard Aboulafia, Teal Group Corporation).

[65] Industry representatives, interviews by USITC staff, Paris, France, October 2011.

[66] See chapter 3, "Global Industry," for more information on Embraer and its labor costs.

[67] Industry representative, interview by USITC staff, São José dos Campos, September 2011.

[68] USITC, hearing transcript, September 28, 2011, 195–96 (testimony of R. Thomas Buffenbarger, International Association of Machinists and Aerospace Workers).

[69] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011, and São José dos Campos, Brazil, September 2011.

Sources report that there is significant demand for airframe and power plant (A&P)-certified mechanics in the industry.[70] Other, engineering-based skills in demand in the business jet industry include composite production and repair, computer numerical control (CNC) machining, programming, CATIA (Computer Aided Three-dimensional Interactive Application) design software, and use of robotic tools.[71] Engineers represent a sizable part of the global business jet industry's workforce, and concerns have been raised by industry officials that the United States will face a significant loss of engineers due to future retirements.[72] To expand its pool of engineers, for example, Cessna has an engineering center in Bangalore for training and is outsourcing some of its engineering work.[73]

Layoffs due to production cuts affect the longer-term capabilities of the workforce by disrupting training and depriving the company of the knowledge and skills workers have accumulated through on-the-job experience. Engineering talent in this field is important human capital that is not easily replicated.[74] For this reason, companies forced to cut their workforce may prefer to use furloughs instead of layoffs, if possible, to preserve their R&D and engineering investment.[75]

Access to Capital

Development of new jet aircraft requires large sums of capital over long periods of time. Thus, the ability of companies to obtain financing is a competitive advantage in this industry. Capital is essential for new aircraft programs; certification; R&D; new plant construction and facility expansions; subassembly, parts, and material procurement; and the establishment of a global after sales support network. Industry sources have noted that even incremental innovations in existing aircraft, such as upgrading avionics, can cost hundreds of millions of dollars.[76] Much of the capital required for business jet development is spent early on in the process, and will not be recouped for a number of years after the aircraft, if successful, is certified and subsequently delivered to customers. Returns on the invested capital are amortized through future sales.[77]

Investment capital can be obtained through a company's own resources, financial markets, partners in risk-sharing ventures, and government aid.[78] Established business jet OEMs and suppliers are likely to have a higher credit rating and better access to lower-cost commercial capital than new entrants.

Economies of Scale and the Learning Curve

For companies that manufacture products with high fixed development costs, such as business jets, the ability to realize lower average unit costs through increased production volume (economies of scale) is an important competitive advantage. OEMs in the business

[70] Certified mechanics are certified by the FAA and do maintenance in a prescribed way. Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[71] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[72] Ibid.

[73] Ibid.

[74] Industry representative, interview with USITC staff, Wichita, KS, July 2011.

[75] Ibid.

[76] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[77] For example, according to one industry source, most deliveries of new business jets occur in the first five years of release of the product, so improvements are made to the existing models about once every five years to stimulate consumer demand. Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[78] Gordon and El-Sabaawi, on behalf of HBC, written testimony to the USITC, September 7, 2011, 6. For more information, see chapter 6, "Financing."

jet industry can achieve economies of scale in two ways. First, to recoup the high costs of developing a clean sheet program, OEMs can seek to amortize these costs over multiple business jet models that are based on the original clean sheet aircraft and move across the size scale to appeal to the different needs of customers.[79] This results in lower average unit costs, as the development costs are spread over more units of output. Industry officials report that having a broad product mix of aircraft is an important competitive strategy in achieving economies of scale.[80] Second, scale economies might also be achieved through high-volume purchases of component parts and raw materials, coupled with improvements in employee skill levels and operational efficiency as production volume increases.[81]

Economies of scale are both a source of competitive advantage to existing firms and a barrier to entry for new firms. New entrants are faced with the choice of either entering on a small scale and accepting high unit costs, or entering on a large scale and running the risk of underutilized capacity while they increase sales volume.[82] One relatively new producer of business jets, Embraer, indicated that it was able to enter the industry with economies of scale advantages due to its ability to leverage its experience, suppliers, and skilled workforce from its pre-existing regional jet business to its business jet operations.[83]

Established firms may also have a cost advantage over new entrants in terms of their learning curve because they entered the market earlier, thereby benefiting from prior experience to better address manufacturing challenges and reduce costs. For example, industry sources report that organizational and management efficiencies result from an OEM's engineering knowledge base and understanding of R&D; gaps in understanding can add to costs and lengthen implementation times.[84] In addition, lack of experience in aircraft certification procedures can be a competitive disadvantage for new suppliers and OEMs.[85]

Manufacturing Infrastructure

A well-developed manufacturing infrastructure is essential for business jet producers, as they require access to R&D facilities; advanced manufacturing facilities and equipment; a sophisticated supply base; and basic aircraft materials, such as aircraft-quality aluminum alloys, titanium, and composites. A manufacturing location must have access to adequate transportation infrastructure offering rail, port, and/or truck shipping of aircraft components, and a dependable utilities infrastructure to provide reliable power and communication to manufacturing and administrative facilities.[86] An additional factor, particularly for new entrants, is the availability of land for production facilities large enough to include a runway and ramp space for delivering and holding aircraft, as well as open space for expansion.

Aerospace clusters, or geographic areas where some combination of one or more OEMs, suppliers, and research and training institutions centralize resources and assets within a several-hundred-mile radius, benefit business jet manufacturers.[87] North American clusters,

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[79] Mustilli and Izzo, "Competition, Technology Innovation, and Industrial Structure in the Business Aviation Industry," 2009, 111; industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[80] USITC, hearing transcript, September 28, 2011, 310 (testimony of David Strauss, UBS Investment Research).

[81] For example, suppliers of components may be able to supply these parts at a lower price if long-term contracts are available under risk-sharing partnerships. Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[82] Grant, *Contemporary Strategy Analysis*, 2007, 76.

[83] Industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

[84] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[85] Ibid.

[86] Industry representatives, interviews by USITC staff, Melbourne, FL, September 2011.

[87] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

for example, include Montreal, Quebec; Wichita, Kansas; and Querétaro, Mexico;[88] similar clusters exist in Brazil (Sáo José dos Campos) and France (Aerospace Valley).[89] Industry sources indicate that such clusters provide important supply chain services to OEMs, including the ability to have close contact with suppliers.[90] However, industry observers also recognize the importance of sourcing globally, as needed, to maintain competitiveness.[91]

Aviation research laboratories and testing centers also are crucial to business jet manufacturing infrastructure, as illustrated by their presence in major aircraft-producing countries. In Wichita, the National Institute for Aviation Research (NIAR) conducts basic research and provides certification on behalf of the FAA. Similar centers are located in Brazil, Canada, and Europe.[92]

Market Analysis Capabilities

Market analysis is a key component in the ability of business jet manufacturers to develop or maintain market shares and profitability, and thus it is critical to competitiveness. According to industry sources, business jet customers constantly expect new upgrades and improvements.[93] Without market analysis capabilities, it is harder for a manufacturer to respond to shifting demand across aircraft segments and models, and to gain a first-mover advantage from investments in innovation. In the context of a differentiated-products market, market analysis capabilities are crucial to identify new or upgraded products that provide value to customers in specific market niches.

Market analysis capability is particularly important in developing a clean sheet aircraft and for new entrants into the market, as manufacturers usually attempt to identify an area of growing demand that is not well served by either their own or by competitors' existing models.[94] For example, an industry source notes that an important factor in Embraer's success in entering the business jet market was that the company created a new market for business jets below $5 million.[95]

Brand Loyalty

Brand loyalty is another important competitive factor in the business jet industry; for some companies, 70 to 80 percent of sales have been to pre-existing customers.[96] This key competitive factor is achieved through company reputation, market positioning, and customer service.[97] As noted earlier, OEMs choose their positions among the various

[88] Ibid.

[89] See chapter 3, "Global Industry," for a fuller discussion of aerospace clusters.

[90] USITC, hearing transcript, September 28, 2011, 117 (testimony of Bob Blouin, HBC).

[91] USITC, hearing transcript, September 28, 2011, 116–17 (testimonies of Bob Blouin, HBC, and Robert Wilson, Honeywell Aerospace).

[92] See chapter 5, "Technological and Business Innovation."

[93] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[94] Cho refers to this as filling in the market niches identified in the price-performance continuum. Cho, "A Chain-Type Price Index for New Business Jet Aircraft," 2006, 46.

[95] USITC, hearing transcript, September 28, 2011, 233 (testimony of Michael D. Chase, Chase & Associates).

[96] Industry representatives, telephone interview by USITC staff, August 2011; USITC hearing transcript, September 28, 2011, 232 (testimony of Michael D. Chase, Chase & Associates).

[97] Economic research has shown that industry (and firm) performance improves if new technology is commercialized through "specialized complementary assets," such as brand loyalty and a global support and service network, which reduce movement among industry brands by consumers. Such assets allow firms to capture the "economic rents" associated with innovation. Rothaermel and Hill, "Technological Discontinuities and Complementary Assets," 2005, 53.

business jet market segments, with some OEMs positioning themselves as premium brands (e.g., Gulfstream) or producing for value in the lighter segments of the market. Some companies emphasize their aircrafts' performance and/or cabin amenities to foster brand loyalty, while others highlight their reputation for guaranteed quality and service.[98] Industry sources noted that once customers in the industry have chosen a brand, they tend to move up through the product lines offered by that same business jet manufacturer. However, one participant at the Commission's hearing noted that brand loyalty may become less of a factor in the future as the industry expands to attract both new customers and new companies.[99]

Service and Global Support Network

After sales support services are provided globally by both OEMs and major systems suppliers. One industry analyst has suggested that ongoing service and support is the most important driver of industry sales, even above price and technological innovation.[100] Customer support networks are provided by OEMs, suppliers, and/or authorized service partners.[101] Services include parts distribution, repair and overhaul services, rental equipment, equipment upgrades, software installations, logistics, and routine maintenance services, with most companies providing round-the-clock support near the locations where aircraft are based or at the intended destinations.[102] The cost of providing this support network can be substantial to OEMs and suppliers, and it, too, constitutes an important barrier to new entrants into the industry.[103]

Corporate Structure, Strategy, and Experience

Corporate structure can determine OEMs' level of access to capital and other resources, and thus has a notable effect on competitiveness. For example, larger companies have greater cash flow and therefore are likely to be more willing to commit funding and absorb the risks associated with development of clean sheet programs.[104] The six business jet OEMs are conglomerates or subsidiaries of larger companies, most with diversified interests and manufacturing experience; as such, they are more likely to have better access to capital than smaller companies.[105] Moreover, a large corporation may be able to leverage its experience and resources from related operations, such as engineering skills or supplier relationships, to lower costs.[106]

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[98] USITC, hearing transcript, September 28, 2011, 155–56 (testimony of Robert Wilson, Honeywell Aerospace).

[99] USITC, hearing transcript, September 28, 2011, 231 (testimony of Richard Aboulafia, Teal Group Corporation).

[100] USITC, hearing transcript, September 28, 2011, 234 (testimony of David Strauss, UBS Investment Research).

[101] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[102] USITC, hearing transcript, September 28, 2011, 90–91 (testimony of Robert Wilson, Honeywell Aerospace).

[103] USITC, hearing transcript, September 28, 2011, 156 (testimony of Robert Wilson, Honeywell Aerospace).

[104] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[105] Cessna and Gulfstream are owned by large conglomerates (Textron and General Dynamics, respectively); Bombardier, owner of Learjet, is a global transportation company; Dassault Aviation is owned by the Daussalt Group, with the European Aeronautic Defense and Space Company as a major shareholder; and Embraer is a global aerospace company. HBC is owned by investment firms Goldman Sachs (United States) and Onex Corporation (Canada(), both with a 49 percent share.

[106] For example, Embraer noted that it migrates its workforce across its aircraft programs. Embraer's business jet program also benefits from scale economies through the supplier relationships the company maintains in its regional jet business. Industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

Organizational experience in running a large program that involves integrating complex technologies provides another competitive advantage to firms in this industry. Business jet OEMs need core competencies in managing the overall design, production, safety, and maintenance of their aircraft. Successful OEMs must develop very broad knowledge and skills to manage the task of integrating systems with multiple technologies while at the same time maintaining the pace of their technological advancement. These management skills are both barriers to entry for new firms and key factors affecting competition among existing business jet manufacturers.[107]

Effective strategies for introducing innovations into aircraft and core competencies in supply chain management are important competitive strengths.[108] To succeed, business jet OEMs must create their innovation strategies, invest in R&D, develop specific technologies and expertise in-house, and decide to what extent they will delegate other functions to suppliers. Finding the right balance in managing the supply chain is especially challenging; one company representative described it as an "art."[109]

Certification of Aircraft

The ability to produce a business jet that meets global safety standards and can therefore be certified by a country's aviation authorities is a major task for a producer, both technologically and financially. The cost of certification is likely to amount to a larger share of development costs for a business jet than for a commercial jet due to the former's lower unit price.[110] Delays in obtaining certification, as well as differences in interpretations of national regulations across countries, can add time and complexity to the certification process, and can put manufacturers at a competitive disadvantage if these factors allow competitors to get their aircraft to market sooner.[111] At the same time, significant experience in obtaining regulatory approval can be an important competitive advantage for firms that are skilled with working with regulatory officials.[112] To speed the reciprocal acceptance of approvals and encourage consistent international regulation, the FAA and national airworthiness authorities in various countries have negotiated bilateral aviation safety agreements (BASAs). These accords establish a framework for aviation authorities to cooperate by validating other authorities' certifications.[113]

[107] Mustilli and Izzo, "Competition, Technology Innovation, and Industrial Structure," 2009, 114.
[108] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011, and São José dos Campos, Brazil, September 2011.
[109] Industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.
[110] Industry representatives, interviews by USITC staff, Montreal, Canada, September 2011.
[111] Bunce, on behalf of GAMA, written submission to the USITC, September 9, 2011, 8.
[112] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.
[113] USITC, hearing transcript, September 28, 2011, 17-18 (testimony of Dorenda Baker, FAA).

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CHAPTER 3
Global Industry

Background

As previously noted, business jets[1] are principally owned and/or used by corporate entities, individuals, and fractional ownership firms to transport quickly and efficiently employees, customers, suppliers, and, to a lesser extent, parts or other assets. Business jets generally refer to turbine-powered general aviation aircraft[2] for business activities. General aviation is one of three aviation segments in the United States, including commercial aviation (i.e., scheduled air passenger and air freight transport services) and military aviation.[3]

Six manufacturers currently account for all known production of business jets in the very light, light, and medium to super midsize segments of the business jet industry (table 3.1). Two firms—Emivest Aerospace Co. (Emivest), now known as SyberJet Aircraft (SyberJet), and Eclipse Aviatian Corp. (Eclipse)—left the industry during the period but are seeking to resume production, while several other firms have also expressed their intent to enter the industry (box 3.1). All six of the OEMs conduct at least one production-related activity in the United States (table 3.2), with finishing operations the most commonly performed. Three of the current producers—Cessna Aircraft Co. (Cessna), Hawker Beechcraft Corp. (HBC), and Gulfstream Aerospace Corp. (Gulfstream)—are headquartered in the United States. Cessna and HBC perform all assembly and finishing of their business jets in the United States, whereas Gulfstream's two business jet models that fall within the scope of this investigation are assembled in Israel by Israel Aerospace Industries (IAI)[4] and are finished in the United States. Bombardier, Inc. (Bombardier), a Canadian firm, builds complete business jets in Canada and also owns Learjet, which has a full range of production facilities in the United States. Dassault Aviation, S.A. (Dassault, France), on the other hand, assembles its business jets in France and finishes them in the United States. Empresa Brasileira de Aeronáutica S.A. (Embraer, Brazil) assembles and finishes most of its business jets in Brazil, but also opened an assembly and finishing facility in the United States in late 2011.

All of these business jet producers are part of larger, diversified corporations, most of which have broader interests in military and/or other aviation sectors. These OEMs have approached the business jet market with different strategies that determine their product offerings and market scope, often with the goal of providing a range of business jets to meet their customers' evolving needs. All six OEMs produce in the medium to super midsize product segment where price is not as important a purchase consideration as in the very light and light business jet market niches (table 3.3). Three OEMs produce in the very light business jet segment, and five firms produce for the light business jet segment.

[1] As identified in the request letter from the House Ways and Means Committee, the focus of this investigation is on business jets at or below 50,000 pounds maximum takeoff weight (MTOW).

[2] General aviation aircraft also include, for example, gliders, sport aircraft, and helicopters.

[3] USITC, hearing transcript, September 28, 2011, 95 (testimony of R. Thomas Buffenbarger, UAW).

[4] While IAI manufactures Gulfstream's G150 and G280 models, Gulfstream owns the manufacturing license, its business jet engineering department, and the manufacturing rights for the product line.

TABLE 3.1 Selected characteristics of business jet models under 50,000 lbs MTOW, by segment[a]

Product segment	Maximum number of passengers	Approximate price[b]	Range in nautical miles (nm)[c]	Examples of models within segment currently in production or under development
Very light	6	$3–$7 million	1,100–1,500	- Cessna Mustang and CJ2+ - Embraer Phenom 100 - Beechcraft Premier 1A - HondaJet [d]
Light	10	$8–$20 million	1,700–3,000	- Bombardier Learjet 40XR, 45XR, 60XR, and 85[d] - Cessna CJ3, CJ4, XLS+, Sovereign - Embraer Phenom 300 and Legacy 450 [d] - Gulfstream G150 - Hawker 400XP, 750, 900XP
Medium to super midsize	19	$21–42 million	3,100–4,800	- Bombardier Challenger 300 and 605 - Cessna Citation X and Citation Ten [d] - Dassault Falcon 900 LX, 2000LX, and 2000S [d] - Embraer Legacy 600 and Legacy 500 [d] - Gulfstream G200 [e] - Hawker 4000

Source: Bombardier, *Bombardier Business Aircraft Market Forecast 2011–2030*, June 2011; *Flight Global*, "NBAA Special," n.d., http://www.flightglobal.com/Features/NBAA/G280/ (accessed October 17, 2011); Forecast International, "The Market for Business Jet Aircraft," December 2010; HBC product brochure, n.d.

[a]For the purposes of this report, the very light segment includes business jets that weigh up to 12,500 pounds MTOW; business jets in the light segment range between 12,501 to 30,000 pounds MTOW; and business jets in the medium to super midsize range between 30,001 to 50,000 pounds MTOW.

[b]Based on 2009 data.

[c]One nautical mile is equivalent to approximately 1.1508 statute miles. Range is the distance an aircraft can fly with NBAA reserves, a term that refers to fuel reserves on an aircraft. The formula to determine the NBAA reserves is complex, but is designed to ensure that an aircraft that is unable to land at its intended airport has sufficient fuel to perform certain in-air maneuvers and reach an alternate airport 200 nautical miles away.

[d]The HondaJet, Embraer Legacy 450 and 500, Cessna Citation Ten, Bombardier Learjet 85, and Dassault Falcon 2000S are in development and not commercially available at this time.

[e]Scheduled to be replaced by the G280 in 2012.

BOX 3.1 New entrants

At least five companies—Cirrus Aircraft, Diamond Aircraft Industries, Eclipse Aerospace, Honda Aircraft Co., and SyberJet Aircraft U.S.A. (formerly Emivest)—have announced plans to offer a business jet in the light or very light segments of the market. Two additional U.S.-based firms, Spectrum Aeronautical, LLC and Stratos Aircraft, Inc., are considering entering this industry.

Cirrus, Eclipse, Honda, and SyberJet are U.S.-based firms with established operations.

- Cirrus currently produces piston-engined aircraft but has announced its plan to produce the Vision SF50, reportedly in Minnesota, for the very light jet market.
- Eclipse is seeking to resume production of its Eclipse 500 twinjet in New Mexico after ceasing operations in 2008.
- Honda Aircraft is in the certification process for its HondaJet, currently produced in North Carolina.
- SyberJet, which purchased the assets of former U.S. business jet producer Emivest out of bankruptcy, intends to resume production of the SJ30 business jet and pursue development of an entire family of SyberJet aircraft. Following the purchase, the manufacturing line was moved from West Virginia to Utah.

Diamond, with operations in Canada, Austria, and China, is in the flight-testing and certification process for its D-Jet in Canada.

Source: Compiled by USITC staff.

TABLE 3.2 Known company-owned business jet activities in operation, by firm and location

Firm	Headquarters	Parent Company (Country)	R&D and Design	Manufacturing/Assembly	Subassemblies/Parts	Finishing
Bombardier	Montreal, Canada	Bombardier, Inc. (Canada)	Canada United States	Canada (Montreal)	Canada (Toronto) Mexico (Querétaro) United Kingdom (Belfast)	Canada (Quebec)
Cessna	Wichita, KS	Textron, Inc. (United States)	United States (KS)	United States (KS)	United States (KS and GA) Mexico (Chihuahua)	United States (KS)
Dassault	Paris, France	Dassault Aviation, S.A. (France)	France (Saint-Cloud)	France	France (various locations)	United States (AR)
Embraer	São José dos Campos, Brazil	Embraer, S.A. (Brazil)	Brazil	Brazil (São Paulo state) United States (FL)	[a]	Brazil United States (FL)
Gulfstream	Savannah, GA	General Dynamics, Inc. (United States)	United States (GA)	Israel	[a]	United States (TX)
HBC	Wichita, KS	GS Capital Partners (United States) and Onex Corp. (Canada)	United States (KS)	United States (KS)	United States (KS) Mexico (Chihuahua)	United States (AR)
Learjet	Wichita, KS	Bombardier, Inc. (Canada)	United States (KS)	United States (KS)	Canada (Toronto) Mexico (Querétaro) United Kingdom (Belfast)	United States (KS)

Source: Compiled by USITC staff.

Note: Business jet production activities are grouped into four primary segments: (1) R&D and design; (2) manufacturing/assembly (assembly and manufacturing of business jets), (3) subassemblies or parts (wings, fuselages, landing gear, aerostructures, etc.), and (4) finishing/completion operations (e.g., painting, installing cabin interiors, optional avionics).

[a]None known.

TABLE 3.3 Global deliveries of business jets, by product segment and producer,[a] 2006–11

	2006	2007	2008	2009	2010	2011[b]
			Units			
Very light jets						
Cessna	63	123	177	160	93	60
Eclipse	1	98	161	0	0	0
Embraer	0	0	2	97	100	41
HBC	23	54	31	16	11	5
Subtotal	87	275	371	273	204	106
Light jets						
Cessna	175	183	196	89	66	101
Embraer	0	0	0	1	26	42
Emivest	1	1	0	2	0	0
Gulfstream	17	30	34	12	12	21[c]
HBC	117	108	123	62	46	18
Bombardier Learjet	71	80	74	46	28	43
Subtotal	381	402	427	212	178	225
Medium to super midsize jets						
Bombardier	84	86	103	69	67	80
Cessna	69	82	93	40	19	22
Dassault	61	64	51	45	54	32
Embraer	27	36	36	18	11	13
Gulfstream	25	29	34	7	12	[c]
HBC	0	0	6	20	16	7
Subtotal	266	297	323	199	179	154
Total	734	974	1,121	684	561	485
Total by company						
Bombardier	84	86	103	69	67	80
Cessna	307	388	466	289	178	183
Dassault	61	64	51	45	54	32
Eclipse	1	98	161	0	0	0
Embraer	27	36	38	116	137	96
Emivest	1	1	0	2	0	0
Gulfstream	42	59	68	19	24	21
HBC	140	162	160	98	73	30
Bombardier Learjet	71	80	74	46	28	43
Total, all deliveries	734	974	1,121	684	561	485

Sources: General Aviation Manufacturers Association, *2011 General Aviation Statistical Databook & Industry Outlook*, n.d. (accessed February 22, 2012); Gulfstream deliveries 2006–10 for models G100/150 and G200 provided in UBS analyst David Strauss's presentation to NBAA Business Aircraft Transactions Conference, June 9, 2011, 27.

Note: The MTOW for very light jets used in this report differs from that of JETNET. In particular, JETNET identifies very light jets as those up to 10,000 lbs. MTOW (see table 4.1) rather than 12,500 lbs. MTOW. JETNET data record business jets between 10,001 lbs. MTOW and 12,500 lbs. MTOW in the "light" product segment.

[a]Cessna, Eclipse, Emivest (now SyberJet), HBC, Gulfstream, and Bombardier Learjet are based in the United States. Gulfstream's business jets within the scope of this investigation are assembled in Israel. Bombardier is based in Canada, Embraer is based in Brazil, and Dassault is based in France.

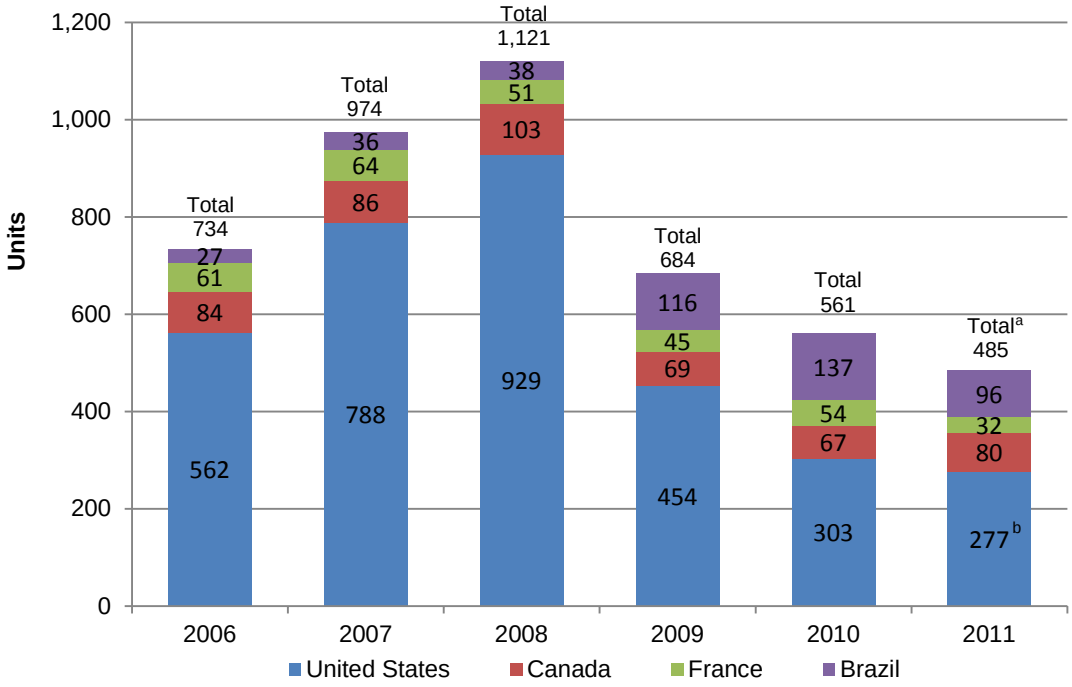
[b]Preliminary.

[c]Delivery data for the Gulfstream G150 (light jet) and G200 (medium to super midsize jet) are not available separately and are consolidated for 2011 only.

During 2006–10, global deliveries of the business jets subject to this investigation peaked in 2008 before dropping sharply during 2009–10 due to the global economic downturn (figures 3.1 and 3.2). All product sectors and most producers posted significant declines in deliveries during the economic downturn; the exception was Embraer, which had entered the very light and light segments of the market previously dominated by U.S. producers Cessna and HBC and was able to increase its shipments. The U.S. industry share of global deliveries exhibited a similar decline, falling from a peak of nearly 83 percent in 2008 to a low of 54 percent in 2010 (table 3.4). In preliminary 2011 data, global deliveries continued to decline, with a drop of 14 percent to 485 aircraft. Light jets were the only segment to post an increase in deliveries, rising by 26 percent to 225 aircraft. The U.S. industry share of global deliveries rose to 57 percent in 2011, as deliveries by Dassault and Embraer declined.

The downturn in the market for business jets within the scope of this investigation is in contrast to deliveries of business jets outside the scope of this study–those weighing over 50,000 lbs. MTOW. Deliveries of these business jets continued to increase despite the economic downturn and credit crisis (figure 3.3). This sector's continued growth is largely attributable to its lower reliance on financing/credit for sales and to stronger demand in emerging markets that were not as severely impacted by the global economic downturn.

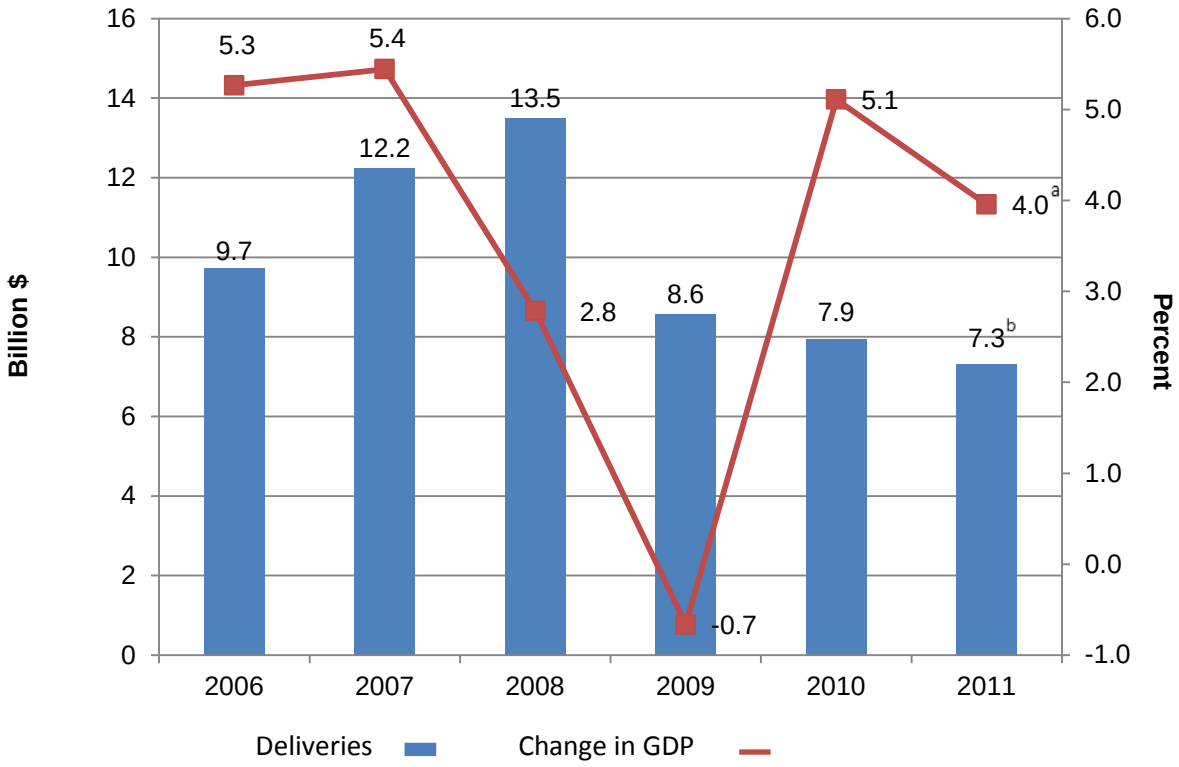
FIGURE 3.1 Global shipments of business jets, by country, 2006–11



Source: General Aviation Manufactures Association, *2011 General Aviation Statistical Databook & Industry Outlook*, n.d. (accessed February 22, 2012. U.S. data include deliveries of Cessna, HBC, Eclipse, Emivest (now SyberJet), and Bombardier Learjet, as well as Gulfstream jets manufactured in Israel.

[a]Preliminary.
[b]Embraer reportedly delivered its first business jet from its Melbourne, Florida, facility in December 2011.

FIGURE 3.2 Global deliveries of business jets (by value) and change in global gross domestic product (GDP) (by percent), 2006–11



Sources: General Aviation Manufacturers Association, shipment database partially based on Business and Commercial Aviation, *2005–11 Purchase Planning Handbook;* International Monetary Fund, World Economic Outlook Database, September 2011.

Note: Value of deliveries is estimated.

[a]Estimated GDP.
[b]Preliminary.

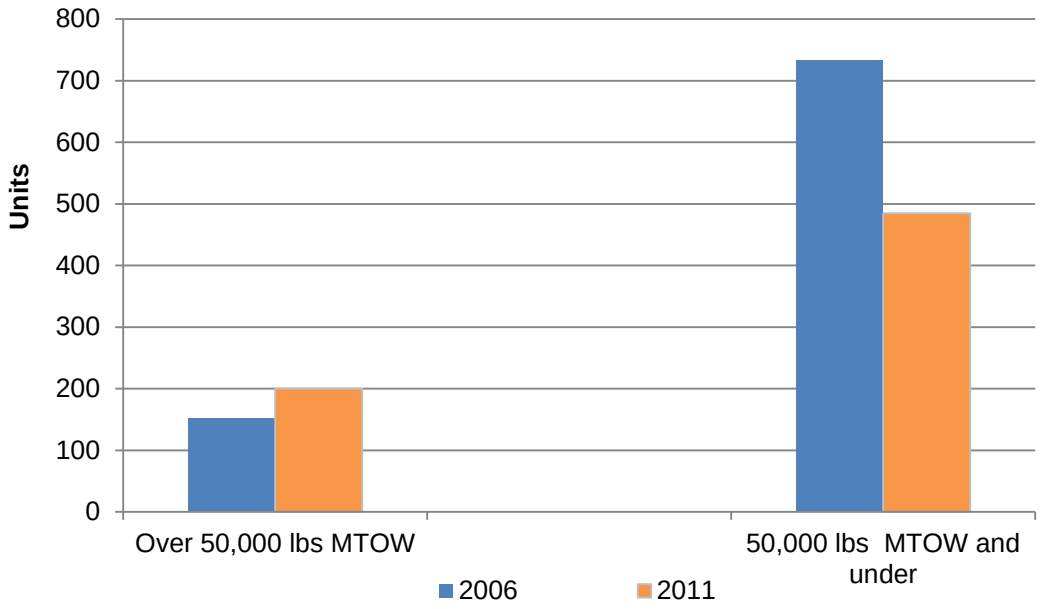
TABLE 3.4 Share of global deliveries of business jets, by country, 2006–11

	2006	2007	2008	2009	2010	2011[a]
			Percent			
United States[b]	76.6	80.9	82.9	66.4	54.0	57.1
Brazil	3.7	3.7	3.4	17.0	24.4	19.8
Canada	11.4	8.8	9.2	10.1	11.9	16.5
France	8.3	6.6	4.5	6.6	9.6	6.6
Total	100	100	100	100	100	100

Source: Derived from the General Aviation Manufacturers Association, *2011 General Aviation Statistical Databook & Industry Outlook*, n.d. (accessed February 22, 2012).

[a]Preliminary.
[b]Includes deliveries of Cessna, HBC, Eclipse, Emivest (now SyberJet), and Bombardier Learjet, as well as Gulfstream jets manufactured in Israel.

FIGURE 3.3 Business jet deliveries, by aircraft segment, 2006 and 2011



Sources: General Aviation Manufacturers Association (GAMA), shipment database provided, based on data in their *2011 General Aviation Statistical Databook & Industry Outlook*, n.d., table 1.4.

The country profiles included in this chapter focus on developments in the business jet industries of the United States, Brazil, Canada, China, and Europe (France) for the period 2006–11, to the extent possible. Because of differences in data availability and the structure of these industries, the analysis and level of detail provided vary by country. In the case of the United States, which has a multi-company industry, the analysis is broader, with company specific information provided as illustrations of trends or activities. The industries of Brazil, Canada, and France, however, each consist of one company, and the ensuing discussion is necessarily firm-focused. The depth of analysis in these country profiles may also reflect the level of participation by the industry/company in the business jet segments under review. In the case of Dassault, for example, its output is concentrated in larger business jets outside the scope of this study, and thus its participation in the subject market is limited. For China, on the other hand, where no known industry currently exists, the analysis outlines China's interest in developing a business jet industry and the initial steps it has taken toward this goal.

U.S. Industry

Summary

The business jet industry has been centered in the United States since its inception in the mid-1960s. The United States is and has been the world's largest producer of, and market for, business jets and has the largest installed base of business jets in the world.[4] The infrastructure to support the industry in the United States includes a multitude of suppliers, universities and research centers, many small regional airports, a nationwide network of maintenance, repair, and fueling facilities, and separate terminals at major commercial airports to service business jets and their customers. Business jet producers in the United States have been at the forefront of technological change and innovation, continually improving business jets in such areas as range, speed, reliability, passenger comfort, and fuel economy. Many of these technological advancements have subsequently been adopted by commercial airline manufacturers.[5]

Industry Structure

The U.S.-based business jet industry has traditionally been represented by four firms—Cessna, HBC, Learjet, and Gulfstream Aerospace Corporation—that have accounted for the majority of business jet production in both the United States and the world in recent years.[6] The first three of these firms are based in Wichita, Kansas, as are a number of aerospace suppliers and services (box 3.2).

BOX 3.2 Wichita aerospace cluster

Wichita, known as the "Air Capital of the World," has a long history of aerospace production, which offers producers in this area a strong infrastructure and supply base and a highly skilled workforce. This cluster includes leading component and systems manufacturers as well as engineering firms. In 2010, aerospace companies in Wichita accounted for 58 percent of all U.S.-built general aviation aircraft and 39 percent of worldwide production of general aviation aircraft.[a] In addition, Wichita is home to a leading center of aerospace research and development, the National Institute for Aviation Research (NIAR), the largest aerospace research and development academic institution in the United States, and the National Center for Aviation Training (NCAT), which trains workers for employment in the aerospace industry.[b]

[a] Industry representatives, interview by USITC staff, Washington, DC, September 2011.
[b] Ibid.

[4] The "installed base" represents the number of aircraft operating within a particular market.

[5] Bombardier Inc., "Leading the Way, Bombardier Business Aircraft Market," July 2010; Brian Foley Associates, "Making Sense of Market Changes: Business Aircraft Transactions Conference," June 8, 2011.

[6] Two other U.S. firms—Eclipse and Emivest—also produced business jets in the United States during the period examined (2006–11). Eclipse, based in Albuquerque, NM, started the development of its very light business jet in the late 1990s and delivered 260 aircraft by 2008, before filing for bankruptcy in late 2008 and ceasing production. Currently, new owners have announced their intention to restart production. The development of Emivest's light business jet began in the mid-1980s. Over the subsequent years, the program experienced production and quality control problems as well as funding difficulties. During 2006–11, Emivest produced and delivered only four light business jets. In 2010, Emivest filed for bankruptcy and ceased production. The company was bought by MT, LLC in the first half of 2011 and intends to restart production under the name SyberJet. Forecast International, "Civil Aircraft Forecast," July 2010; Forecast International, "The Market for Business Jet Aircraft," December 2010, 33; Garvey, "Chinese Mull Another Bizav Buy," March 25, 2011; SyberJet Aircraft, "SyberJet Aircraft Continues the SJ30 Program," June 15, 2011.

Cessna is a wholly owned subsidiary of Textron Inc., a U.S. corporation that also makes Bell Helicopters, and that produces a variety of combat and weapons systems and other industrial products.[7] In addition to Wichita, Cessna's business jet operations are located in Independence, Kansas; Columbus, Georgia; and Chihuahua, Mexico. Wichita is the site of the corporate headquarters and most of the firm's business jet manufacturing activities; some business jets are also made at the Independence plant. The Columbus and Chihuahua facilities make parts and subassemblies for business jets.[8] Most of the company's business jet production consists of very light and light jets, with lesser output of medium to super midsize jets. Cessna also manufactures turboprop and single piston-engine aircraft, but does not make any business jets outside the scope of this study.

As previously noted, HBC is privately owned by Goldman Sachs and Onex Corporation.[9] HBC's business jet operations are located in Wichita, Kansas; Salina, Kansas; Little Rock, Arkansas; and Chihuahua, Mexico. The Wichita facilities are home to the corporate headquarters as well as most of the company's business jet manufacturing activities. The Salina plant makes subassemblies for some business jets, the Little Rock plant paints and installs interiors of the business jets, and the Chihuahua facility makes business jet parts.[10] HBC also sources major portions of certain models from England and Japan. The company's business jet production is concentrated in the very light and light jet segments, although it began production of medium to super midsize jets in 2008. HBC produces turboprop and piston-engine aircraft for the civilian market and trainer/attack military aircraft; however, it does not produce business jets outside the scope of this study.

Learjet is a fully owned subsidiary of Bombardier Inc., a Canadian company that produces commercial and business jets and rail transportation equipment, systems, and services.[11] The business jet operations of Learjet are located in Wichita, Kansas, and are similar in scope to those of Cessna and HBC. The company sources fuselages for some of its business jets from its facility in Belfast, Northern Ireland; wings from its facility in Toronto, Canada; and major composite aerostructures from its plant in Querétaro, Mexico.[12] Its operations in Wichita solely produce business jets within the scope of this study, and these jets are concentrated primarily within the light jet segment. Learjet is currently investing $600 million at its Wichita plant for the production of a new business jet, the Learjet 85.[13] This investment, which includes a new building to house the assembly line and new production equipment, will create 500 jobs in Wichita.[14] In January 2012, Learjet announced a further expansion of its Wichita plant, including the construction of new facilities and the expansion of the Bombardier Flight Test Center.

[7] Textron, corporate Web site, April 9, 2012.

[8] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[9] The Hawker line of business jets was originally created by the De Haviland Aircraft Company (Canada); the company was sold to Hawker Siddeley Corporation (England) in 1968, then to Raytheon Aircraft Company in 1993. Raytheon Aircraft Company became HBC in 2007 after being acquired by Goldman Sachs and Onex. HBC, "About us: History," April 9, 2012.

[10] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[11] Bombardier Inc. makes the Challenger brand of business jets in Canada. See the section on Canada in this chapter for a discussion of Bombardier's business jet operations in Canada.

[12] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[13] The Learjet 85 will compete in the medium to super midsize segment and is Learjet's first composite business jet.

[14] Bombardier Inc., "Bombardier Input to ITC Section 332 Investigation," August 2011; Learjet Inc., posthearing submission to the USITC, October 5, 2011, 3–4.

According to Learjet, this new investment will help create an additional 450 new jobs over the next 10 years.[15]

Gulfstream is a wholly owned subsidiary of General Dynamics, a U.S. corporation involved in aerospace, combat systems, marine systems, and information systems and technology.[16] Gulfstream's business jet operations are located in Savannah, Georgia, and Dallas, Texas. Savannah is the site of Gulfstream's corporate headquarters as well as its R&D and engineering activities. The company's two business jet models that fall within the scope of this report consist of light and medium to super midsize jets. They are manufactured in Israel by Israel Aerospace Industries and then flown to Gulfstream's Dallas facility for completion, which includes exterior painting and installation of the cabin interior and any optional avionics.[17] Gulfstream also manufactures business jets that fall outside the scope of this report at its plant in Savannah and completes them at its U.S. completion centers in California, Georgia, Texas, and Wisconsin. These larger jets account for most of the revenue generated by the firm's business jet operations.[18]

Foreign Direct Investment

In addition to the four established U.S. business jet producers, two foreign-based firms, Dassault and Embraer, either perform finishing work (Dassault) or assemble business jets (Embraer) in the United States, and a third foreign-based firm, Honda Aircraft Company, Inc., expects to begin production of business jets in the United States during 2012. Although data are not available on the total value of the foreign investment in the U.S. business jet industry, the size and structure of these firms' U.S. operations suggest that the United States is the world's largest recipient of such investment.

Dassault, Europe's only business jet producer, is a French firm that manufactures business jets, military aircraft, and software.[19] Dassault has several facilities in France involved in the production of business jets. Once built in France, these jets are flown to Dassault's completion center in Little Rock, Arkansas, for installation of the cabin interiors, including cabin wiring, electrical systems, and customized furniture, and painting. While the total number of Dassault's employees in France exceeds those in the United States, the completion center in Little Rock is the single largest Dassault business jet production facility on an employee basis.[20]

Embraer, Brazil's sole business jet producer, manufactures business, commercial, and military aircraft.[21] In May 2008, Embraer announced that it would build a $50 million, 150,000-square-foot complex in Melbourne, Florida, for its business jet operations to be closer to its customers and its largest market, the United States.[22] Embraer has stated that

[15] Bombardier Inc., "Bombardier Learjet and Governor Brownback Announce Further Expansion," January 10, 2012.

[16] General Dynamics purchased Gulfstream in the late 1990s. General Dynamics, "Business Groups," April 9, 2012.

[17] Israel Aerospace Industries is a large Israeli aerospace and defense company.

[18] Industry representative, interview by USITC staff, Washington, DC, November 2011; General Dynamics, "Annual Report 2010 and Form 10-K," 2011, 3–4.

[19] See the section on France in this chapter for a discussion of Dassault's business jet operations in France.

[20] Industry representatives, interview by USITC staff, Bordeaux, France, October 2011.

[21] See the section on Brazil in this chapter for a discussion of Embraer's business jet operations in Brazil.

[22] Embraer, "Embraer Inaugurates Its First," February 21, 2011.

it was attracted to Melbourne because of its access to ports, a skilled workforce,[23] existing airport infrastructure, government incentives, and pleasant, sunny locale for customers to take delivery of their business jets.[24] In February 2011, Embraer opened the first part of this complex—an 80,000-square-foot plant for final assembly and finishing of business jets.[25] The assembly line in Melbourne resembles Embraer's assembly line in its facility in Gavião Peixoto, São Paulo, Brazil, and consists of stations that mate the wings with the fuselage, prepare the fuselage interior with parts and wiring, install the engine and nacelles, install the avionics, and finish the interior. The fuselages and wings are produced in Embraer's facility in Botucatu, São Paulo, Brazil, and shipped by sea to Melbourne. Systems such as engines and avionics are shipped directly from suppliers in North America to reduce transportation costs.[26] The second part of the complex, a customer delivery center, opened on December 5, 2011.[27] Embraer currently assembles its Phenom 100 business jet in Melbourne, with the first of these delivered in December 2011.[28] Seventy-five people, many of whom received training at Embraer's Brazilian facilities, work in the assembly plant.[29] According to Embraer, the plant will eventually employ 200 people and also assemble the Phenom 300 business jet.[30]

After many years of R&D on business jets and jet engines and the assembly and testing of business jet prototypes in the United States, Japan's Honda Motor Co., Ltd., established the Honda Aircraft Company, Inc., in August 2006 to develop, produce, and market a new business jet, the HondaJet. Honda Aircraft Company has constructed a large complex at Piedmont Triad International Airport in Greensboro, North Carolina, that houses the corporate headquarters, engineering and design, R&D, flight testing, and assembly of the HondaJet. It has also announced that it will invest $20 million at this location to build a maintenance, repair, and overhaul facility for its jet. The company plans to begin production of the HondaJet in 2012, with deliveries expected in mid-2013, but it is currently awaiting FAA certification. The assembly facility has a maximum capacity to produce 100 HondaJets per year. Employment at the complex is more than 550 people, anticipated to rise to nearly 1,000 as production is ramped up.[31] According to industry officials, the Honda Aircraft Company will be a formidable competitor in the business jet market because of the parent company's financial resources, its reputation for quality and advanced technology in its other product lines, and the perception in the

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[23] Embraer has been able to select from a large pool of highly-qualified labor to run its Melbourne facility, due in part to former National Aeronautics and Space Administration (NASA) engineers and technicians who lost their jobs when the NASA shuttle program shut down. Industry representative, interviews by USITC staff, Melbourne, FL, September 2011; Pope, "Embraer Opens Florida Customer Center," December 6, 2011; Carroll, written testimony to the USITC, September 28, 2011, 2.

[24] Industry representatives, interview by USITC staff, Melbourne, FL, September 2011. The airport in Melbourne had contiguous open space as well as existing aprons (expansive ramps that lead from the runway to adjoining buildings).

[25] Embraer, "Embraer Inaugurates Its First," February 21, 2011.

[26] Industry representatives, interview by USITC staff, Melbourne, FL, September 2011. A nacelle system is the aerodynamic structure that surrounds a jet engine. Goodrich Web site, http://www.goodrich.com/Goodrich/Businesses/Aerostructures/Products/Nacelle-Systems (accessed November 15, 2011).

[27] Price, "New Embraer Facility Puts Melbourne on Aviation Map," December 6, 2011.

[28] Croft, "Embraer Completes Melbourne Project," December 6, 2011.

[29] Industry representatives, interview by USITC staff, Melbourne, FL, September 2011.

[30] Larson, "Embraer Phenom Assembly Plant," February 23, 2011.

[31] Honda Aircraft Company, Inc., "Honda Aircraft Company to Establish," February 9, 2007; Patterson, "HondaJet Production Nears," July 13, 2011; Forecast International, "Civil Aircraft Forecast," June 2010; Norris, "HondaJet Resets Delivery Date," October 11, 2011; Honda Aircraft Company, written submission to the USITC, October, 2011, 1–5; Honda Aircraft Company, Inc., "Honda Aircraft Company to Build New HondaJet," October 10, 2011.

industry and among potential customers that Honda has carefully and methodically designed and built a high-quality business jet and intends to remain in the business.[32]

Production/Deliveries

U.S. producers accounted for more than 50 percent of global deliveries of business jets on a unit basis during 2006–11. Their share of global deliveries ranged from a low of 54 percent in 2010 to a high of nearly 83 percent in 2008. Cessna, the world's largest business jet manufacturer, accounted for more than one-half of U.S. deliveries, by units, during the period (table 3.5). HBC was the second-largest U.S. producer during the period.

TABLE 3.5 U.S. producers' global deliveries of business jets under 50,000 lbs MTOW, 2006–11

	2006	2007	2008	2009	2010	2011[a]
	(Units)					
Cessna	307	388	466	289	178	183
Eclipse	1	98	161	0	0	0
Emivest	1	1	0	2	0	0
Gulfstream[b]	42	59	68	19	24	21
HBC	140	162	160	98	73	30
Bombardier Learjet	71	80	74	46	28	43
Embraer	0	0	0	0	0	([c])
Total	562	788	929	454	303	277

Source: General Aviation Manufacturers Association (GAMA), shipment database provided, based on data in their *2011 General Aviation Statistical Databook & Industry Outlook*, n.d., table 1.4.

[a]2011 data preliminary.
[b]Gulfstream's business jets that are within the scope of this investigation are manufactured in Israel.
[c]Embraer reportedly delivered its first business jet from its Melbourne, Florida, facility in December 2011.

U.S. business jet producers enjoyed rising sales during the first half of the 6-year period, with global deliveries of business jets increasing by 65.3 percent between 2006 and 2008, from 562 units to 929 units. In fact, 2008 was a record year for deliveries of business jets. The financial crisis in the fall of 2008 and subsequent global recession led to a sharp decline in demand for the business jets covered in this report. U.S. producers' global deliveries of business jets declined by one-half between 2006 and 2011, from 562 units to 277 units. Measured from the peak in 2008, deliveries fell by two-thirds in 2010 and continued to decline during 2011.

In response to these market conditions, U.S. business jet producers cut their production significantly beginning in 2009 as deliveries of business jets plummeted. Some capacity was eliminated, and some of the assembly lines slowed from two shifts to one shift.[33] Cessna cancelled an entire new program designed to build its largest business jet ever, the Citation Columbus.[34] HBC announced it was suspending production of one of its business jet models, the Hawker 400XP (light jet) as of January 2011; in December 2011,

[32] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.
[33] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interview by USITC staff, Washington, DC, September 2011.
[34] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

the firm announced that it was suspending further development of the Hawker 200 (very light jet) because of the continued downturn in demand for business jets.[35]

U.S. Workforce

Although employment data for the U.S. business jet industry are unavailable, U.S. industry officials indicate that employment has declined dramatically over the last several years due to the recession, as orders fell and production was cut.[36] Employment has also been negatively affected by the trend toward increased outsourcing of parts and components heretofore made by U.S. producers. Most of the producers have built facilities in Mexico to make labor-intensive parts, a strategy that was accelerated by cost concerns resulting from the recession and competition from new entrants.[37]

Employment in the U.S. business jet industry includes jobs in engineering, R&D, assembly and manufacturing operations, administration, sales, and customer support. Business jet firms employ large numbers of engineers, many with advanced degrees, who work in such areas as avionics, electrical systems, airframe structures and analysis, and certification and testing. Many of the hourly workers involved in assembly and manufacturing operations are covered by collective bargaining agreements with the International Association of Machinists and Aerospace Workers (IAM). Their work tends to be relatively skilled and high paying. To maintain a proficient workforce, business jet firms provide professional development training for salaried workers and technical skills training for hourly workers.[38]

U.S. business jet producers have taken steps to reduce labor costs and improve productivity over the last several years. They reduced the size of their hourly work force and negotiated new labor contracts with the IAM. Some salaried workers lost their jobs, and others took pay cuts. Cessna and HBC, the two largest U.S. producers, experienced significant job losses. Since the fourth quarter of 2008, Cessna has cut its workforce by more than 51 percent (8,000 workers), and HBC has laid off nearly 58 percent (4,000 workers) of its workforce. Although these figures include workers involved in activities other than business jet production, significant workforce reductions occurred in business jet operations.[39] Producers also took steps to increase the productivity and educational levels of the remaining workers, resulting in many instances of faster build times for business jets and better product quality. Firms altered assembly lines to achieve greater speed and efficiency and to reduce waste, and they encouraged better communication and cooperation between the various assembly line departments and between assembly line workers and engineers.[40]

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[35] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; McMillin, "Hawker Beechcraft Will Suspend 400XP Program," November 13, 2010; George, "Hawker 200 Development Put on Hold," December 2, 2011.

[36] In 2008, total employment at Cessna and HBC was approximately 16,000 and 9,500, respectively. Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[37] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[38] Industry representatives, interview by USITC staff, Washington, DC, September 2011; industry representatives, interviews by USITC staff, Wichita, KS, July 2011; USITC, hearing transcript, September 28, 2011, 235, 236 (testimony of Richard Aboulafia, Teal Group Corporation).

[39] McMillin, "Hawker Beechcraft Issues 350 Layoff Notices," October 22, 2010; Hegeman, "Cessna Cuts 700 Jobs," September 21, 2010; Trautvetter, "Hawker Beechcraft Gears Up for More Layoffs," November 8, 2011.

[40] Industry representatives, interview by USITC staff, Washington, DC, September 2011; Flightglobal, "Flightglobal Test Pilot Mike Gerzanics" (accessed October 17, 2011).

HBC rapidly increased its employee training beginning in early 2011, taking advantage of a three-year, $10 million grant from the state of Kansas for tuition reimbursement and training. The funds can be used at the National Center for Aviation Training, Wichita State University, and other Kansas state universities. Thus far, under the grant, more than 2,000 of the firm's employees have completed technical training courses, and approximately 250 employees are attending college. HBC notes that the worker training has improved teamwork; has given employees new skills, including the ability to perform multiple tasks and work on different assembly lines; and will likely lead to many employees generating cost-saving ideas.[41]

Supply Chains

Given the immense complexity of designing and building a business jet from thousands of parts, the four U.S. business jet producers have traditionally relied on many suppliers for major components such as engines, wheels, brakes, avionics, landing gear, and auxiliary power units. Although they also make many of their own parts, in recent years U.S. producers have focused more on core competencies such as the design, engineering, integration, and final assembly phases of the business jet manufacturing process.

The supplier base for the U.S. business jet industry is largely centered in the United States. The suppliers of engines, wheels, brakes, avionics, landing gear, and auxiliary power units are typically large corporations with multiple business interests and manufacturing locations. Most are U.S. corporations with manufacturing operations in the United States; other suppliers are based in the United Kingdom and France (table 3.6). They frequently sell components and systems to both commercial and business jet producers, with their sales to the former usually exceeding their sales to the latter.[42]

TABLE 3.6 Major suppliers to U.S. business jet producers

Engines	Wheels	Brakes	Avionics	Landing gear	Auxiliary power units
Honeywell (U.S.)	Goodrich (U.S.)	Goodrich (U.S.)	Honeywell (U.S.)	Messier-Dowty (France)	Honeywell (U.S.)
Pratt & Whitney (U.S.)	Meggitt (U.K.)	Messier-Bugatti (France)	Rockwell Collins (U.S.)	Messier-Bugatti (France)	Hamilton Sundstrand (U.S.)
Rolls-Royce (U.K.)		Meggitt (U.K.)	Garmin (U.S.)		
Williams International (U.S.)		Crane/Hydro-Aire (U.S.)			

Source: Bank of America, Merrill Lynch, "Commercial Aerospace Report," May 13, 2010, 56.

With respect to in-house parts production, the three Wichita-based business jet producers make many of their own parts and components at their facilities in both the United States and foreign countries. For example, wings and fuselages are made at their plants in the United States, Canada, Northern Ireland, and Mexico. Two of the producers make

[41] Industry representatives, interview by USITC staff, Washington, DC, September 2011; McMillin, "CEO: Hawker Adjusts to New Reality," October 13, 2011; HBC, "Hawker Beechcraft Reaches Agreement," December 21, 2010.

[42] Bank of America, Merrill Lynch, "Commercial Aerospace Report," May 13, 2010, 56, 79–87; industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

landing gear for their business jets. Assembly of electrical harnesses and sheet metal fabrication occur at the three producers' Mexican facilities.[43]

Manufacturing

Although the basic assembly process for business jets has generally not changed in recent years, one difference among the producers involves the fuselage, which is typically made of metal. Some years ago, HBC made a sizable investment in the specialized machines, tooling, and employee training to produce fuselages made of composite materials for two of its jets, the Hawker 4000 and the Hawker 200; however, development of the latter aircraft has been suspended. Fuselages made of composite materials save weight, which can improve an aircraft's range and speed performance. Learjet is currently making a substantial capital investment in the specialized machinery and tooling necessary to make a composite fuselage for its new business jet, the Learjet 85. Its equipment and processes differ in some respects from those of HBC.[44]

Financing[45]

Customer financing is often critical to sales of business jets, which are priced from $2 million to more than $40 million. Before the financial crisis in the fall of 2008, credit conditions for business jet customers were relatively favorable. Since the crisis, obtaining buyer financing has become more difficult and expensive, with many customers facing higher interest rates, longer payment terms, and higher down payments.[46] According to industry officials, tighter credit is an important reason why demand for business jets has remained weak despite the overall economic recovery.[47]

Certification[48]

In the United States, the FAA ensures air safety in a number of ways, from developing standards to maintain the airworthiness of aircraft in service to approving new aircraft. The FAA's approval process is complicated and time-consuming, involving separate approvals (certifications) for the design, the production, and the airworthiness of new aircraft and certain aircraft parts. U.S. business jet producers have expressed concern that a lack of resources at the FAA has often significantly delayed the necessary certifications for new business jets, thus seriously hindering their ability to bring new products to market in a timely manner. According to industry representatives, such delays may place U.S. producers at a competitive disadvantage with foreign business jet producers, which can often obtain certifications from their own national aviation authorities in less time.[49]

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[43] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Bank of America, Merrill Lynch, "Commercial Aerospace Report," May 13, 2010, 56.

[44] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interview by USITC staff, Washington, DC, September 2011.

[45] See chapter 6, "Financing," for more information on this issue.

[46] Brian Foley Associates, "Making Sense of Market Changes: Business Aircraft Transactions Conference," June 8, 2011.

[47] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[48] For more information on certification, see chapter 5, "Technological and Business Innovation."

[49] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Aviation International News, "The Aircraft Certification Process," January 2007, 4.

Industry Developments

The business jet industry is competitive and fast-moving, and the severe downturn in business jet deliveries that began in 2009 has intensified the competitive pressures for producers. To survive and prosper, U.S. producers have continually looked for ways to innovate and bring new products to market, become more customer focused, and reduce supply chain costs.

Innovation and Research and Development

To remain competitive and to meet frequent customer demand for larger and more advanced aircraft, U.S. business jet producers have invested substantial sums in R&D to ensure a steady stream of new products as well as enhancements to existing products (table 3.7). They have regularly brought new models to market to stimulate customer demand by differentiating their product from predecessor models as well as from competitors' models. Continual improvements in such areas as cabin size, range, speed, fuel efficiency, avionics, and cabin amenities have created interest in the marketplace and brought customers into the showroom.[50] For example, HBC's ongoing R&D involves a number of areas, including advanced metallic joining, low-cost composites, noise attenuation, efficient structures, systems integration, advanced design and analysis methods, and new material application. Absent constant innovation, a firm risks its future competitiveness in the market.[51]

Despite the severe industry downturn during 2009–11, U.S. business jet producers have generally maintained R&D spending because of the importance of continued product innovation. They have also continued existing new and derivative model programs to maintain customers' interest and to be positioned for the eventual upturn in demand.[52] Cessna recently announced the development of two new models, the Citation M2 and the Citation Latitude. These two business jets, positioned between other Cessna models, offer improvements in speed and range as well as newly-designed cabin interiors. The Learjet 85, announced in 2007, is a new business jet model to be made principally from advanced composite materials. Gulfstream's model G280, announced in 2008, has a shorter takeoff distance, a longer range, and better fuel efficiency than its predecessor, the Gulfstream 200; HBC's model 200 (Hawker 200), announced in 2010, was designed for higher speed, a longer range, and a greater payload than its predecessor, although, as mentioned earlier, development of this model has recently been suspended.[53]

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[50] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011

[51] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Hawker Beechcraft Acquisition Company, "Form 10-K Annual Report," 2011, 9; General Dynamics, "Annual Report 2010 and Form 10-K," 2011, 4.

[52] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[53] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Flightglobal, "Gulfstream G280" (accessed October 17, 2011); Hawker Beechcraft Acquisition Company, "Form 10-K Annual Report," 2011, 5; Cessna Aircraft Company, "Cessna Debuts New Citation," October 9, 2011; Cessna Aircraft Company, "Cessna Announces 'Game-Changing' Citation Latitude," October 10, 2011.

TABLE 3.7 U.S. business jet manufacturers, models produced, passenger capacity, and range, 2011

Parent company	Manufacturer	Model	Passenger capacity	Range, in nautical miles
Bombardier, Inc.	Learjet	40XR and 45XR	8	1,975 to 1,991 with four passengers
		60 XR	8 to 9	2,405 with four passengers
		85XR	8	3,000 with four passengers
GS Capital Partners and Onex Corp.	HBC	Hawker 200[a]	5 to 6	1,546 with four passengers
		Hawker 750	9	2,111 with four passengers
		Hawker 900 XL	9	2,818 with four passengers
		Hawker 4000	8 to 10	3,190 with four passengers
General Dynamics, Inc.	Gulfstream Aerospace Corp.[b]	G150	6 to 8	3,000 with four passengers
		G200	8 to 10	3,400 with four passengers
Textron, Inc.	Cessna Aircraft Co.	Mustang	4	1,150 at MTOW
		Citation CJ series	7 to 9	1,300 to 2,002 at MTOW
		XLS +	9 to 12	1,858 at MTOW
		Sovereign	9 to 12	2,847 at MTOW
		X	9 to 12	3,070 at MTOW

Source: Company Web sites.

[a]Production suspended December 2011.
[b]Data for Gulfstream Aerospace Corp. taken from *Jane's All the World's Aircraft 2011–12*, 749–751.

Service/support Network

U.S. business jet producers have typically provided aftermarket maintenance, inspection, and repair services for some of their customers through a network of company service centers and company-authorized third-party service centers. According to industry representatives, quick and reliable business jet service and repair increase customer satisfaction and loyalty. During 2006–11, U.S. producers expanded their efforts in this area to take advantage of the aftermarket service opportunities created by the rapid growth in the installed base of their business jets that occurred during the early years of this period, as well as to take market share for aftermarket services away from independent service providers. U.S. producers hope that increased revenue in this area will help offset the drop in revenue from sales of new business jets. Because much of the

demand for new business jets is now coming from foreign markets rather than from the United States, they have focused much of their aftermarket efforts overseas.[54]

These aftermarket efforts include opening new company service centers in foreign countries, hiring more field service employees, increasing spare parts inventory, and opening customer call centers that are available 24 hours a day, seven days a week. In 2011, Cessna began construction of a new service center in Valencia, Spain, to support its existing service center in Paris, opened another service center in Prague, increased its inventory of spare parts at its parts distribution facility in Amsterdam, and added a second mobile service unit to service the European market.[55] In May 2011, Gulfstream established field and airborne support teams—groups of employees who can respond quickly to maintenance and repair issues with Gulfstream business jets anywhere in the world. In 2011, Gulfstream also added new warehouses in the United Kingdom and Spain to hold increased inventory of replacement parts for its business jets, positioning the firm to better serve its customers in Europe and the Middle East.[56] HBC opened spare parts distribution warehouses in London, Dubai, and Singapore; increased the number of international field service representatives; and opened customer call centers in overseas locations.[57] Learjet's parent company, Bombardier Inc., opened a regional support office in Mumbai, India, in April 2010 to serve the Asia-Pacific region, opened a spare parts depot in Hong Kong in March 2011, and announced its intention to open several other regional support offices worldwide throughout the remainder of 2011.[58]

Marketing Activities

Coincident with expanded aftermarket activities overseas, U.S. producers also increased marketing and sales efforts in international markets to take advantage of growing demand for business jets there. Although the United States will likely remain the largest single market for business jets for years to come, markets in Asia Pacific, the Middle East, and Latin America present significant commercial opportunities that require a stronger onsite presence.[59] U.S. business jet producers reorganized their overseas sales territories into more specific regions to better focus their marketing activities and posted more sales personnel in each of these regions. They also took steps to improve the marketability of their business jets by adapting to local tastes and culture (also referred to as rebranding). HBC's business jets intended for foreign markets will have different interior colors and furnishings than its business jets sold in the United States; the jets may also have simplified avionics to account for less experienced pilots and language differences.[60] Cessna changed its marketing strategy and the models of aircraft being marketed in China when it realized that there was a mismatch between the kind of business jets the Chinese wanted and the models of jets it was initially marketing.[61] Gulfstream changed the model

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[54] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[55] Cessna Aircraft Company, "Cessna Expands European Customer Service," May 16, 2011.

[56] Gulfstream Aerospace Corporation, "Gulfstream Introduces Field and Airborne," May 16, 2011; Gulfstream Aerospace Corporation, "Gulfstream Increases Parts and Materials," May 16, 2011.

[57] Croft, "Hawker Beechcraft Looks to Take Back," October 17, 2011; Sarsfield, "Face the Facts−Bill Boisture," May 16, 2011.

[58] Bombardier Inc., *Annual Report, Year Ended January 31, 2011*, 81.

[59] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011. To assist marketing efforts, U.S. producers typically have a market analysis group−employees who analyze and track the business jet market through customer surveys and interviews, quantitative methods, and business jet databases and proprietary market studies purchased from aviation consulting firms. Industry representatives, interview by USITC staff, Washington, DC, September 2011.

[60] Mustoe, "Goldman's Hawker Beechcraft Pursues," May 24, 2011.

[61] Padfield, "Cessna Expects Slightly Better 2011," October 11, 2011.

number of its new business jet to another number that was more acceptable in certain countries and cultures.[62]

Supply Chain Relationships

The U.S. business jet supply chain changed significantly during the 2006–11 period as producers strived to reduce costs and remain competitive in an environment of falling demand that began after 2008. According to industry representatives, U.S. producers were compelled to rethink the way that they had traditionally done business, particularly in manufacturing operations. These operations were typically vertically integrated, with in-house production of many parts and components.[63] Producers examined every facet of these operations to find ways to reduce costs and increase production efficiencies. These producers generally determined that their core competencies—R&D, design and engineering, and final assembly—should continue in their U.S. facilities, and that the production of certain parts and components should gradually be shifted to emerging aerospace clusters, typically in lower-wage nations.[64] In so doing, they believed they could remain globally competitive and thereby ensure the long-term economic health of their U.S. manufacturing operations.[65]

Consequently, in the past several years, the three Wichita-based business jet producers have begun to source more parts and components from unrelated U.S. suppliers and from their facilities in Mexico. These plants, located in Chihuahua and Querétaro, Mexico, were built within the past five years. Mexico has been the low-cost destination of choice for labor-intensive processes such as sheet metal formation and electrical harness assembly (box 3.3). Some higher-skilled work is also moving. Learjet, for example, will be manufacturing the principal composite aerostructures for the Learjet 85 aircraft, including assembly of the fuselage, in Bombardier's Querétaro facility.

[62] Gulfstream Aerospace Corporation, "Gulfstream Renames G250," July 18, 2011. "The number 250 can translate in Mandarin to mean "stupid" or "idiotic", while the number "8" has connotations of good fortune." Flight Global, "IN FOCUS: Gulfstream Family Cutaway - Market Confirms Family Values," March 12, 2012.

[63] Industry representatives, interview by USITC staff, Washington, DC, September 2011; industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[64] Mexico and Morocco are two examples of emerging aerospace clusters with wage rates lower than those in the United States. Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interviews by USITC staff, France, October 2011.

[65] Industry representatives, interview by USITC staff, Washington, DC, September 2011; industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Learjet Inc., posthearing submission to the USITC, October 5, 2011, 4, 5.

BOX 3.3 Industry in Mexico

Mexico reportedly is working to build up the skills of its workforce to attract aerospace companies.[a] Industry representatives report that an aerospace cluster is forming in Querétaro.[b] The Mexican government has invested in training for its local workforce, has designated an aerospace industrial park, and has worked to offer incentive packages to aerospace companies to encourage them to locate operations in the country.[c] Mexican state and federal governments created the first Mexican aerospace trade school mandated to provide public education to prepare its students for technical and engineering careers in aerospace—the Universidad Nacional Aeronáutica en Querétaro (UNAQ), which produced its first graduates in 2009.[d] UNAQ works directly with companies to tailor courses relevant to their needs. For example, the school will offer a composite material course with access to a $1.5 million open-composite lab, which will prepare its graduates for work on projects like the Learjet 85.[e] The training provided at UNAQ has been essential to drawing aerospace companies to Querétaro and makes the prospect of growing into more complex activities plausible. GE, for example, employs roughly 1,300 engineers at its design center in Querétaro, where it is working on jet engine designs, among other things.[f]

[a] Hawley, "Aerospace Industry Migrating to Mexico," April 2, 2008.
[b] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011.
[c] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011; Learjet, posthearing submission to the USITC, September 18, 2011, 4.
[d] Everest Group, Web site, http://www.theeverestgroup.com/clients/item/national-aerospace-training-center-in-mexico.html (accessed November 21, 2011).
[e] Sobie, "Mexico's Massive Expansion," October 20, 2009; Sobie, "Querétaro Prepares for Massive Aerospace Growth," April 20, 2009.
[f] Casey, "The New Learjet…Now Mexican Made," July 29, 2011.

The quality of the work in the Mexican facilities is reported to be good, although some time was required to train the workers and get the production lines up and running.[66] The three Wichita-based business jet producers were attracted to Mexico for a number of reasons, including low labor costs; incentives offered by both national and local governments; relatively good infrastructure; and the proximity of the plants to Wichita, allowing the rapid transport of parts from Mexico as well as enabling company officials to travel quickly between sites.[67] The wage savings are said to be significant, with one company reporting cost savings of 30 percent, even taking increased transportation costs into account.[68]

Risk Sharing and Systems Integration

Another major change in U.S. business jet producers' relationships with their suppliers in recent years has been the development of risk-sharing partnerships and systems integration models of production. By drawing on the strengths of the supplier base, risk sharing and systems integration have assisted U.S. business jet producers in developing and selling new business jets.[69] Faced with increased cost, risk, and complexity in bringing more new business jet models to market, U.S. producers shifted from the build-to-spec (or build-to-print) model to risk-sharing relationships with many of their major

[66] Industry representatives, interview by USITC staff, Washington, DC, September 2011; industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Learjet Inc., posthearing submission to the USITC, October 5, 2011, 4, 5. Production of parts and components for other types of aircraft also occurs in some of these plants. Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.
[67] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Learjet Inc., posthearing submission to the USITC, October 5, 2011, 4–5; Garvey, "Mexican Cluster," March 28, 2011, 52; Casey, "The New Learjet…Now Mexican Made," July 29, 2011.
[68] Hawley, "Aerospace Industry Migrating to Mexico," April 2, 2008.
[69] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interview by USITC staff, Washington, DC, September 2011; Bombardier Inc., "Bombardier Input to ITC Section 332 Investigation," August 2011.

suppliers.[70] This model often requires suppliers to perform R&D activities heretofore done by the OEMs, and to rigorously monitor their manufacturing operations to eliminate unnecessary cost and improve product quality. They became partners in the entire process of design and production of an aircraft, with a vested interest in the success of the program.[71]

To simplify the supply chain (from the producers' perspective) and shift greater responsibility (and risk) to major suppliers, the producers in many instances have required them to become systems integrators, i.e., to manage the smaller companies that provide the major suppliers with parts and to offer the producer a complete system or subassembly rather than individual parts.[72] One U.S. business jet producer noted a concern with this approach, explaining that if the complete system or subassembly fails to perform up to specifications, the issue of which supplier is responsible (liable) can become problematic.[73] Another U.S. producer indicated that this situation can be avoided if the systems integrator is carefully evaluated to ensure it has the expertise to manage the smaller suppliers and if contracts are properly written to assign liability for a product defect.[74]

Brazil

Summary

Brazil is both a growing market and a major manufacturing base for the business jet industry. The country's sole business jet manufacturer is Embraer, which is also a producer of commercial aircraft. Embraer entered the business jet market in 2002 with the introduction of the Legacy 600, a super midsize business jet aircraft. Embraer subsequently produced the Phenom 100 and 300 aircraft in the very light and light product segments and, with these aircraft models, rapidly gained global market share. The majority of Embraer's business jet production takes place in Brazil, but the company has also established manufacturing facilities in China, Portugal, and the United States.

Industry Structure

Although the business jet industry in Brazil has developed only within the last decade, successful regional and military aircraft programs are well established.[75] Embraer was created in 1969 as a government-controlled enterprise to develop aircraft for the Brazilian

[70] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interview by USITC staff, Washington, DC, September 2011; Bombardier Inc., "Bombardier Input to ITC Section 332 Investigation," August 2011.

[71] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interview by USITC staff, Washington, DC, September 2011; Bombardier Inc., "Bombardier Input to ITC Section 332 Investigation," August 2011. Risk-sharing partnerships can also occur among the component suppliers. General Electric and Honeywell partnered to produce and market an engine for business jets. USITC, hearing transcript, September 28, 2011, 173 (testimony of Robert Wilson, Honeywell Aerospace).

[72] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interview by USITC staff, Washington, DC, September 2011.

[73] Industry representatives, interview by USITC staff, Washington, DC, September 2011.

[74] Ibid.

[75] Brazilian aviation can be traced back to the 1940s with the establishment of the Aerospace Technological Center (CTA), which housed Brazil's first school of aeronautic engineering, Instituto Tecnológico de Aeronáutica (ITA). Also within the CTA was the Institute for Research and Development (IPD), which developed the first Brazilian prototype aircraft in the 1960s. Vertesy, "Interrupted Innovation," November 2010, 31, 28.

Air Force, and privatized in 1994.[76] Privatization prompted the company to search for new ways to generate revenue and develop sources of capital.[77] Embraer first entered the business jet market in 2002, based on industry projections indicating substantial and growing demand for business jets.[78] The company viewed the business jet market as one that would provide opportunities for growth and diversification of production.[79] By 2005, Embraer's publicly stated vision was to become a major player in the business aviation market by 2015,[80] a goal it plans to achieve by offering jets in all product segments. [81]

As of 2010, executive aviation (business jets) accounted for 21 percent of Embraer's revenues, compared to 54 percent from commercial aviation (regional jets).[82] The relative importance of business jets as a revenue generator tripled over the last five years, increasing from 7 percent of revenues in 2005 to 21 percent in 2010 (figure 3.4). Concurrently, Embraer's share of the global business jet market in terms of deliveries increased from 3 percent in 2008 to 19 percent in 2010, largely due to the successful launch of the company's very light and light business jets.[83]

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[76] Embraer is now a publicly held company listed on both the São Paulo and New York stock exchanges. Some of these shares are government owned: the Brazilian Development Bank's (BNDES) equity investment branch owns 5.5 percent, and the employee pension fund of the state-owned Banco do Brasil owns another 12 percent. The government also retains a "golden share" that gives it veto power over changes to the strategic focus of the company and to military production. Embraer industry representatives have explained that the golden share does not affect the business jet segment of the company, but it has nonetheless raised concerns among U.S. OEMs about potentially disproportionate government influence over Embraer. Embraer, "Form 20-F," April 18, 2011; industry representative, interview by USITC staff, São José dos Campos, Brazil, September 2011; HBC, prehearing brief to the USITC, September 7, 2011, 2.

[77] Privatization in 1994 did not mean government support ceased altogether. The role of government support for Embraer's R&D activities and exports is discussed in chapter 6, "Financing."

[78] Embraer, prehearing brief to the USITC, September 18, 2011, 1.

[79] Embraer, posthearing brief to the USITC, September 18, 2011, 1.

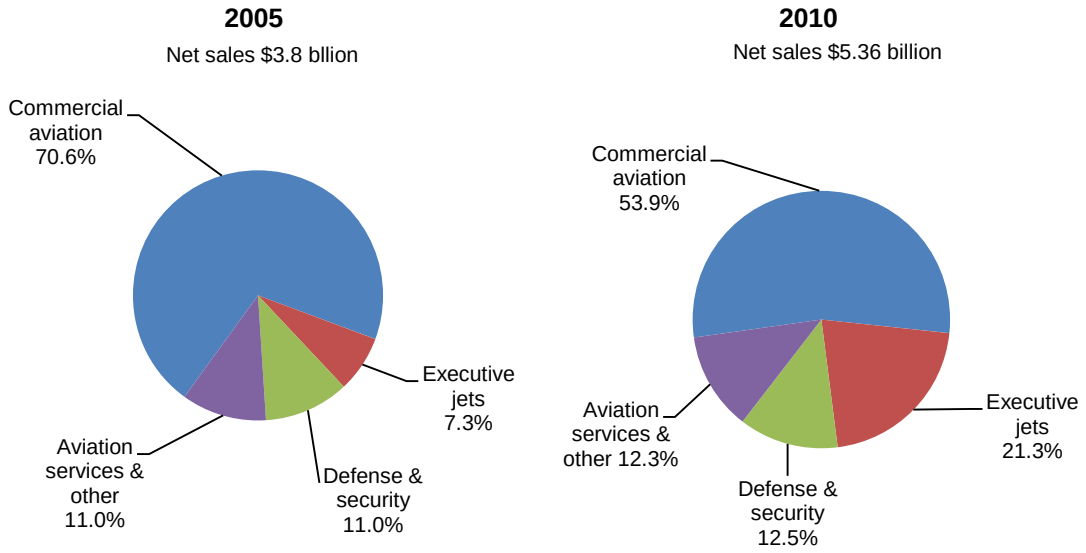
[80] Done, "Embraer Faces Headwinds," October 10, 2011; Embraer, "Executive Aviation Market," November 18, 2005.

[81] Embraer, "Form 20-F," April 8, 2011, 24.

[82] Embraer, "Form 20-F," April 8, 2011. The figure for business jets reflects all of Embraer's business jets, including two models that are outside the scope of this study. The trend, however, still reflects the contribution of Embraer's business jets under 50,000 lbs. MTOW to revenues.

[83] Trautvetter, "Embraer Eyes Global Jet Segment," March 31, 2011. For the business jets included in the scope of this investigation, Embraer's (Brazil's) share of global deliveries peaked at 24 percent in 2010 and fell to 20 percent in 2011. See table 3.4 in this chapter.

FIGURE 3.4 Business (executive) jet revenue as percentage of total Embraer revenue, 2005 and 2010



Source: Embraer, "Form 2-F," June 30, 2006; Embraer, "Form 20-F," April 18, 2011.

Production/Deliveries

Embraer currently produces three models of business jets that fall within the scope of this report: the Phenom 100 (very light jet segment), the Phenom 300 (light jet segment), and the Legacy 600 (super midsize jet segment).[84] Embraer began deliveries of its first business jet in 2002, the Legacy 600, which is a derivative of Embraer's ERJ 135 regional jet. Deliveries of the Phenom 100 began in December 2008, followed by the Phenom 300 in 2009. Embraer has rapidly gained market share in the very light and light business jet segments, selling over 300 Phenom 100/300 business jets since they entered service (table 3.8). The company delivered 83 Phenom 100/300 jets in 2011, just shy of its of goal of 100; it temporarily halted deliveries of these aircraft in the first half of 2011 to implement design changes required by service bulletins.[85] The Phenom 100/300 has experienced particular success in Latin America—notably in Brazil itself, a growing market for business jets not as severely impacted as the United States by the recent economic downturn (box 3.4).[86]

[84] Embraer also produces the Legacy 650, which is a slightly larger derivative of the Legacy 600, and the Lineage 1000, which is part of the ultra-large segment. These have a MTOW above 50,000 lbs. and are outside the scope of this study.

[85] Trimble, "Embraer Links Plunging Phenom Deliveries to Service Bulletins," July 29, 2011. A service bulletin is a notice issued by the FAA recommending changes to systems or warning of potential problems. General Aviation Manufacturers Association, *2011 General Aviation Statistical Databook & Industry Outlook*, n.d. (accessed February 22, 2012).

[86] For further discussion of the Latin American business jet market, see chapter 4, "The Market for Business Jet Aircraft."

TABLE 3.8 Deliveries of Embraer's business jets under 50,000 lbs MTOW (in units), 2006–11

	2006	2007	2008	2009	2010	2011
Phenom 100	([a])	([a])	2	97	100	41
Phenom 300	([a])	([a])	([a])	1	26	42
Legacy 600	27	36	36	18	11	13
Total	27	36	38	116	137	96

Source: General Aviation Manufacturers Association*, 2011 General Aviation Statistical Databook & Industry Outlook,* n.d., table 1.4.

[a]Phenom 100 and 300 deliveries did not begin until 2008 and 2009, respectively.

BOX 3.4 Brazilian market for light and very light jets

Brazil is a leading market for the Phenom 100 and 300 jets, second only to the United States. Although more than one-half of Embraer's Phenom 100 and 300 jets were delivered to U.S. customers as of early 2011, Brazil received one-quarter of global deliveries.[a] While Brazil accounts for only a fraction of the total global business jet fleet, it has a significantly higher share of the very light and light jet markets and is growing rapidly. Very light and light jets such as the Phenom 100 and Cessna Mustang have been particularly popular as Brazilian SMEs start to use them as a tool to expand their businesses. Business is concentrated in the southeast of Brazil, but economic growth in the north, combined with limited road and commercial airline infrastructure, make Brazil a receptive market for business jets.[b]

Within Brazil, the Phenom 100 fleet is larger than any other type of business jet.[c] Embraer is a very strong brand in Brazil, and a source of national pride. It is also the only light jet manufacturer with wholly owned maintenance and service facilities in Brazil, allowing it to perform all levels of maintenance in Brazil and distinguishing it from competitors.[d] Outside of Brazil, Embraer may be at a competitive disadvantage compared to more long-established business jet OEMs with proven records of quality and service that induce sustained brand loyalty.

[a] George, "Brazil's Bizjet Phenom," March 28, 2011. For a broader discussion of the Brazilian business jet market, see chapter 4, "The Market for Business Jet Aircraft."
[b] Sobie, "Brazil's Light Jet Sector Explodes," August 9, 2010.
[c] Ibid.
[d] Competitors Cessna and HBC use local partners to sell their aircraft as well as provide maintenance services. George, "Brazil's Bizjet Phenom," March 28, 2011; Sobie, "Brazil's Light Jet Sector Explodes," August 9, 2010.

When Embraer unveiled its plans to produce a very light jet, the Phenom 100, in 2005, it represented the company's first purpose-built, clean sheet business jet design. At the time of Embraer's decision to begin development of the Phenom 100, the company was projecting growth for the very light and light jets segments.[87] Embraer, like other business jet manufacturers, believed that it would be possible to expand the market for business jets by reaching out to new types of operators, such as air taxis and pilot owners. Before launching the Phenom 100, Embraer was already producing a super midsize jet, the Legacy 600. To complement this offering and expand its product line, the firm targeted the lower end of the market, first with an entry-level (very light) jet, followed by a light jet.[88]

Currently, Embraer also has a $750 million project underway to develop two medium-sized jets, the Legacy 450 and 500, which will expand the company's business jet offerings and fill the gap between the Phenom 100/300 and the much larger Legacy 600.[89] The Legacy 450 and 500 will reportedly incorporate full fly-by-wire technology, a

[87] White, "A Jet Phenom-enon," January 2006, 10.
[88] White, "A Jet Phenom-enon," January 2006, 8.
[89] The estimate $750 million includes investment in plant, property, and equipment in addition to development costs for the Legacy 450/500 programs. Embraer, "Form 20-F," April 18, 2011, 22; Epstein, "Legacy 500 to Fly by Year End," October 11, 2011.

feature not previously available on jets in comparable size segments.[90] The aircraft development programs were officially launched in April 2008 and reportedly employed an estimated 650 people at the end of 2010. The Legacy 500 is expected to enter service in 2012 or 2013, followed by the Legacy 450 one year later.[91] However, recent reports indicate the Legacy 500 program has been delayed due to problems associated with its fly-by-wire software, pushing back the aircraft's first delivery to 2014.[92] The Legacy 450 and 500 will give Embraer one of the most complete ranges of business jets in the industry (table 3.9).[93]

TABLE 3.9 Embraer business jets under 50,000 lbs MTOW, in production or development, 2011

Model	Price (in million $)	Range (no. of passengers)	Max passengers (plus crew)	Entry into service
Phenom 100	3.75	1,100 nm (4)	7(1)	2008
Phenom 300	8.14	1,900 nm (6)	9(1)	2009
Legacy 450	15.25	2,300 nm (6)	9(2)	2014
Legacy 500	18.40	3,000 nm (6)	12(2)	2013
Legacy 600	27.45	3,900 nm (4)	14(2)	2002

Sources: Embraer Web site, http://www.embraerexecutivejets.com (accessed January 9, 2012); Peaford, *2011 Pocket Guide to Business Aircraft*, 2011; Croft, "New Legacies Facing One Year Delay–Embraer," November 9, 2011.

Note: nm = nautical mile = 1.1508 miles.

Workforce

In 2010, Embraer employed 70 percent of the workers in Brazil's aerospace industry.[94] Embraer reduced its workforce by 20 percent in February 2009 due to the economic downturn. At the end of 2010, Embraer employed roughly 18,900 workers worldwide, 85 percent of whom were located in Brazil.[95] Specific employment data relating to Embraer's business jet segment are not available because company resources are shared across product lines rather than separated into military, commercial, and business aviation divisions. For example, one machine shop serves all product lines, as do shipping, accounting, and other administrative functions.[96] In addition, Embraer's roughly 4,000 engineers rotate among divisions according to the company's priorities.

The minimum level of education required of an Embraer employee is a high school diploma, and 38 percent of Embraer's employees hold at least a bachelor's degree.[97] Approximately 24 percent of Embraer's workforce is made up of engineers, most of whom trained at Brazilian engineering schools.[98] Brazil's premier engineering university, Instituto Tecnológico de Aeronáutica (ITA), is located across from Embraer's

[90] Epstein, "Legacy 500 to Fly by Year End," October 11, 2011. Among business jets, full fly-by-wire systems are only present on the Dassault Falcon 7X and Gulfstream's G650, both outside the scope of this study.
[91] Embraer, "Form 20-F," April 18, 2011, 22.
[92] Arabian Aerospace, "NBAA: Embraer Facing Delays on Legacy 500 Programme," October 10, 2011; Done, "Embraer Faces Headwinds," October 10, 2011.
[93] Malova, "Raymond Jaworowski: The Market for Business Jet Aircraft," January 24, 2011.
[94] Industry representative, interview by USITC staff, São José dos Campos, Brazil, September 2011.
[95] Embraer, "Form 20-F," April 18, 2011, 87.
[96] Industry representative, interview by USITC staff, São José dos Campos, Brazil, September 2011.
[97] Embraer, *Annual Report*, 2010, 71.
[98] Embraer, "Form 20-F," April 18, 2011, 27.

headquarters in São José dos Campos, São Paulo,[99] and provided Embraer with a steady pool of highly trained engineers at the company's inception. Currently, more than 200 Embraer engineers are from ITA.[100] The aerospace industry reportedly has found it increasingly difficult to recruit engineers from ITA because many of its graduates choose to pursue more lucrative careers in finance.[101] Embraer has its own training facility that actively supports and develops existing employees, while also ensuring a pipeline of qualified new talent. For example, the company's 18-month Engineering Specialization Program (SPE) gives specialized aeronautics training to new engineering graduates in any discipline and from any university in Brazil, bringing them up to the level of an "Embraer engineer."[102]

Brazil's rapid economic growth, the appreciation of the Brazilian *real* against the U.S. dollar, and high costs related to employment have reportedly eroded some of the cost advantage that may have previously existed in Brazil.[103] According to industry representatives, the cost of labor in Brazil for Embraer, which includes taxes, social programs, healthcare, and transportation, has been increasing.[104]

Location and Production Facilities

The Brazilian aerospace industry is anchored by Embraer and is clustered around São José dos Campos, which is home to government research institutions and a technology park.[105] Embraer also has facilities in surrounding cities in São Paulo state for assembly of the Phenom 100/300. Moreover, the company has invested in facilities in the United States (Florida), Portugal, and China to either assemble business jets or manufacture their components.

Embraer's Phenom 100 and 300 business jets may be assembled in either Brazil or the United States.[106] In Brazil, assembly, interior finishing, painting, and testing of the Phenom 100 and 300, all take place in Gavião Peixoto, São Paulo state.[107] The plant is currently producing around 10 Phenom 100/300s per month, but could produce as many as 15, with the time-intensive painting process as the limiting factor.[108] Wings, fuselage, and other aerostructures are produced at Botucatu, also in São Paulo state, and then transported north by truck to Gavião Peixoto or southeast to a port near São Paulo city, where they are shipped to Florida for final assembly. Customers have predominantly

[99] ITA Web site, http://www.ita.br/ingles (accessed November 7, 2011).

[100] Industry representative, interview by USITC staff, São José dos Campos, Brazil, September 2011.

[101] Ibid.

[102] See chapter 5, "Technological and Business Innovation in Business Aviation," for more information on training in Brazil and at Embraer. Industry representative, interview by USITC staff, São José dos Campos, Brazil, September 2011; Embraer, "Form 20-F," April 18, 2011, 87.

[103] Anselmo, "Productivity Drive," May 10, 2010, 54.

[104] Industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

[105] For more discussion of Brazil's aerospace cluster, see chapter 5, "Technological and Business Innovation in Business Aviation."

[106] All of Embraer's business jets had been assembled in Brazil until December 2011, when the first U.S.-assembled Embraer Phenom 100 was delivered to a U.S. customer. The plant in Melbourne, Florida, has the capacity to produce the Phenom 300 as well, but had not done so by the end of 2011. Croft, "Embraer Completes Melbourne Project," December 6, 2011.

[107] The site was chosen by Embraer through a site selection process to enable expansion beyond its capacity in São José dos Campos; the land is on temporary authorization from the state of São Paulo, but the facilities are owned by Embraer. Embraer, "Form 20-F," April 18, 2011; industry representative, interview by USITC staff, Gavião Peixoto, Brazil, September 2011.

[108] Industry representative, interview by USITC staff, Gavião Peixoto, Brazil, September 2011. The Phenom 100 and Phenom 300 are produced on the same assembly line and are occasionally referred to in tandem as Phenom 100/300 throughout this report.

taken delivery of their aircraft in São José dos Campos, but with the 2011 completion of the customer center in Melbourne, Florida, they have the option of taking possession of their aircraft in the United States as well.

Embraer has invested in state-of-the art design and manufacturing tools to accelerate product development and to manufacture more efficiently.[109] For example, Embraer used Dassault System's CATIA V5 state-of-the-art design software to design the Phenom 100, and has used cost-reducing robotic riveting tools to assemble its aluminum fuselage at the Botucatu facility since 2006.[110] Embraer invested $90 million from 2007 to 2010 in the robotics infrastructure of its Botucatu facility, introducing automated machines that can drill and weld seven times faster than when the work was done manually.[111] In 2011, the Embraer painting facility at Gavião Peixoto was undergoing a substantial investment to increase the capacity of the center and partially automate the process.[112]

Foreign Direct Investment

Aerospace foreign direct investment in Brazil by U.S. multinationals has been somewhat limited, consisting primarily of maintenance and repair facilities. A handful of other foreign suppliers have located in São José dos Campos to be near Embraer and are supplying aerostructures and other components to the company's business jets.[113]

Embraer has established facilities in the United States, China, and Portugal related to business jet production. The company's U.S. investment has been the largest, and its Florida plant is designed to mirror Embraer's very light and light jet assembly plant in Brazil. Embraer invested $52 million in Melbourne, Florida, to construct an assembly facility, paint shop, and customer delivery center.[114] The plant is currently assembling Phenom 100s, the first of which was delivered in December 2011.[115] The facility is capable of assembling both Phenom 100s and 300s on the same line, and at full capacity will assemble eight jets per month.

Embraer had several motivations for establishing production facilities in the United States. First, the jets assembled in Melbourne are destined primarily for U.S. customers, the largest market for Embraer's Phenom 100 and 300.[116] The Phenoms lack the range to make a direct flight from Brazil to the United States, so such a trip could include multiple stops. European customers may also find taking possession of their jet in Melbourne more convenient than Brazil.[117] Second, because the majority of components for Embraer's business jets come from North American suppliers, locating a facility in the United States optimizes the company's supply chain.[118] Third, the United States made sense from a cost perspective, as the Brazilian *real* has appreciated against the dollar.[119]

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[109] George, "Embraer Phenom 100," October 2008, 3.
[110] George, "Embraer Phenom 100," October 2008, 4.
[111] Anselmo, "Productivity Drive," May 10, 2010, 54; Embraer, "Form 20-F," April 18, 2011, 22.
[112] Industry representative, interview by USITC staff, São José dos Campos, Brazil, September 2011.
[113] These foreign suppliers include Aernnova (Spain), ENAER (Chile), Sonaca (Belgium), and Alestis (Spain).
[114] Embraer, posthearing brief to the USITC, September 18, 2011, 3.
[115] Croft, "Embraer Completes Melbourne Project," December 6, 2011.
[116] Spruce, "Embraer Customer Center in Florida," October 11, 2011.
[117] Carroll, written testimony to the USITC, September 28, 2011, 2.
[118] Embraer, posthearing brief to the USITC, September 18, 2011, 13.
[119] USITC, hearing transcript, September 18, 2011, 217 (testimony of David Strauss, UBS Investment Research); industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

Outside of the United States, Embraer is in the process of transitioning a regional jet production line (ERJ-145) in Harbin, China, to a production line for its business jet derivative, the Legacy 600.[120] Deliveries are estimated to begin within 18 months.[121] Production of the ERJ-145 in Harbin came to a halt in late 2010,[122] but the converted business jet production line will take advantage of the infrastructure, financial resources, and workforce already in place.[123] The Harbin facility was initially created as part of a joint venture with the Aviation Industry Corporation of China (AVIC) and aims to serve China's growing business jet market.[124] Embraer also began building two facilities in Evora, Portugal, in mid-2008, one for the manufacture of composite assemblies and the other for metallic assemblies.[125] The factories will provide parts across Embraer's business segments, including business jets, and are scheduled to begin production in 2012.

Supply Chain Relationships

Embraer's supply chain is predominantly global in nature, with local Brazilian suppliers playing a relatively limited role. According to Embraer, one of the company's core competencies is supply chain management;[126] for the best technology, the company routinely looks to leading suppliers—often multinationals—and then focuses on integration and assembly. In keeping with general industry practice, certain Embraer business jets may use the same components, manufactured by the same suppliers, as competing aircraft,[127] particularly since the majority of content for Embraer's business jets comes from U.S. suppliers.[128] For example, both Embraer's Phenom 100 and Cessna's Mustang use Garmin avionics and Pratt &Whitney engines, reflecting the state-of-the-art technology available at the time these very light jets were being developed.

Although the local Brazilian supply chain benefited from Embraer's growth following privatization in the 1990s, local content decreased with new products launched in the 2000s as risk sharing became a more pervasive model. Many Brazilian companies lacked the size, capital, or proven technology to compete against foreign suppliers.[129] Although boosting the competitiveness of local SMEs and increasing domestic content appear to be goals of the Brazilian government, reportedly this is not a significant consideration for Embraer as it makes its supplier decisions.[130] Even the Brazilian government acknowledges that it is difficult to strike a balance between its objective to support local

[120] The production line will be for both the Legacy 600 and 650, though the 650 is outside the scope of this study. Anselmo, "Deal Saves Embraer Production in China," April 14, 2011.

[121] Moscrop, "Embraer Preps to Build Bizjets in China," July 19, 2011.

[122] Ibid.

[123] Embraer, "Form 20-F," April 18, 2011.

[124] Embraer, "Form 20-F," June 30, 2006; Embraer, "Embraer Entered into Framework Agreement with China," n.d. (accessed November 17, 2011). The initial joint venture was formed in 2002 with Harbin Aircraft Industry Co. and Hafai Aviation Industry Co., both subsidiaries of AVIC. Embraer owns 51 percent of the resulting company, Harbin Embraer Aircraft Industry Co. Ltd. (HEAI).

[125] Embraer, "Form 20-F," April 18, 2011, 143.

[126] Embraer, posthearing brief to the USITC, October 5, 2011, 7.

[127] In some cases the components may be identical. In others, the baseline system and essential technology will be common to different competing aircraft models, but it will have been tailored to the specific demands of the OEM.

[128] Embraer, posthearing brief to the USITC, October 5, 2011, 3.

[129] Vertesy, "Interrupted Innovation," November 2010, 31.

[130] Vertesy, "Interrupted Innovation," November 2010, 31; industry representative, interview by USITC staff, São José dos Campos and Rio de Janeiro, Brazil, September 2011.

SME growth to develop the domestic supply chain and its desire to foster the competitiveness of Embraer.[131]

Risk Sharing

Embraer has embraced a risk-sharing model in which certain suppliers become partners, contributing capital and sharing the development costs of an aircraft program (table 3.10).[132] First used for the development and production of its regional jets in the 1990s,[133] Embraer now uses the model for its business jets as well. Embraer appears to be unique in the number of capital-intensive business jet development programs it has launched in a short period of time, and one explanation may be its extensive use of risk sharing, which reduces the time and capital necessary to develop a new aircraft.[134] Risk sharing also allows Embraer to focus on its core competencies, which it identifies as aircraft design, aircraft assembly, supply chain management, aircraft certification, and global customer support.[135] Risk-sharing partners further the more integrative approach of aircraft assembly as well, with increasing responsibility assigned to the suppliers. Garmin, for example, provided the Phenom 100/300s with a fully integrated avionics suite that integrates "primary flight, navigation, communication, terrain, traffic, weather, engine instrumentation, and crew-alerting system data."

TABLE 3.10 Risk-sharing partners for Embraer's business jets under 50,000 lbs MTOW

Product	Phenom 100/300	Legacy 450/500	Legacy 600[a]
Engine	Pratt & Whitney Canada	Honeywell	–
Avionics	Garmin	Rockwell Collins	–
Other[b]	Eaton	Heroux–Devtek	Aernnova
		Goodrich	Sonaca
		B/E Aerospace	ENAER
		Parker	
		BMW Group	

Source: Embraer, "Form 20–F," April 18, 2011.

[a]The risk-sharing partners for the Legacy 600 are the same as those for the ERJ 145 family, from which it was derived.

[b]"Other" includes various components such as hydraulic systems, flight control systems, landing gear, and aerostructures.

Risk-sharing partners had contributed a total of $582 million to Embraer as of December 31, 2010.[136] These funds appear to have been used for the development of the Phenom 100/300 and the Legacy 450/500, as well as the commercial E170/190 regional

[131] Industry representative, interview by USITC staff, Rio de Janeiro, Brazil, September 2011.

[132] Embraer, "Form 20-F," April 18, 2011. Embraer defines risk sharing as agreements in which suppliers are responsible for the design, development, and manufacture of major components or systems of the company's aircraft, such as wings, tail, or fuselage. These partners must invest their own money in development and share the risk and success of the aircraft with Embraer.

[133] Figueiredo, "Risk Sharing Partnerships with Suppliers," March 2008.

[134] HBC refers to the number of new aircraft Embraer has developed in a short time frame as "extraordinary," given the financial investment required. HBC, prehearing brief to the USITC, September 7, 2011, 6; Embraer, posthearing brief to the USITC, October 5, 2011, 7.

[135] Embraer, posthearing brief to the USITC, October 5, 2011, 7.

[136] Embraer also requires risk-sharing partners to contribute cash to the aircraft program, which is refundable if Embraer fails to fulfill agreed-upon milestones. Embraer, "Form 20-F," April 18, 2011.

jet family.[137] Monetary contributions rise and fall with aircraft development phases. For example, the $134.8 million in contributions in 2008 were received in connection with certification of the Phenom 100. In 2009, contributions from risk-sharing partners totaled $102.2 million, reflecting lower total R&D expenditures in that year. Certification of the Phenom 300 was less costly than for the Phenom 100 due to their common platform, which reduced the need for additional product development expenses.[138] In 2010, contributions declined slightly because there were no ongoing certifications that required extra development expenditures. These declines were partially offset by contributions to the Legacy 450/500 program. Embraer did not anticipate substantial monetary contributions from risk-sharing partners in 2011.[139]

Industry Developments

Embraer's ability to enter a market with traditionally high barriers to entry is noteworthy, as is its success in increasing its market share in the midst of the global downturn. Embraer's sales were reportedly depressed by the economic downturn in the United States, the company's largest market for business jets.[140] However, Brazil, another important market for Embraer's business jets, was not as severely affected as the United States; in fact, business jet demand in Brazil grew during the recent downturn.[141] Several factors may have contributed to Embraer's growth in the business jet industry from 2006 to 2011, including the company's experience in military and commercial aviation, market analysis capability, availability of customer financing, and product development strategy.

Experience

Despite being a relatively new entrant to the business jet industry, Embraer has been producing military and commercial jets for more than 40 years—experience that it has leveraged in the development of business jet products. Following the development of its regional E-jet program,[142] Embraer redirected its core engineering team to business jets, applying the knowledge attained through building commercial aircraft to its business jet programs. According to industry analysts, this "jetliner DNA" translates to durability, ease of maintenance, and reduced operating costs for the Phenom 100.[143] For example, the Phenom 100 has a 35,000-flight cycle basic design life, compared to most other business jets, which are designed for 15,000 to 20,000 flights.[144] Embraer credits the Phenom 100's success to the aircraft's lower operating costs, higher fuel efficiency, and fewer maintenance inspection requirements compared to its competitors.[145] Embraer's experience in the regional jet industry also gives the company a track record of safety and reliability that a typical new entrant might lack.[146]

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[137] Embraer, "Form 20-F," April 18, 2011, 15.
[138] Embraer, "Form 20-F," April 29, 2010, 22.
[139] Embraer, "Form 20-F," April 18, 2011, 25–26.
[140] Embraer, "Form 20-F," April 29, 2010, 53.
[141] Sobie, "Brazil's Light Jet Sector Explodes," August 9, 2010; industry representatives, interviews by USITC staff, São Paulo, Brazil, September 2011. There is some evidence that Brazilian customers were able to supplement demand and even move up in the production line as foreign customers cancelled or postponed their deliveries. Industry representatives, interviews by USITC staff, Rio de Janeiro, Brazil, September 2011.
[142] E-jets are Embraer's largest regional jets.
[143] George, "Embraer Phenom 100," October 2008, 3.
[144] Ibid.
[145] Embraer, posthearing brief to the USITC, September 18, 2011, 17.
[146] USITC, hearing transcript, September 18, 2011, 273–74 (testimony of David Strauss, UBS Investment Research).

Certification

Embraer's experience building regional jets was also beneficial in navigating the certification process. Whereas this can be a difficult and costly undertaking for a first-time aircraft manufacturer, Embraer had an experienced team of engineers devoted to the certification process and already-established relationships with certifying agencies, such as the FAA and Agência Nacional de Aviação Civil (ANAC), the Brazilian civil aircraft certification body.[147] In 2006, Embraer had access to more than 200 Designated Engineering Representatives (DERs) in Brazil, authorized by the FAA to approve data for certification.[148]

Market Analysis Capability

Embraer reportedly conducts thoughtful, careful market analysis before entering the market.[149] According to one industry source, it identifies a specific market niche and then aims to offer more value for its product at only a slightly higher price point.[150] For example, when the Phenom 100 was launched, it was priced competitively as a very light jet, but had a cabin large enough to rival those in the light jet category above it.[151] While this demonstrates the difficulty of delineating strict product categories, it also shows how Embraer was differentiating itself, carefully positioning itself in the market. Embraer has a team of over 100 employees devoted to market intelligence and partly attributes its success to unique product positioning achieved through advisory panel discussions and customer surveys.[152] For example, Embraer touts its luggage compartments, which are large compared to those available in competitors' aircraft and were developed in response to customer feedback.[153]

Customer Financing[154]

The majority of Embraer's business jet class sales are to foreign customers. These export sales are eligible for Brazilian export credit financing, which has been offered on terms permitted under the Aircraft Sector Understanding (ASU) of the Organisation for Economic Cooperation and Development (OECD) since 2007. Brazil's development

[147] ANAC was created in 2006 to separate the regulation of commercial and business aircraft from military aircraft. All certification previously took place within the Instituto de Fomento e Coordenação Industrial (IFI). Industry representatives, interviews by USITC staff, São Paulo, Brazil, September 2011; ANAC Web site, http://www.anac.gov.br/.

[148] White, "A Jet Phenom-enon," January 2006, 7.

[149] Industry representative, phone interview by USITC staff, September 6, 2011; industry representative, interview by USITC staff, São José dos Campos, September 2011.

[150] Industry representative, interview by USITC staff, Rio de Janeiro, September 2011.

[151] White, "A Jet Phenom-enon," January 2006, 7.

[152] Embraer, posthearing brief to the USITC, September 18, 2011, 2; industry representative, interview by USITC staff, São José dos Campos, September 2011.

[153] White, "A Jet Phenom-enon," January 2006, 8; industry representative, interview by USITC staff, Melbourne, FL, September 2011.

[154] For a more complete discussion, see chapter 6, "Financing."

bank, BNDES, serves as its export credit agency, but also provides indirect financing to domestic aircraft customers through Brazilian commercial banks.[155] [156] Such customer financing alternatives available through the Brazilian government have reportedly accelerated domestic demand for light jets. According to a U.S. Export-Import Bank official, BNDES's financing support for domestic sales is available on "more favorable terms" than those permitted under ASU, which are adhered to for export financing,[157] meaning that Brazilian customers would be able to obtain more attractive financing for a Brazilian-made jet than a foreign-made one. The specific details of BNDES's domestic financing are not publicly available because they are not covered by the ASU.[158] Brazilian officials maintain that their financing for domestic sales is generally consistent with ASU parameters, even though they are not bound by its terms.[159]

Product Development Strategy

As a relative newcomer to the business jet industry, Embraer was able to introduce new products to the market that incorporated the latest technologies in design, materials, and aerodynamics, just as other OEMs are able to do when they develop new aircraft.[160] Because most of the cutting-edge technology is imported from U.S. and other foreign suppliers, some of whom are risk-sharing partners, Embraer was free to focus on the competencies it had already developed working on commercial and military aircraft, in design, systems integration, and assembly.[161]

Several of Embraer's business jets are considered clean sheet designs. By pursuing a clean sheet strategy, Embraer was able to optimize an entire aircraft for the particular mission the company identified through its market analysis. Efficiency in the end product is the key advantage to designing an aircraft for a specific mission, rather than creating a derivative from an existing product family.[162] The tradeoff is that clean sheet aircraft require greater resources, expertise, and time to develop.[163]

Embraer's Phenom 100 was a clean sheet design, which was then leveraged to develop the Phenom 300, launched one year later.[164] Although the two aircraft have different wings, engines, passenger capacity, and range, they share most of the same suppliers and risk-sharing partners, as well as the same type rating.[165] The commonality allows the company to use one assembly line for both aircraft, streamlining the manufacturing process and the skills and expertise necessary to produce these aircraft. Development of the Legacy 450/500 appears to be following a similar strategy to that of the Phenom 100/300. Embraer reports that the Legacy 500 is a clean sheet design, which will be leveraged to develop its slightly smaller counterpart, the Legacy 450.[166] The two jets will

[155] Industry representative, interview by USITC staff, Rio de Janeiro, Brazil, September 2011.
[156] Embraer, *Annual Report*, 2010, 30.
[157] USITC, hearing transcript, September 18, 2011, 48 (testimony of Robert Morin, U.S. Ex-Im Bank). Brazil is a signatory of the ASU, even though not a member of the OECD.
[158] Embraer, posthearing brief to the USITC, September 18, 2011, 24.
[159] Industry representative, interview by USITC staff, Rio de Janeiro, Brazil, September 2011.
[160] White, "A Jet Phenom-enon," January 2006, 8.
[161] Embraer, posthearing brief to the USITC, September 18, 2011, 7.
[162] Asian Aviation, "Single-Aisle Contenders Line Up," November 10, 2011.
[163] Embraer, posthearing brief to the USITC, September 18, 2011, 2.
[164] Ibid.
[165] A common type rating means the pilot training required to fly these aircraft will be similar.
[166] Industry representative, interview by USITC staff, São José dos Campos, September 2011.

share a type rating and have 95 percent systems commonality, significantly reducing the cost of developing the second aircraft.[167]

According to Embraer, the firm developed both the Phenom 100 and 300 for less than $500 million,[168] due in part to the use of risk-sharing partners who contributed cash and shouldered the development of the systems they were creating. Embraer first used this model to produce its regional jets, emphasizing its role as an integrator or assembler. Embraer made use of the lean manufacturing and supply chain management strategies it had already developed to control costs and delegate responsibility to suppliers. Embraer also had a certain amount of leverage with its suppliers because of the company's scale across product lines.[169]

In addition to cash contributions from risk-sharing partners, funds from operations, advance payments from customers, and borrowing from commercial entities, Brazilian government development institutions such as FINEP (Research and Projects Financing Agency) and BNDES serve as sources of financing.[170] For example, Embraer entered into credit facilities amounting to $60 million with FINEP to support the research and development expenses of the Phenom 100 and 300.[171] Embraer also has $331 million outstanding in pre-export credit financing from BNDES.[172] Embraer's SEC filings also reference grants received from FINEP for developing "technologically innovative projects," but do not identify the specific projects being supported.[173]

Canada

Summary

Canada is home to Bombardier, a manufacturer of both business and commercial aircraft. Bombardier, which began as Canadair in 1986, has a long history in the aerospace industry and is also the parent company of a major U.S. business jet OEM, Learjet.[174] Two of Bombardier's Challenger series models, the 300 and the 605, are within the scope of the current report and compete within the medium to super midsize product segments. Bombardier is able to draw on significant aerospace engineering talent and expertise within Canada for the domestic production of its business jets. The company also has a significant international presence with its overseas manufacturing facilities, including those in Mexico and the United Kingdom. At present, the company is focused on improving production efficiency and expanding its aftermarket services business.

[167] Epstein, "Legacy 500 to Fly by Year End," October 11, 2011. There are some indications that the basic airframe of the aircraft, as evidenced by the fuselage cross section, is similar to that of the Legacy 600, which in turn was derived from the ERJ-135. Nevertheless, Embraer is marketing these aircraft as clean sheet designs. Embraer's posthearing brief refers to the Legacy 450/500 as a "clean sheet" program.

[168] Embraer, posthearing brief to the USITC, September 18, 2011, 16.

[169] Industry representative, interview by USITC staff, São José dos Campos, September 2011.

[170] Embraer, "Form 20-F," April 18, 2011, 88; Embraer, posthearing brief to the USITC, September 18, 2011, 2.

[171] Embraer, "Form 20-F," April 18, 2011, 67.

[172] Ibid.

[173] Embraer, "Form 20-F," April 18, 2011, 155. See chapter 6, "Financing," for a more complete discussion.

[174] For more information on Learjet, see the U.S. industry section earlier in this chapter.

Industry Structure

Bombardier, headquartered in Dorval near Montreal,[175] is currently the only business jet OEM in Canada and the third-largest manufacturer of civil aircraft in the world. The company's operations are split between its aerospace division and its transportation division, the latter comprising trains and systems for rail transportation.[176] These two industries are complementary, particularly in terms of business cycles,[177] and both fit with Bombardier's recent strategy to produce large, capital-intensive items.[178]

Bombardier's history, particularly in aerospace, has been an evolution with a focus on growth: a progression of OEM acquisitions, starting with Canadair in 1986;[179] developing new production facilities internationally; and offering new services, such as its fractional ownership aircraft company Flexjet.[180] In its 25 years in aerospace, Bombardier has grown in products and capabilities and has completed 28 new aircraft programs.[181] Bombardier is a market share leader for deliveries and revenues within the business jet markets in which it competes.[182] Including the aircraft offered by Learjet, which Bombardier acquired in 1990, the company has 12 business jet models, the broadest

[175] Montreal, an internationally recognized aerospace cluster, is an ideal location for Bombardier. With a host of different aerospace companies, research facilities, and engineering and technical schools, the area is a valuable Canadian aerospace resource. Investissement Québec Web site, http://www.investquebe.com (accessed April 9, 2012).

[176] Fiscal year 2011 revenues were almost evenly divided between the two divisions: aerospace accounted for $8.6 billion and transportation, $9.1 billion. Bombardier Web site, http://ir.bombardier.com/en?docID=0901260d8001aea6 (accessed June 17, 2011).

[177] Baghai et al., "The Growth Philosophy of Bombardier," 1997, 6; Bombardier, *Annual Report: Year Ended January 31, 2011*, 2011, 16, 25–26. Additionally, trains provide more free cash flow than aerospace, a trait that is useful for income smoothing within the company as a whole. Bombardier, *Annual Report: Year Ended January 31, 2011*, 2011, 26.

[178] Bombardier started as a snowmobile company in 1959 but divested this portion of its portfolio in 2003 to focus on "core business operations." Bombardier Web site, http://www.bombardier.com/en/corporate/about-us/history?docID=0901260d8001dffa (accessed January 6, 2012); Hoover's, "Bombardier, Inc.," July 5, 2011, 6.

[179] Canadair was incorporated in 1944 and took over management of the Canadian Vickers-developed production plant for maritime patrol aircraft located in Cartierville, near Montreal, Canada. In 1946, Electric Boat bought a controlling share in Canadair and in 1952 the two companies, along with Electro-Dynamic, were merged into General Dynamics (GD). Until its acquisition from GD by the Canadian government in 1976, Canadair was involved in nine different aircraft production programs. Pickler and Milberry, *Canadair*, 1995, 15, 18, 35, 57, 88, 261.

[180] Baghai et al., "The Growth Philosophy of Bombardier," 1997, 4, 14, 22; Flexjet Web site, http://www.flexjet.com (accessed January 6, 2012). For an explanation of fractional ownership, see box 4.1 in chapter 4, "The Market for Business Jet Aircraft."

[181] Bombardier, "Canada's Bombardier," 2011, 7.

[182] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 9.

range of any OEM.[183] Such a large range of aircraft has advantages, such as countercyclicality[184] and cross-product research and development.[185]

Production/Deliveries

Bombardier assembles and finishes certain of its business jets in Canada, including the two Challenger models in the range of this report (table 3.11).[186] In Bombardier's broad portfolio of aircraft, the Challenger series fills the segment between the light to medium-sized Learjets (assembled and finished in the United States) and Bombardier's large Global series (outside the scope of this report).[187] Final assembly and finishing of the Challengers is performed at Bombardier's Dorval facility near Montreal, Canada, where Challenger aircraft components and systems are integrated, interiors are installed, exterior painting is performed, and final deliveries are made.[188]

TABLE 3.11 Bombardier business jets under 50,000 lbs MTOW, in production, 2011

Model	Price (new) in million $	Range (no. of passengers)	Max. passengers	Entry into service
Challenger 300	24.50	3,100 nm (8)	10	2004
Challenger 605	32.00	4,000 nm (6)	13	2007

Sources: Bombardier Web site, http://businessaircraft.bombardier.com/en/3_0/3_2/3_2_2/3_2_2.jsp; Corporate Jet Investor, "Bombardier Challenger 300," August 21, 2010; Corporate Jet Investor, "Bombardier Challenger 605," October 4, 2010.

Note: nm = nautical miles; 1 nautical mile = 1.1508 miles.

The Challenger 605 was first delivered in 2007, replacing the earlier Challenger 604 and offering enhanced avionics, increased range, and an improved interior.[189] The Challenger 600 series has been in production since the 1980s and has gone through various efficiency and comfort upgrades.[190] Bombardier inherited the aircraft when it bought the Canadian government-owned aircraft producer Canadair in 1986. This series has remained a staple of Bombardier's aircraft portfolio, and the company's flagship regional jet, the CRJ, was derived from this model.[191] In terms of cabin volume, range capability,

[183] Bombardier, "Leading the Way," 2010, 4; Forecast International, *The Market for Business Jet Aircraft*, December 2010, 13. Bombardier is also well known for its regional jets and its amphibious and firefighting aircraft. Bombardier Web site, http://www.bombardier.com/en/aerospace/products/overview?docID=0901260d80018714 (accessed January 6, 2012).

[184] Baghai et al., "The Growth Philosophy of Bombardier," 1997, 20–21; Bombardier, "Paris Airshow Presentation," June 21, 2011, 31. For instance, regional jets, which are a key portion of Bombardier's aircraft portfolio, have historically been less prone to up-and-down business cycles and had longer order backlogs than business jets.

[185] Industry Canada Web site, http://www.ic.gc.ca/eic/site/ic1.nsf/eng/04447.html (accessed January 6, 2012). Although this is a distinct advantage, the majority of Bombardier's R&D funds are designated to specific aircraft model research. Bombardier, *Annual Report: Year Ended January 31, 2011*, 2011, 103; industry representative, interview with USITC staff, Montreal, Canada, September 2011.

[186] Bombardier offers three Challenger models: the 300, 605, and 850. However, only the Challenger 300 and 605 are within the scope of this report.

[187] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 4; Harrison, "Bombardier Profits Soar," September 1, 2011.

[188] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 17.

[189] Forecast International, *The Market for Business Jet Aircraft*, December 2010, 32.

[190] Forecast International, "Bombardier Challenger," June 2010, 4.

[191] Baghai et al., "The Growth Philosophy of Bombardier," 1997, 22; Hoover's, "Bombardier, Inc.," July 5, 2011, 6; Trimble, "The Business Aircraft that Changed the World: No. 7," May 24, 2011.

and price, the Challenger 605 competes primarily with Dassault's Falcon 2000LX, Embraer's Legacy 600[192] and, to a lesser extent, Gulfstream's G350 (table 3.12).

TABLE 3.12 Characteristics of Challenger models and their competitors

Model	Cabin volume	Range capability (no. of passengers)	Max speed	Price (in millions)	MTOW
Bombardier Challenger 300	**860 ft^3**	**3,100 nm (8)**	**541 mph/mach 0.82**	**$24.50**	**38,850 lbs**
Cessna CX	525 ft^3	3,070 nm (8)	607 mph/mach 0.92	$22.00	36,100 lbs
Gulfstream G200	868 ft^3	3,400 nm (4)	561 mph/mach 0.85	$23.50	35,450 lbs
HBC H4000	762 ft^3	3,190 nm (4)	541 mph/mach 0.82	$21.52	39,500 lbs
Bombardier Challenger 605	**1,150 ft^3**	**4,000 nm (6)**	**541 mph/mach 0.82**	**$32.00**	**48,200 lbs**
Dassault Falcon 2000LX	1,024 ft^3	4,000 nm (6)	567 mph/mach 0.86	$32.00	42,200 lbs
Embraer Legacy 600	1,413 ft^3	3,250 nm (8)	528 mph/mach 0.80	$27.45	49,604 lbs
Gulfstream G350	1,525 ft^3	3,800 nm (8)	581 mph/mach 0.88	$33.25	70,900 lbs

Sources: Corporate Jet Investor, "Bombardier Challenger 300," August 21, 2010; Corporate Jet Investor, "Bombardier Challenger 605," October 4, 2010; Corporate Jet Investor, "Cessna Citation X," August 8, 2010; Corporate Jet Investor, "Dassault Falcon 2000LX EASy," August 22, 2010; Corporate Jet Investor, "Embraer Legacy 600," August 9, 2010; Corporate Jet Investor, "Gulfstream G200," October 4, 2010; Corporate Jet Investor, "Gulfstream G350," August 5, 2010; and Corporate Jet Investor, "Hawker 4000," August 13, 2010.

Note: nm = nautical miles; 1 nautical mile = 1.1508 miles.

The Challenger 300 has led the super midsize business jet category since its initial delivery in 2004. With a 3,000-nautical-mile range targeting a niche between a medium and large business jet, the Challenger 300 sold well until the business cycle peaked in 2008, after which deliveries dropped by almost one-half in 2009 and declined further in 2010 (table 3.13).[193] Deliveries of the Challenger 300 have since improved, with a 28 percent increase in 2011 to 37 aircraft. According to one industry publication, the Challenger 300 is unlikely to return to its 2008 delivery record, as it faces increased competition from other established super midsize aircraft such as Cessna's Citation X (to be upgraded to the Citation Ten), Gulfstream's G200 (now the G280), and HBC's Hawker 4000, as well as future competition from Dassault's 2000S and Embraer's Legacy 500.[194]

TABLE 3.13 Challenger deliveries in units, 2006–11

	2006	2007	2008	2009	2010	2011
Challenger 300	55	51	59	33	29	37
Challenger 605	29	35	44	36	38	43
Total	84	86	103	69	67	80

Source: General Aviation Manufacturers Association, *2011 General Aviation Statistical Databook & Industry Outlook*, n.d. (accessed February 22, 2012).

The global economic downturn triggered numerous cancellations of orders for all of Bombardier's Challenger aircraft models, which is reflected in a decline in business jet deliveries in 2009 and 2010. As a result, Bombardier reduced overall production to be

[192] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 7.

[193] Forecast International, *The Market for Business Jet Aircraft*, December 2010, 28; GAMA, *2011 General Aviation Statistical Databook & Industry Outlook*, n.d., 16 (accessed February 22, 2012).

[194] Forecast International, "Bombardier Challenger 300," June 2010, 4.

more in line with market demand.[195] Deliveries of some models, including the Challengers, have since improved in 2011.

Foreign Direct Investment

Canada's business jet industry received some foreign direct investment during the 2006–11 period. Diamond Aircraft Industries GmbH (Diamond), headquartered in Austria, has been working to produce the D-Jet (a very light business jet) in Canada since 2008. However, the D-Jet remains uncertified, as Diamond has had financing issues in developing this aircraft. The company received a $20 million loan from the Canadian federal government in 2008, but it was denied a second loan of $35 million in March 2011 that was contingent on funding from the Ontario government and private backers.[196] Most recently, Diamond announced that Medrar Financial Group of Dubai had acquired a majority share of the Canadian portion of the company, which will allow the D-Jet program to restart.[197] Diamond intends to produce the D-Jet at its London, Ontario, facility, where it currently manufactures two piston aircraft and a turbo-diesel aircraft.[198]

Bombardier engages in significant foreign direct investment to produce aircraft components outside of Canada. The company currently has a presence in 25 countries, including Belfast, United Kingdom, where Challenger 300 and 605 fuselages are made.[199] Most recently, Bombardier built a manufacturing facility in Querétaro, Mexico (opened in 2008), where the wiring and major composite structures for the Learjet 85 are made. Bombardier is locating more production at this facility, which will also soon build the rear fuselage section of the new models in Bombardier's Global business jet series.[200] Bombardier's foreign production locations mean the company has significant operating costs in different currencies.[201] Bombardier uses its considerable experience managing foreign exchange rates to minimize the company's exposure to currency fluctuations.[202]

Workforce

Bombardier Aerospace has 30,300 employees around the world, including an estimated 17,500 in Canada performing high-skilled jobs related to all of the company's aircraft programs.[203] The Challenger programs generate a significant share of these jobs, as an estimated 2,200 workers are devoted to designing, customizing, and completing

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[195] Bombardier, *Annual Report: Year Ended January 31, 2011,* 2011, 93; Hoover's, "Bombardier, Inc.," July 5, 2011, 5.

[196] Croft, "New Financing," June 16, 2011; Huber, "Diamond D-Jet," *Business Aviation Aircraft,* September 13, 2011.

[197] Padfield, "Dubai Financial Company," November 15, 2011.

[198] Diamond Aircraft Web site, http://www.diamondaircraft.com/news/news-article.php?id=12 (accessed January 6, 2012).

[199] Bombardier Web site, http://www.belfast.aero.bombardier.com/categories/69/bombardier-aircraft-programmes.aspx (accessed January 6, 2012).

[200] Lynch, "Bombardier Increases Presence in Mexico," October 26, 2011.

[201] Bombardier, *Annual Report: Year Ended January 31, 2011,* 2011, 152, 204. Bombardier Aerospace has production costs in four currencies: Canadian dollars, U.S. dollars, pounds sterling, and Mexican pesos.

[202] For more information on foreign exchange risk, see chapter 6, "Financing."

[203] Bombardier, "Canada's Bombardier," PDF, 2011, 10.

Challenger aircraft in Canada at the Dorval facility.[204] More specific business jet employment numbers in Canada are not available.

With educational programs throughout the country to train engineers and technicians, Canada offers a broad aerospace skills base benefitting Bombardier's business jet design and production.[205] For example, Montreal has two universities with aerospace engineering departments, McGill and Concordia, as well as two dedicated aerospace trade schools.[206] The National Aerotechnical School, one of Montreal's trade schools that produces technicians specializing in aircraft construction, maintenance, and avionics, has a fleet of 30 aircraft and is the largest such school in North America, with more than 1,300 students.[207] This education base contributes to a strong local supply of aerospace workers.

Supply Chain

As part of Bombardier's current competitiveness policy, the company is now focused on its core competencies and the highest value added activities—design, integration, and final assembly—rather than parts production. This ongoing trend is a significant change from the company's earlier, vertically integrated model.[208] Although all of Bombardier's business jet aircraft are finished and delivered in the United States and Canada, subassemblies and parts are produced around the world. Bombardier is committed to foreign sourcing and manufacturing, which it views as a competitive factor and an overall industry trend.[209] Most of the parts and subassemblies for Challenger business jets are now made elsewhere, either at Bombardier's own international production sites or by more than 1,200 Challenger suppliers around the world.[210]

Risk Sharing

Bombardier works closely with its suppliers and collaborates to develop technology, often in risk-sharing partnerships. Risk sharing has been a key part of Bombardier's model since its development of the Global Express in 1993 and allows Bombardier to

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[204] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 4. This estimate does not include employees for the out-of-scope global models; other business jet development workers, such as those for Diamond jets (currently 220 employees in London, Ontario); or supplier employees who may make parts for both business and nonbusiness jet aircraft. Padfield, "Dubai Financial Company," November 15, 2011.

[205] AIAC Web site, http://www.aiac.ca/resources-and-publications/employment-resources/educational-programs/ (accessed February 21, 2012); Shane, "Feds Should Boost R&D Investment," October 25, 2010.

[206] Thisdell, "Canada Special," May 24, 2011.

[207] Ecole Nationale d'Aérotechnique Web site, http://www.college-em.qc.ca/ecole-nationale-aerotechnique/lena/presentation (accessed January 6, 2012).

[208] Baghai et al., "The Growth Philosophy of Bombardier," 1997, 11–12, 20.

[209] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 17; Bombardier, *Annual Report: Year Ended January 31, 2011*, 2011, 17.

[210] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 2–4. Bombardier has announced plans to invest $200 million to build a facility in Morocco to take advantage of lower transportation costs, given Morocco's proximity to the European market, although the company is still undecided what parts will be produced there and how this will affect its business jet supply chain. Morocco has emerged as a low-cost aerospace manufacturing cluster, primarily for companies that operate in or serve the European market, such as those in France. The Moroccan Aeronautical Institute (IMA), a public and private sector partnership, offers courses free of charge and works with companies to offer specifically relevant training programs. Marotte, "Bombardier Setting Up Shop in Morocco," November 16, 2011. Le Groupement des Industries Marocaines Aéronautiques et Spatiales (GIMAS) Web site, brochure, http://www.gimas.org (accessed November 21, 2011); industry representative, interview with USITC staff, Paris, France, October 2011.

focus on its core competencies.[211] Risk sharing in turn has led to suppliers becoming "major integrators." That is, Bombardier's aircraft programs have progressively asked its suppliers to act as systems integrators, where they are expected to develop and integrate full components of the progressing aircraft. Examples include GKN's designed and certified nacelles and Messier-Bugatti-Dowty's integrated landing gear, both for the Challenger 300.[212]

Research and Development

Bombardier works on aircraft design at four facilities in the United States and Canada, and continues to innovate in areas such as composite materials for the Learjet 85 and flight deck improvements with Global Vision.[213] Bombardier also works with universities and other partners on what it terms fundamental and strategic research, both of which are general purpose and can be applied across aircraft programs.[214] With such a wide range of aircraft, Bombardier's own product development R&D has many cross-model benefits as well. For example, R&D for the Challenger 300 business jet was used in updating the Challenger 605.[215] Nevertheless, to upgrade aircraft or develop clean sheet aircraft over such a wide range of established models requires significant company technical and financial resources. One industry publication suggests that the number of other aircraft programs Bombardier is working on has prevented the company from developing a clean sheet aircraft to replace the Challenger 605.[216] Overall, Bombardier estimates that is has spent more than C$4 billion on general aerospace and transportation research and program development over the past 25 years.[217]

Industry Developments

In the past five years, Bombardier has focused on lean manufacturing to improve efficiency.[218] Most recently, the company has pursued advanced quality and logistics planning, which the company credits with helping maintain its profitability in aerospace despite the difficult economic environment.[219] Bombardier has also been working to increase its aftermarket aircraft services, such as developing more maintenance and repair operations, which currently account for about 20 percent of the company's aerospace revenues (up from 16 percent in 2006).[220] Services were identified in recent years as an

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[211] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 18–19.

[212] GKN Web site, http://www.gknaerospace.com/integratedpropulsionsystems.aspx (accessed January 6, 2012); Safran Web site, http://www.safranmbd.com/spip.php?article890 (accessed January 6, 2012).

[213] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 2, 20.

[214] Kafyeke, "Collaboration," September 13, 2011, 8.

[215] Industry representative, interview with USITC staff, Montreal, Canada, September 2011.

[216] Forecast International, "Bombardier Challenger," June 2010, 4–5; USITC, hearing transcript, September 28, 2011, 301 (testimony of Heidi Wood, Morgan Stanley). Various Challenger 600 series models have been in production since 1980.

[217] Bombardier, "Canada's Bombardier," 2011, 14. Data specific to Bombardier's business jet R&D are not available.

[218] Bombardier, *Annual Report: Year Ended January 31, 2007*, 2007, 8; Bombardier, *Annual Report: Year Ended January 31, 2011*, 2011, 10; Bombardier, "Paris Airshow Presentation," June 21, 2011, 12.

[219] Bombardier, *Annual Report: Year Ended January 31,2011*, 2011, 10; Nadeau, "Sharpening the Axe," May 1, 2011, 1.

[220] Bombardier, *Annual Report: Year Ended January 31, 2007*, 2007, 42; Bombardier, *Annual Report: Year Ended January 31, 2011*, 2011, 99; Harrison, "Bombardier Profits Soar," September 1, 2011.

area Bombardier would like to further develop, based on its ongoing expectations for growth in the aftermarket.[221]

In terms of product development, Bombardier is currently more focused on its heavy Global series of business jets—large-cabin, long-range aircraft that Bombardier has identified as having the greatest growth potential.[222] Large business aircraft sales, including the Challengers, were already an important piece of Bombardier's aerospace profits in 2011.[223] Bombardier is working to develop two new Global series aircraft, outside the range of this report, for deliveries in 2016 and 2017 to compete in that market segment.[224]

France

Summary

France, with one of the most developed aerospace industries in the world and a leading global aerospace cluster,[225] is home to the high-end business jet manufacturer Dassault Aviation (Dassault) as well as a host of suppliers to business jet OEMs. Dassault is highly competitive in the medium to super midsize product segments and also manufactures heavy business jets, which are outside the scope of this report. The company's focus on the use of cutting-edge technology in aircraft production, combined with its adoption of lean manufacturing techniques, has enhanced its status as a leading business jet OEM. Although Dassault's business jet sales are primarily to the traditional markets of Europe and North America, the company has increased its sales to new and emerging markets, such as China.

Industry Structure

Dassault, one of the oldest privately held aircraft manufacturers in the world, is the only European firm that produces complete business jets.[226] Dassault was created in 1936 to manufacture fighter aircraft and produced its first business jet in 1963.[227] Dassault Aviation is a subsidiary of the privately held Groupe Dassault, which notably includes Dassault Systèmes. Separated from Dassault Aviation in the 1980s, Dassault Systèmes

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[221] Bombardier, *Annual Report: Year Ended January 31, 2007*, 2007, 36; Bombardier, *Annual Report: Year Ended January 31,2011*, 2011, 81; Bombardier, "Paris Airshow Presentation," June 21, 2011, 49, 53.

[222] Asian Aviation, "Bigger Is Better," May 2011, 27; Bombardier, "Leading the Way," 2010, 37; Forecast International, *The Market for Business Jet Aircraft*, December 2010, 32; USITC, hearing transcript, September 28, 279 (testimony of David Strauss, UBS Investment Research).

[223] Harrison, "Bombardier Profits Soar," September 1, 2011; Lynch, "Global Aircraft Provide Financial Bounce for Bombardier," December 5, 2011.

[224] Asian Aviation, "Bigger Is Better," May 2011, 28.

[225] Traditionally, the area around the city of Toulouse has been designated an aerospace cluster, but the recent creation of Aerospace Valley in 2005 extended this to the entire Midi-Pyrénées and Aquitaine regions. For a further discussion of Aerospace Valley, see chapter 5, "Technology and Business Innovation in Business Aviation."

[226] Two other companies have recently considered producing business jets in Europe. Daher-Socata, a French turboprop manufacturer and Tier 1 supplier, has considered taking over the development of the composite SPn light jet designed by the German company Grob before its bankruptcy in 2008. Piaggio Aero, an Italian turboprop airframer, is currently working to secure an established business jet OEM as a risk-sharing partner for its nascent business jet program, the P1XX. Alcock, "Piaggio," September 22, 2011; Moscrop, "EBACE 2011," May 19, 2011; Sarsfield, "Daher Socata," June 18, 2011.

[227] Dassault Aviation, *2008 Annual Report*, 2009, 6; Dassault Falcon Web site, http://www.dassaultfalcon.com (accessed January 6, 2012).

produces leading 3D industrial design and product lifecycle management software used by other aircraft and industrial OEMs.[228] Its various computer programs are still used extensively by Dassault Aviation in military and civil aircraft development and have been credited as the source of many of the company's efficiency improvements and state-of-the art production technologies.[229]

Production/Deliveries

Two series of business jet models produced by Dassault in France—the Falcon 2000 and 900—are within the scope of this report. In the past five years, various models within these two series have been produced, all of which have at least a transcontinental range and are also capable of nonstop transatlantic flights under certain conditions (table 3.14). These aircraft compete with other high-end, long-range aircraft, most of which are outside the scope of this report.

TABLE 3.14 Falcon business jets under 50,000 lbs MTOW, in production or development, 2007–13

Model[a]	Price new million $	Range (no. of passengers)	Max Passengers (in a high density configuration)	Entry into service
Falcon 50EX[b]	([c])	3,025 nm (8)	(19)	1996
Falcon 900DX	38	4,150 nm (6)	(19)	2005
Falcon 900EX EASy	42	4,550 nm (6)	(19)	2004
Falcon 900LX	39	4,750 nm (6)	(19)	2010
Falcon 2000	([c])	3,000 nm (8)	(12)	1994
Falcon 2000DX	30	3,250 nm (6)	(12)	2008
Falcon 2000EX EASy	([c])	3,800 nm (6)	(12)	2004
Falcon 2000LX	32	4,000 nm (6)	(12)	2009
Falcon 2000S	25	3,350 nm (6)	10	2013[d]

Sources: Airliners.Net Web site, http://www.airliners.net;Corporate Jet Investor, "Dassault Falcon 900DX," July 20, 2010; Corporate Jet Investor, "Dassault Falcon 900EX EASy," August 18, 2010; Corporate Jet Investor, "Dassault Falcon 900LX," September 5, 2010; Corporate Jet Investor, "Dassault Falcon 2000DX," August 20, 2010; Corporate Jet Investor: "Dassault Falcon 2000LX," August 22, 2010; Dassault Falcon Web Site, http://www.dassaultfalcon.com; Dassault Falcon 2000S Web Site http://www.falcon2000s.com/. Over the 2006–10 period, Dassault successively replaced models within the company's established aircraft series. This can be seen in table 3.16 as some models entered or exited production.

Notes: nm = nautical miles; 1 nautical mile = 1.1508 miles.

[a]EX, DX, LX, and EASy essentially designate different model options. The EX versions were early derivatives and denote an "extended" range capability. EASy designates the inclusion of EASy avionics, DX denotes the shorter range option, and LX indicates the addition of range-enhancing winglets.
[b]First delivered in 1979, the Falcon 50 is one of the few business jet series to be completely retired. The Falcon 50EX was the final model.
[c]Not available.
[d]Anticipated year of delivery.

Since its entrance into business jet production, Dassault has primarily produced medium and large business jets, enabling the company to invest profitably in high levels of engineering and sell its leading-edge technologies.[230] The two series of Falcons included

[228] Dassault Falcon Web site, http://www.dassaultfalcon.com/ourstory/family_catia.jsp (accessed January 6, 2012); Groupe Dassault Web site, http://www.dassault.fr/en/index.php (accessed January 6, 2012).
[229] Dassault Aviation, *2009 Annual Report*, 2010, 14; ECORYS, *FWC Sector*, December 15, 2009, 99.
[230] Industry representative, interview with USITC staff, Paris, France, October 2011.

in this report compete with heavier business jets because of engineering invested in the aircraft to reduce weight, increase fuel efficiency, and improve aerodynamics.[231] To illustrate, the Falcon 2000LX is in direct competition with Bombardier's Challenger 605 in terms of range and price.[232] However, the Falcon 2000LX not only has better airfield performance with a shorter required takeoff and landing distance, but also has a 6,000 feet higher operating altitude and more than a 1,000 pound higher payload capability.[233] The Falcon 900s compete in an even larger, longer-range class and maintain a niche of their own. The Falcon 900's closest competitors, Gulfstream's G450 and Bombardier's Global 5000, have significantly different characteristics and are both outside of the scope of this report (table 3.15).

TABLE 3.15 Characteristics of Falcon models and their competitors

Model	Cabin volume	Range capability	Max speed	Price million $	MTOW
		No. of passengers			
Falcon 2000LX	**1,024 ft^3**	**4,000 nm (6)**	**567 mph/mach 0.86**	**32.00**	**42,200 lbs**
Bombardier Challenger 605	1,150 ft^3	4,000 nm (6)	541 mph/mach 0.82	32.00	48,200 lbs
Embraer Legacy 650	1,650 ft^3	3,900 nm (4)	528 mph/mach 0.80	<30.00	53,572 lbs
Gulfstream G350	1,525 ft^3	3,800 nm (8)	581 mph/mach 0.88	33.25	70,900 lbs
Falcon 900 LX	**1,264 ft^3**	**4,750 nm (6)**	**528 mph/mach 0.80**	**39.00**	**49,000 lbs**
Bombardier Global 5000	2,022 ft^3	5,200 nm (8)	590 mph/mach 0.89	33.50	92,500 lbs
Gulfstream G450	1,525 ft^3	4,350 nm (8)	581 mph/mach 0.88	33.00	73,900 lbs

Sources: Bombardier, "Bombardier Global 5000 Fact Sheet," 2010; Corporate Jet Investor, "Bombardier Challenger 605," October 4, 2010; Corporate Jet Investor, "Dassault Falcon 2000LX EASy," August 22, 2010; Corporate Jet Investor, "Dassault Falcon 900LX," September 5, 2010; Corporate Jet Investor, "Embraer Legacy 650," October 4, 2010; Corporate Jet Investor, "Gulfstream G350," August 5, 2010; Corporate Jet Investor, "Gulfstream G450," August 21, 2010; George, "Embraer Legacy 650," 2011; Higdon, "Bombardier Global 5000 Update," April 2004.

Note: nm = nautical miles; 1 nautical mile = 1.1508 miles.

Additionally, Dassault has pursued the medium to large business jet markets because historically they have faced less volatility.[234] Even recently, demand for medium and large business jets suffered less during the recent global economic downturn. As a result, Dassault was not as severely affected as business jet OEMs who were positioned in the very light to light market segments.

Dassault entered the recession with a large order backlog accumulated before 2009.[235] As a result of this backlog, Dassault was the only business jet OEM besides Embraer to increase deliveries in 2009 compared to 2008 (table 3.16).[236] Also, despite negative net orders as a result of cancellations in 2009 and 2010,[237] in both years the company broke

[231] Dassault Aviation, *2010 Annual Report*, 2011, 22; Dassault Falcon, "Dassault's Falcon," *AMT*, June 15, 2011; Forecast International, "Dassault Falcon 900/7X/SMS," June 2010, 3; industry representative, interview with USITC staff, Paris, France, October 2011.

[232] Forecast International, "Dassault Falcon 2000," June 2010, 6; Julian, "Aviation d'affaires" [Business aviation], August 23, 2011.

[233] Corporate Jet Investor, "Bombardier Challenger 605," October 4, 2010; Corporate Jet Investor, "Dassault Falcon 2000LX Easy," August 22, 2010.

[234] Industry representative, interview with USITC staff, Bordeaux, France, October 2011.

[235] Jaggi, "Flight Test," October 15, 2010. Dassault had a backlog of 500 business jet aircraft at the end of 2008. Although sometimes countercyclical, Dassault's defense side did not assist in this instance; in fact, Dassault had trouble finding foreign buyers for its new fighter jet as governments cut back their defense budgets. ECORYS, *FWC Sector*, December 15, 2009, 99.

[236] GAMA, *2010 General Aviation Statistical Databook & Industry Outlook, n.d.*, 16–17.

[237] Dassault Aviation, *Annual Report 2009*, 2010, 3; Forecast International, "Dassault Falcon 900/7X/SMS," June 2010, 6.

previous Falcon delivery records for all of its business jet models.[238] Overall deliveries decreased substantially in 2011 compared to the peak in 2010, but were in line with Dassault's average annual deliveries in the past decade.

TABLE 3.16 Falcon deliveries in units, 2006–11

Model	2006	2007	2008	2009	2010	2011
Falcon 50EX	5	2	1	–	–	–
Falcon 900DX	4	10	4	1	3	–
Falcon 900EX EASy	16	18	19	17	17	1
Falcon 900LX	–	–	–	–	4	11
Falcon 2000	6	1	–	–	–	–
Falcon 2000DX	–	–	3	1	–	–
Falcon 2000EX EASy	30	33	24	3	–	–
Falcon 2000LX	–	–	–	23	30	20
Subtotal	61	64	51	45	54	32
Falcon 7X[a]	–	6	21	32	41	31
Total	61	70	72	77	95	63

Source: General Aviation Manufacturers Association, *2011 General Aviation Statistical Databook & Industry Outlook,* n.d. (accessed February 22, 2012).

Note: Models that were not delivered in given year are indicated by "–".

[a]The Falcon 7X aircraft is outside the scope of this report. Since 2009, the Falcon 7X led deliveries of business jets by Dassault.

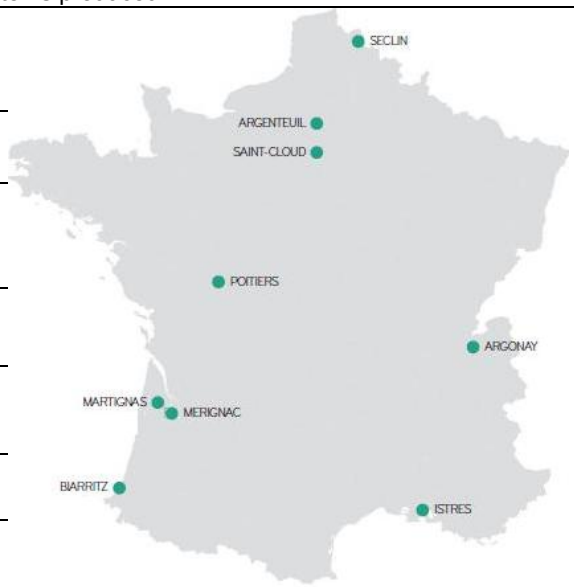
Manufacturing

Unlike most business jet OEMs, Dassault still manufactures large segments of its business jets at the company's own facilities in France (figure 3.5). After the Falcons are assembled and flight-tested at Mérignac, their third test flight is across the Atlantic Ocean to Little Rock, Arkansas, where they are finished by Dassault's wholly owned subsidiary, Dassault Falcon Jet.

[238] This includes deliveries of the Falcon 7X, which is not within the scope of business jets covered by this investigation.

FIGURE 3.5 Dassault's French manufacturing locations and items produced

Argenteuil	• Metal parts machining and tooling • Front fuselage section • Some Falcon cockpits
Argonay	• Cabling and cards for flight control systems
Biarritz	• Fuselage assembly • Resins and composites • Wingboxes
Istres	• Flight testing • Simulation
Martignas	• Wings • Falcon section assembly
Mérignac	• Final assembly
Poitier	• Vertical stabilizers
Saint-Cloud	• Technical Management Department & Research Offices
Seclin	• Large metal structural components o Fuselage frames o Wing panels



Source: *Dassault Aviation, Annual Report* 2010, 2011, 32; Dassault Aviation, *Manufacturing*, 2005; Dassault Falcon Web site, http://www.dassaultfalcon.com/ourstory/family_manufacturing.jsp (accessed February 1, 2012).

Of note, Dassault Aviation machining and tooling operations are a mixture of partially and fully automated procedures designed using Dassault Systèmes' 3D CAD software, CATIA and PLMV6 (Product Lifecycle Management version 6). For example, Dassault's Seclin facility, where the company produces large structural aircraft components, uses a fully digital and automated high-speed milling machine, eliminating the need for a physical prototype before production. After manufacturing models have been developed at Dassault's production facilities from 3D CATIA design specifications, the process is then computer simulated before physical machining is performed. According to Dassault, the finished parts also need minimum position tooling due to CATIA, since the parts assemble almost perfectly the first time, saving time and reducing costs.[239] Also, entire factory floors can be designed and tested virtually using PLMV6. With its digital mockup, collaborative work platform, and digital simulation of production, Dassault claims that PLMV6, too, has reduced production lead times and development costs.[240]

[239] Dassault Aviation, *2010 Annual Report*, 2011, 45; Dassault Aviation, *Manufacturing*, 2005.
[240] Dassault Aviation, *2009 Annual Report*, 2010, 13–14, 21.

Foreign Direct Investment

Currently, there is no known foreign direct investment in France for the manufacture of business jets. Dassault itself has also been engaged in only limited outbound foreign direct investment, with one finishing facility in Little Rock, Arkansas, and four international Falcon service centers, three in the United States and one in Brazil.[241] The Little Rock plant has been used to install the interiors and paint the exteriors of virtually all Falcon business jets since 1975. At the time it was a strategic decision to locate within the historically dominant U.S. business jet market.[242] The dollar operating costs of this facility also help mitigate some of Dassault's foreign exchange risk, which it incurs by selling business jets in dollars while the bulk of the company's development and production costs are in euros.[243]

Workforce

Of Dassault's 12,000 employees worldwide, more than 8,000 are located in France, a number that has remained relatively stable over the past five years.[244] Also during this time period, and with relatively small fluctuations, about 45 percent of employees were engineers, managers, and executive staff; 20 percent were supervisory and technical staff; 10 percent were administrative staff; and 25 percent were production employees.[245] Ongoing process improvements and equipment upgrades helped Dassault to reduce redundancies before the recent economic downturn and to preserve jobs during the downturn.[246]

Workforce education and training is a French strength in this industry. France has three "Grandes Ecoles" (top universities) for aerospace engineering[247] and a handful of other universities that offer aerospace engineering degrees. France also has various regional skills and maintenance training facilities, as well as a new technical school under development in Bordeaux near Dassault's Mérignac facility, called Aquitaine Aerocampus.[248]

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[241] In total, Dassault operates five service centers through its wholly owned subsidiaries located in Le Bourget, France; Little Rock, Arkansas; Reno, Nevada; Wilmington, Delaware; and São Paolo, Brazil. Dassault Aviation Web site, http://www.dassault-aviation.com/en/falcon/falcon-philosophy/organization.html?L=1 (accessed January 6, 2012).

[242] Dassault Aviation, "Little Rock," *Manufacturing*, 2005.

[243] Dassault Aviation, "*2010 Annual Report*, 2011, 112; USITC, hearing transcript, September 28, 218 (testimony of David Strauss, UBS Investment Research).

[244] Dassault Aviation, "Average Number of Employees Tables," 2006–10 Annual Reports. Worldwide employment figures were based on numbers from the Dassault Aviation Group, while France-based employment figures were estimated from the Dassault Aviation Parent Company. Employment data specific to business jet production are not available.

[245] Dassaualt Aviation, "Parent Company Average Number of Employees Table," *2006–10 Annual Reports*.

[246] Dassault Aviation, *2010 Annual Report*, 2011, 1.

[247] These Grandes Ecoles are the Ecole Nationale de l'Aviation Civile (ENAC), the Ecole Nationale Supérieure de Mécanique et d'Aérotechnique (ENSMA), and the Institut Supérieur de l'Aéronautique et de l'Espace (ISAE, which was created in 2007 from the merger of ENSICA and SUPAERO, two formerly separate Grandes Ecoles). ENAC Web site, http://www.enac.fr/en (accessed April 9, 2012); ENSMA Web site, http://www.enac.fr/en (accessed April 9, 2012); ISAE Web site, http://www.isae.fr (accessed April 9, 2012).

[248] Bordeaux Region Web site, http://www.bordeaux-region.com/en/+Aquitaine-Aerocampus-is-go+.html (accessed January 6, 2012); industry representative, interview with USITC staff, Bordeaux, France, October 2011.

Some industry suppliers have expressed concern that there may be a pending shortage of employees with the requisite technical or engineering skills in France, as students may opt into less manual jobs or other non-aerospace career paths; however, according to industry representatives, this problem has not yet emerged.[249] So far, Dassault's very high employee retention rate has minimized this concern.[250] However, the company may encounter problems because of expected higher rates of retirement in the near future; it has a published policy to develop a wider presence in schools to recruit younger workers.[251] Currently, 17 percent of Dassault's employees are over 55; this group represents an important skills and knowledge base.[252]

Supply Chain

Although Dassault still keeps much of its production in-house, the company has a number of North American and European suppliers for large components of its civil aircraft, such as engines, landing gear, and aerostructures.[253] Some of these suppliers are also risk-sharing partners that have provided between 20 and 25 percent of past civil aircraft program costs.[254] Dassault has also branched out to nominate suppliers for nontraditional parts for its newer aircraft programs. For its most recently announced clean sheet aircraft, the SMS,[255] Dassault has nominated suppliers for conventional structures such as the landing gear and engines, as well as a supplier for an empennage (the aircraft tail) designed from the latest composite material and another for the wing design and manufacture.[256]

Dassault's leading-edge design software has led to changes in the aircraft development phase for Dassault and its suppliers, as the software's use requires close digital collaboration. CATIA software was instrumental in Dassault's most recent business jet program, the Falcon 7X (out of the scope of this report) and likely with the Falcon SMS.[257] For the Falcon 7X, Dassault and its supply partners first worked together on the aircraft's design at Dassault's Saint-Cloud facility. Collaborators and suppliers then successfully finished their design portions separately at their respective office sites. To accomplish this, and avoid delays due to nonconformity, Dassault required its suppliers to use the same version of Dassault Systèmes software and perform daily data uploads so that the entire project development team, no matter their location, could work with up-to-date information.[258] In this way, the Falcon 7X was entirely digitally designed; that is, there were no paper drawings or physical models used during development.[259] In fact, it was not necessary to develop a prototype of the aircraft, although the first four aircraft

[249] Industry representatives, interviews with USITC staff, Paris, Bordeaux, and Toulouse, France, October 2011.

[250] Industry representative, interview with USITC staff, Bordeaux, France, October 2011; Jaggi, "Flight Test," October 15, 2010.

[251] Dassault Aviation, *2010 Annual Report*, 2011, 48; ECORYS, "FWC Sector," December 15, 2009, 302.

[252] Dassault Aviation, *2010 Annual Report*, 2011, 49.

[253] Dassault Aviation, *2010 Annual Report*, 2011, 47; PIPAME, *Étude*, September 2009, 77.

[254] Forecast International, "Dassault Falcon 900/7X/SMS," June 2010, 4–5; Forecast International, "Dassault Falcon 2000," June 2010, 4.

[255] This aircraft will likely be within the scope of this report although the maximum takeoff weight specifications are currently unknown.

[256] Croft, "Forecasts 2011," January 4, 2011; Huber, "Dassault Prepares For Economic Upswing," October 12, 2011; Spruce, "GKN Aerospace Wins Wings," June 20, 2011.

[257] Dubois and Trautvetter, "Falcon SMS '100 Percent Go' at Dassault," October 11, 2011.

[258] Dassault Aviation, "Saint-Cloud," *Manufacturing*, 2005; industry representative, interview with USITC staff, Paris, France, October 2011.

[259] Dassault Aviation, *2008 Annual Report*, 2009, 17; Dassault Aviation, "Saint-Cloud," 2005.

produced were used for testing and in the certification phase before later sale and delivery to customers.[260]

Research and Development

Research and development for all of Dassault's aerospace activities is primarily performed in-house at its Saint-Cloud facility, an arrangement that allows many military and civil research crossovers.[261] These synergies have existed since the first Falcon business jet included the modified wings and tail of Dassault's Mirage IV fighter.[262] More recently, Dassault's development of fully fly-by-wire digital flight control for military aircraft has been brought to the civil side; before that, its EASy (Enhanced Avionics System) flight deck, developed with Honeywell, brought the improved man-machine interface from combat aircraft to business jets.[263] Currently, Dassault is working on research in many areas, including a supersonic business jet and cutting-edge production technology for composite materials[264] and resin transfer molding,[265] to name a few.[266]

Dassault's airframe research and new aircraft programs are principally self-funded.[267] Dassault's most recent clean sheet design, the Falcon 7X, had an estimated development cost of $700 million, while earlier upgrade programs, such as the Falcon 900EX, are said to have cost approximately $500 million.[268] More broadly, Dassault's expenditures for non-program-specific military and civil research in the past five years have averaged about €250 million ($345.75 million) annually.[269]

Industry Developments

During the past five years, Dassault has primarily worked to develop derivative models within the Falcon 2000 and 900 series. The DX models, introduced in 2005 for the Falcon 2000 and in 2008 for the Falcon 900, were intended to target a large-cabin, shorter-range business jet market that did not materialize. They have since been

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[260] Dassault Aviation, "Merignac," 2005; Forecast International, "Dassault Falcon 900/7X/SMS," June 2010, 4; industry representative, interview with USITC staff, Bordeaux, France, October 2011.

[261] Dassault Aviation also partners with educational institutions, the French government, and European institutions for general research such as for aerodynamics or within the Clean Sky initiative. Dassault Aviation, *2008 Annual Report*, 2009, 14; Dassault Aviation, *2010 Annual Report*, 2011, 44; ISAE, "La Recherche," December 2008, 11.

[262] Trimble, "The Business Aircraft that Changed the World: No. 2," May 24, 2011.

[263] Dassault Aviation, *2010 Annual Report*, 2011, 26; Dassault Aviation, *2006 Annual Report*, 2007, 12.

[264] Madehow.com, "How Business Jets Are Made" (accessed November 10, 2011). Composites include carbon epoxies, graphite, fiberglass, carbon fiber-reinforced plastics (CFRP), boron fiber-reinforced plastics (BRFP), and glass-reinforced plastics (GRP).

[265] RTM Composites Web site, "Glossary," http://www.rtmcomposites.com/glossary.html#r (accessed December 20, 2011). This is a process whereby catalyzed resin is transferred or injected into an enclosed mold in which fiberglass or other reinforcement has been placed.

[266] Dassault Aviation Web site, http://www.dassault-aviation.com/en/aviation/innovation/a-technological-leadership/research-development.html?L=1 (accessed January 6, 2012).

[267] Weber et al., "Study of European Government Support," TECOP International, August 15, 2005, 23; Forecast International, "Dassault Falcon 2000," June 2010; Forecast International, "Dassault Falcon 900/7X/SMS," June 2010. Dassault Aviation has large available cash reserves that have averaged around €3 billion annually during the past five years. Dassault Aviation, "Financial Structure," 2006–10 Annual Reports.

[268] Forecast International, "Dassault Falcon 900/7X/SMS," June 2010, 6.

[269] Dassault Aviation, "Research and Development Costs," 2006–10 Annual Reports; European Central Bank Web site, http://www.ecb.int/stats/exchange/euroxref/html/euro(xref-graph-usd.en.html (accessed March 6, 2012). Converted with an average 2011 euro-dollar exchange rate of 1.383.

discontinued after poor sales.[270] More successful were the Falcon 2000LX (certified in 2009) and the Falcon 900LX (2010).[271] With the addition of winglets, a focus on range capabilities, and a goal to exceed current environmental standards, these two aircraft have performed well in terms of sales. According to Dassault, the Falcon 900LX is considered the most efficient aircraft in its class, burning up to 60 percent less fuel than its newest competitors such as Gulfstream's G450 or Bombardier's Global 5000 for a given mission, a feature of its tri-jet design.[272] The Falcon 2000LX also outperforms its competitors in terms of fuel efficiency, which translates into significant operating cost savings and may become even more important in the event of future environmental regulations or higher fuel costs.[273] Dassault states that because of its performance, the Falcon 2000LX has become particularly sought after by fractional ownership programs.[274]

In a similar pursuit of performance improvements, but with an eye towards increased affordability, Dassault is currently developing the derivative Falcon 2000S, which would be in the range of this report and is generally described as a super midsize business jet. This aircraft is anticipated to be the most affordable Falcon aircraft at a sales price of $25 million and will become the company's new entry-level business jet. Cost savings were found by standardizing the interior, which was developed by BMW Dreamworks, and by shortening the range of the aircraft. Besides price, the lighter Falcon 2000S will also have an advantage in its ability to access shorter, more difficult runways.[275] The Falcon 2000S will enter a class with heavy competition from Bombardier, Embraer, Gulfstream, and HBC.[276] However, Dassault has been a late entrant in other product segments and succeeded before, most recently in the long-range niche with their Falcon 7X in 2007.[277] With a new wing, significantly more cabin volume, and improved performance capabilities over competitors, it is speculated that Dassault is aiming to define a separate super midsize class with the Falcon 2000S in the hope that the combination of performance and luxury will make it a new fractional favorite.[278]

Dassault has also pursued new markets over the past five years, as sales have trended away from the traditional U.S. clientele.[279] The Chinese market has been particularly significant to Dassault. Since the first Falcon was delivered to China in 2006, the country has become a new market for this aircraft series, which reportedly has the range and

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[270] Sarsfield, "EBACE," May 10, 2011; Forecast International, "Dassault Falcon 2000," June 2010.

[271] Chase, "Medium Jet Category," April 2011; Forecast International, "Dassault Falcon 2000," June 2010.

[272] Dassault Falcon, "Dassault's Falcon," *AMT*, June 15, 2011; Jaggi, "Flight Test," October 15, 2010. Similarly, the 900 DX also had lower fuel consumption and operating costs than its competitors. Dassault Aviation, *2009 Annual Report*, 2010, 26. According to industry officials, the efficiency that tri-jet Falcons are able to attain is due to the certification requirement that, should an engine fail during an airplane's ascent, the remaining engine(s) must have the thrust to complete the climb. By using three engines instead of two, each of the engines can be smaller because, were one to fail, the two engines remaining would need to compensate for only an additional 33 percent of the airplane's thrust. Industry representative, interview with USITC staff, Bordeaux, France, October 2011.

[273] Collins, "Flight Test and Cutaway: Dassault Falcon 2000LX," May 8, 2009.

[274] Dassault Aviation, *2010 Annual Report*, 2011, 27. For an explanation of fractional ownership, see box 4.1 in chapter 4, "The Market for Business Jet Aircraft."

[275] Huber, "Dassault Prepares for Economic Upswing," October 12, 2011; industry representative, interview with USITC staff, France, October 2011.

[276] Forecast International, "Dassault Falcon 900/7X/SMS," June 2010, 7.

[277] USITC, hearing transcript, September 28, 2011, 296 (testimony of Michael D. Chase, Chase & Associates).

[278] Collins, "Flight Test: Essential Logic," May 16, 2011.

[279] Huber, "Dassault Prepares for Economic Upswing," October 12, 2011; Thisdell, "Falcon Orders," July 28, 2011.

capabilities currently sought by Chinese customers.[280] Indeed, in the first half of 2011, Dassault's largest market for the Falcon jet was China, with increasing sales in other developing economies (India and Latin America).[281]

China

Industry Developments

With no history until very recently of business jet travel and with an environment in which private air travel was restricted, China historically has not been conducive to the development of a business jet industry. This situation is slowly changing, though, as domestic demand for such aircraft grows. Through the state-owned Aviation Industry Corporation of China (AVIC), the Chinese government has actively pursued investment in this sector. General aviation aircraft and helicopters, among other products, are identified in China's 12th Five-Year Plan (2011–15) for National Economic and Social Development as part of one of seven strategic industries for which the Chinese government will provide priority support over the period.[282]

With the 12th Five-Year Plan, China has embarked on a multiyear strategy to develop a business jet industry. According to one industry source, the central government has provided the working capital to aggressively acquire assets of foreign general aviation aircraft companies as well as develop an indigenous supply chain for this industry.[283] In doing so, it has bought existing expertise in design, development, and certification of aircraft and parts, eliminating the time-consuming effort to gain these independently.

AVIC, a diversified manufacturer of industrial products and China's primary source of all aviation products, has demonstrated its ambition to manufacture business jets. In June 2011, AVIC purchased U.S.-based general aviation manufacturer Cirrus Aircraft. While Cirrus is a producer of piston engine aircraft, it also has a prototype business jet and hopes to use AVIC's financial resources to accelerate its development.[284] To develop the expertise to enter the business jet market, AVIC recently initiated a competitive bidding process with business jet producers to form a joint venture to assemble business jets in Chengdu, China. Four producers, two of which are U.S. producers (Cessna and HBC), were in the running for the joint venture.[285] On March 23, 2012, Cessna and AVIC announced a joint venture to build business jets in China.[286] Additionally, in April 2011, AVIC signed an agreement with Embraer to convert an existing regional jet production line in Harbin, China, into a business jet production line. Deliveries of business jets from this new joint venture will likely begin in late 2012.[287] From the business jet producers' perspective, any joint venture with a Chinese firm involves the sharing of valuable intellectual property and the strengthening of a new competitor. However, producers also

[280] Dassault Aviation, *2006 Annual* Report, 2007, 6; Sarsfield, "Orders Flow In," October 17, 2011.
[281] Thisdell, "Falcon Orders," July 28, 2011.
[282] Perrett, "Growth Engine," March 28, 2011, 22–23.
[283] USITC hearing transcript, September 28, 2011, 250 (testimony of Richard Aboulafia, Teal Group Corporation).
[284] Trautvetter, "Cirrus Aircraft Sold to Chinese Interests," June 28, 2011.
[285] Perrett, "Chinese Fighter Group Seeks Bizjet Partners," March 12, 2011; "Bombardier, Cessna, Hawker Beechcraft and IAI," June 29, 2011;
[286] Cessna, "Cessna and AVIC Join Forces," March 23, 2012; Francis, "Cessna Uses China," March 28, 2012. HBC is no longer in discussions with AVIC. Industry representative, e-mail to USITC staff, April 11, 2012.
[287] Moscrop, "Embraer Preps to Build Bizjets in China," July 19, 2011.

feel that this risk may be worth taking in order to gain a sizeable share of China's hitherto small but now fast-growing market.[288]

[288] Industry representatives, interviews by USITC staff, Wichita, Kansas, July 2011; Mustoe, "Goldman's Hawker Beechcraft Pursues," May 24, 2011.

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CHAPTER 4
The Market for Business Jet Aircraft

Summary

The business jet market has grown significantly in the last two decades, driven principally by increased corporate demand for business jets and the wider recognition of the utility of business jet travel.[1] In some cases, business aviation has become a viable alternative to commercial air transport, allowing users to travel to multiple locations in a single day, to continue working while in transit, and to reach locations that are underserved by commercial airlines.[2] The introduction of more advanced and more efficient business jet models, combined with the advent of charter and fractional ownership programs, have further increased the customer base for business jets and contributed to growing global demand.[3]

Despite these positive trends, the most recent economic recession had a strong negative impact on demand for business jets. Pronounced decreases in demand occurred in North America and Western Europe—the two largest geographic markets for business jets—and disproportionally affected the market for light and medium-sized jets.[4] A bright spot in the overall demand picture is the growing appetite for business jets in the emerging markets of Asia, Eastern Europe, Latin America, the Middle East, and Africa.[5] Business jet demand in each of these regions, while relatively small in proportion to total global demand, is forecast to increase rapidly, and will likely drive future growth of the business jet market.[6] For their part, established business jet manufacturers are poised to meet future demand growth with upgrades of existing aircraft models and the development of innovative, "clean sheet" designs, although they may be challenged by several new entrants that are seeking to capture a portion of the market.

[1] As identified in the request letter from the House Ways and Means Committee, the focus of this investigation is on business jets at or below 50,000 pounds MTOW.

[2] Bolen, NBAA, written testimony to the USITC, September 28, 2011, 2–3. The term "business aviation," as defined by the FAA, refers to the use of piston- or turbine-powered general aviation aircraft for business activities.

[3] Forecast International, "The Market for Business Jet Aircraft," December 2010, 11–14.

[4] TRB, Light Commercial and Business Aviation Committee—Business Aviation Subcommittee, meeting notes, June 2, 2011. A decrease in demand refers specifically to a year-on-year decline in the number of new business jets delivered to these markets. Latin America includes Mexico, Central America, and South America.

[5] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 15–16; Wilson, Honeywell Aerospace, prehearing statement to the USITC, September 9, 2011, 7.

[6] Bruce, prehearing brief to the USITC, September 9, 2011, 4.

Introduction

Demand for business jets is highly responsive to the state of the economy.[7] When the economy is performing well and corporate profits are robust, the demand for business jets increases. Conversely, when the economy is weak, as in the latter half of the period under investigation, the demand for business jets falls and inventories of used aircraft rise. Inventory levels of used business aircraft are in fact used as a barometer for the health of the industry—levels of roughly 10 percent or below are indicative of a strong market,[8] whereas levels of 13 percent and above are indicative of a weak one.[9] In the recent recession, inventory levels of used aircraft reached as high as 18 percent.[10]

Despite the economic climate, manufacturers of business jets continue to invest heavily in upgrades and new designs.[11] This investment is necessary because the market for business jets is highly competitive, so product differentiation is critical to capturing and retaining customers.[12] It is also an industry in which customer demand, in part, drives technological innovation.[13] In addition to technologies that improve an aircraft's efficiency and performance (e.g., by increasing fuel efficiency or reducing noise and carbon emissions), those technologies to which the customer is exposed in the cabin and the cockpit (e.g., touch-screen panels and wireless access) are important selling points of an aircraft, particularly for customers purchasing medium to super midsize jets.[14] This trend is evident not only in the traditional markets of North America and Western Europe, but in new, emerging markets such as China and Russia where demand for business jets is being driven by an increasingly sophisticated customer base.[15]

This chapter presents data on the leading markets for business jets; describes the customer base for business jets that are the subject of this report; examines the demand characteristics for business jets in both established and emerging markets; and discusses the effects of the global recession on the market for business jets.

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[7] Brian Foley and Associates, "Making Sense of Market Changes: Business Aircraft Transactions Conference," June 8, 2011; and Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 6. Demand forecasts for business jets are largely based on corporate profitability, or stock market, indices. Although business jet demand usually follows the same trajectory as market indicators—i.e., rising or falling with peaks and troughs in the economy, demand recovery often lags an upswing in the economic cycle by several months.

[8] In this case, 10 percent represents the proportion of used business jets for sale as a percentage of the in-service fleet of business aircraft (including those with a maximum takeoff weight of more than 50,000 pounds.).

[9] USITC, hearing transcript, September 28, 2011, 283 (testimony of Michael D. Chase, Chase & Associates).

[10] Industry representatives, interviews with USITC staff, Montreal, Canada, September 2011; Done, "Decline in Stock of Aircraft for Sale Points to Recovery," May 17, 2011, 2; and UBS Investment Research, "UBS Business Update," September 7, 2011. By contrast, during the last recession, business jet inventories reached a peak of roughly 16–17 percent in mid-2002.

[11] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011, and Montreal, Canada, September 2011.

[12] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011.

[13] USITC, hearing transcript, September 28, 2011, 170 (testimony of Bob Blouin, HBC).

[14] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011, and Montreal, Canada, September 2011.

[15] USITC, hearing transcript, September 28, 2011, 223–224 (testimony of Heidi Wood, Morgan Stanley); industry representatives, interviews with USITC staff, Wichita, KS, July 2011.

Leading Geographic Markets[16]

North America and Europe were the leading geographic markets for business jets in 2010, as indicated by the number of business jets operating in those markets. North America accounted for 10,854 aircraft, or 70 percent of the global fleet,[17] while Europe accounted for 2,501 aircraft, or 16 percent (figure 4.1). These regions were followed by South America with 984 aircraft (6 percent) and Asia with 844 aircraft (5 percent).[18] Africa represented the smallest geographic market for business jets in 2010 with only 322 aircraft in operation, representing 2 percent of the global business jet fleet.[19]

The United States was by far the single largest country market for business jets in 2010 with an installed base of 9,620 aircraft, or 65 percent of the global fleet. Mexico was the second-largest country market for business jets, with an installed base of 634 aircraft, accounting for 4 percent of the global fleet; Brazil ranked third with 569 aircraft (nearly 4 percent).

Growth trends in number of business jets operating globally during the period 2006–10 highlight the significance of emerging markets.[20] During this period, the number of business jets in Asia increased at an average annual rate of 16.2 percent, in South America by 16.3 percent, and in Africa by 10.5 percent (table 4.1).[21] In Europe, the number of business jets grew by 10.8 percent during 2006–10, whereas in North America the size of the business jet fleet increased by only 3.2 percent.

[16] Chase & Associates, "Emerging Markets—Business Jets," written statement to the USITC, September 9, 2011, 10; data provided by JETNET, e-mail to USITC staff, December 19, 2011.

[17] JETNET data for North America cover the United States, Canada, and Mexico, as well as the following countries and territories: The Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Jamaica, Netherlands Antilles, Panama, Puerto Rico, Saint Kitts and Nevis, and Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, Virgin Islands (British), and Virgin Islands (U.S.).

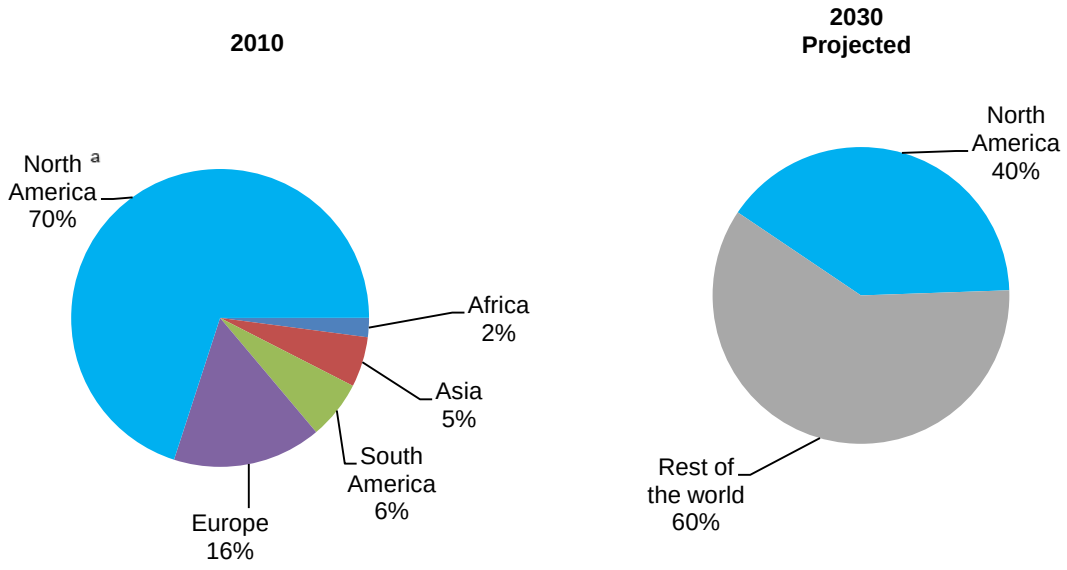
[18] This number includes Australia and Oceania. In 2010, Australia and Oceania had 154 business jets in operation, representing 1 percent of the global business jet fleet.

[19] Data provided by JETNET, e-mail to USITC staff, December 19, 2011.

[20] The number of business jets operating within a particular market may be referred to as the fleet or the "installed base" of business jets.

[21] The data in this section pertain to business jets with an MTOW of 50,000 pounds or below. However, if business jets above 50,000 lbs. MTOW were included as part of the data, percentage growth rates by region would differ only slightly.

FIGURE 4.1 North America was by far the largest geographic market for business jets under 50,000 lbs MTOW in 2010, but its share is forecast to decline over the next 20 years



Total = 14,720 aircraft

Source: Chase & Associates, JETNET, and Bombardier Business Aircraft, *Market Forecast 2001–30*, May 18, 2011.

[a]In 2010, the United States accounted for 89 percent of the North American total for business jets less than 50,000 lbs MTOW.

TABLE 4.1 Business jet fleet up to 50,000 lbs MTOW, in selected markets, 2006–10

Product segment[a]	Very light			Light			Medium to super midsize			All segments
Region/Country	2006	2010	% change, 2006–10	2006	2010	% change, 2006–10	2006	2010	% change, 2006–10	2006–10 AAG[c] %
Africa	0	12	(b)	90	108	20.0	126	202	60.3	10.5
Asia	0	18	(b)	135	164	21.5	244	508	108.2	16.2
China	0	1	(b)	21	22	4.8	10	32	220.0	
India	0	2	(b)	21	37	76.2	25	74	428.6	
Australia & Oceania	0	13	(b)	59	74	25.4	40	67	67.5	11.7
Europe	1	147	14,600.0	814	949	16.6	845	1,405	66.3	10.8
Germany	0	5	(b)	189	228	20.6	104	158	71.2	
France	0	9	(b)	64	85	32.8	86	112	30.2	
Russia	0	2	(b)	2	5	150.0	39	80	105.1	
United Kingdom	0	34	(b)	101	115	13.9	145	221	52.4	
North America	1	510	50,900.0	5,099	4,796	(5.9)	4,453	5,548	24.6	3.2
United States	1	474	47,300.0	4,682	4,309	(8.0)	3,966	4,837	22.0	
Canada	0	16	(b)	124	141	13.7	167	251	50.3	
Mexico	0	11	(b)	231	275	19.0	264	348	31.8	
South America	0	85	(b)	359	522	45.4	193	377	95.3	16.3
Of which:										
Brazil	0	80	(b)	216	280	29.6	95	209	120.0	

Source: USITC staff calculations based on data provided by JETNET, e-mail to USITC staff, December 19, 2011.

[a]According to JETNET, the "very light" product segment includes business jets up 10,000 lbs MTOW, whereas the "light" product segment includes business jets between 10,001 lbs and 20,000 lbs MTOW. For the purposes of this report, staff consolidated JETNET data on business jets between 20,001 lbs and 50,000 lbs MTOW into the "medium to super midsize" product segment. It should be noted that the 12,500 lbs MTOW used for very light jets in this report differs from that of JETNET.

[b]The percentage change could not be calculated because data for the base year (2006) equal 0, meaning there were no known very light jets (maximum 10,000 lbs MTOW) operating in the country during that year.

[c]Average annual growth.

Industry forecasts for new business jet deliveries during 2011–30 (including those outside the scope of this report) indicate a continued shift in market demand away from North America and toward the emerging markets. At the end of this period, North America will likely account for only 40 percent of new business jet deliveries worldwide, with the remaining 60 percent of new business aircraft destined for markets outside the United States and Canada.[22] For example, China and Latin America are forecasted to account for 10 percent and 9 percent, respectively, of new business jet deliveries over the next 20 years, while Russia and India will each account for roughly 6 percent of such deliveries. Europe will remain the second-largest market for business jets during 2011–30, with an estimated market share of 17 percent.[23]

[22] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 16. Bombardier does not include Mexico as part of the North American market.

[23] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 16.

Customers and Factors Affecting Demand

Customer Segmentation

Business jet customers generally consist of four groups: very high net worth individuals (VHNWIs), or those with financial assets of $100 million or more; high net worth individuals (HNWIs), or those with financial assets of $1 million or more; private and public corporations; and charter and fractional ownership firms (table 4.2).[24] VHNWIs, HNWIs, and private and public corporations account for nearly 80 percent of the demand for business jets, while charter and fractional operators (box 4.1) represent roughly 15 percent of business jet demand.[25] The remaining 5 percent of business jet demand is accounted for by government entities. Among private and public corporations, an estimated 85 percent of those that use business jets are small and medium-sized enterprises (SMEs).[26]

Across all customer segments, the primary selection criteria for a business jet are the speed and range at which it flies; the price of the aircraft; the configuration of the aircraft's cabin and cockpit; and the quality of customer, or aftermarket, support.[27] Although all business jet users evaluate a new aircraft purchase according to its price-to-value proposition, the ranking of the above criteria may differ depending on the customer segment. For VHNWIs and HNWIs, including owners of private companies, the look and feel of an aircraft may be an important selling point, second only to the aircraft's range and speed. For small corporate customers, as well as charter and fractional ownership firms, the utility of an aircraft may be paramount, including its ability to fly in and out of smaller airports and make multiple trips without the need for unscheduled maintenance or excessive downtime.[28]

Price sensitivity also varies among customer segments. Certain HNWIs and large public corporations are typically less price sensitive when evaluating the potential purchase of a business jet, and are more likely to pay for a new aircraft using their own financial assets rather than relying on financing from the manufacturer or commercial banks. By contrast, for small companies, as well as charter and fractional ownership firms, price may be a deciding factor in their determination to purchase a new or used business jet or in choosing one aircraft model over another. These customers are also more reliant on third-party financing to fund all or part of their aircraft purchase.[29]

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[24] Both charter and fractional ownership firms specialize in the provision of on-demand travel, though their business models differ.

[25] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011.

[26] USITC, hearing transcript, September 28, 2011, 129 (testimony of Ed Bolen, NBAA); industry representatives, interviews with USITC staff, Wichita, KS, July 2011. Here, SMEs refer to companies with revenues less than $100 million, which typically occupy the small end of the business jet market (i.e., the very light and light jet segments). Trip lengths for customers in this segment may average between 350 and 600 miles.

[27] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 15–16; Wilson, Honeywell Aerospace, prehearing statement to the USITC, September 9, 2011, 7; USITC, hearing transcript, 158 (testimony of Robert Wilson, Honeywell Aerospace).

[28] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011; Forecast International, "The Market for Business Jet Aircraft," December 2010, 12.

[29] USITC, hearing transcript, September 28, 2011, 201 and 232 (testimony of Richard Aboulafia, Teal Group Corporation). For a complete discussion of customer financing, see chapter 6, "Financing."

TABLE 4.2 Customer profiles for business jets under 50,000 lbs MTOW

Segment	Customer characteristics	Type of aircraft purchased	Primary use of aircraft	Price sensitivity
Very high net worth individual (VHNWI)	–Individual with assets of at least $100 million, including owners of private companies. –May use aircraft for business purposes, for personal/family travel, or both.	Medium to super midsize aircraft; purchases new models.	Business, some leisure	Low
High net worth individual (HNWI)	–Individual with assets of at least $1 million. – May be both owner and operator (pilot) of aircraft. –May use aircraft for business, for personal/family travel, or both. –Example: A physician with offices in multiple locations not served by commercial airlines.	Very light to light aircraft; may purchase new or used models.	Business, some leisure	Medium
Public company	–Large corporation with its own flight department. –May own several business jets for the transport of company staff. –May use aircraft for both domestic and international travel. –Example: Fortune 100 company.	Light to super midsize aircraft; purchases new models.	Business	Low to medium
Charter or fractional ownership firm	–Small to large firm with a fleet size ranging from dozens to hundreds of aircraft. –Examples of some of the largest national firms are NetJets, Flight Options, and Avant Air. In addition, OEM firms include FlexJet (Bombardier) and Citation Air (Cessna).	–Very light to super midsize aircraft. –Price sensitivity, especially on the part of smaller charter and fractional firms, may stimulate purchase of used aircraft. –Larger firms may purchase new models.	Business	Medium to high

Source: Industry representatives, interviews with USITC staff, Wichita, KS, July 19–22, 2011; Sarsfield, "Orders Flow in at NBAA," *Flight Global*, n.d. (accessed October 18, 2011); Warwick, "Flight Options' New Owner Buys," December 3, 2007.

BOX 4.1 Fractional ownership programs

Fractional ownership programs permit customers to purchase a share of a business jet in exchange for use of that aircraft for a specific length of time, usually denominated in hours.[a] A customer may own as little as one-sixteenth of a business jet, equivalent to 50 flight time hours, with the remaining shares sold to other customers of the fractional ownership firm.[b] Fractional ownership appeals to customers who cannot afford to buy a whole aircraft, but whose use of business aviation is frequent enough (typically between 50 and 250 flight time hours per year) that the purchase of a fractional share is more cost-effective than the charter of business jets on a case-by-case basis.[c] Under a fractional ownership program, the piloting, maintenance, and licensing of the aircraft is performed by the fractional company, saving customers both time and costs.[d] Fractional ownership customers may use the program to supplement other forms of air travel, including commercial air transport or transport on company-owned business jets. Fractional programs may also be combined with jet card programs. Under a jet card program, a customer pays an annual membership fee for a certain number of flight time hours per year; travel is booked with either an air charter company or a fractional ownership firm.[e]

Fractional ownership programs are more prevalent in the United States than overseas, in part due to market conditions.[f] In Europe, for example, fractional ownership firms are treated as private rather than commercial carriers and are subject to certain tax laws that make their operation costly.[g] Leading U.S. fractional ownership firms are NetJets, Inc., Flight Options (a subsidiary of the large multinational firm Raytheon), and Avant Air.[h] Other large fractional firms are owned by business jet manufacturers, including Bombardier's FlexJet, which leases the company's Learjet and Challenger models, and Cessna's Citation Air.[i]

Beginning in the mid-1990s, fractional ownership programs grew rapidly, partly stimulated by demand from first-time customers of business aviation. At the time, some industry experts viewed business jet purchases by fractional ownership firms as one of the main drivers of industry growth. However, beginning in 2008, new aircraft purchases by fractional firms, which typically rely on third-party financing, declined significantly due to the tightening of credit in the financial markets. Looking forward, it is unclear how important business jet demand by fractional ownership firms will be to the performance of the industry. Some postulate that such demand will remain modest and will be driven largely by the need for fractional firms to replace older business jets with new ones rather than by a desire to expand their aircraft fleets.[j] Others say growth in the fractional ownership sector may depend on the popularity of business aviation in places like China, where licensed pilots are so few that purchasing a business jet through a "service" company may be an attractive option to potential customers.[k]

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[a] Forecast International, "The Market for Business Jet Aircraft," December 2010, 16; NetJets company Web site. The first fractional ownership program was established in 1986 by U.S. company NetJets. In 1998, NetJets was acquired by Warren Buffet, CEO of Berkshire Hathaway.

[b] Industry representatives, interviews with USITC staff, Wichita, KS, July 22, 2011; USITC, hearing transcript September 28, 2011, 166 (testimony of Ed Bolen, NBAA) and 276 (testimony of Michael D. Chase, Chase & Associates); industry representative, telephone conversation with USITC staff, October 24, 2011. There are nearly 800 fractionally owned jets currently in operation globally.

[c] GAMA, PowerPoint presentation before USITC staff, July 14, 2011. According to industry representatives, customers who use business jets less than 50 hours per year tend to charter aircraft; those that fly between 50 and 250 hours per year use fractionals; and those that fly more than 250 hours per year typically buy their own business jets.

[d] Industry representatives, interviews with USITC staff, Wichita, KS, July 22, 2011. Fractional ownership customers may be assessed separate per-trip fees for fuel and for maintenance and repair.

[e] Forecast International, "The Market for Business Jet Aircraft," December 2010, 16–17, 19. Under a charter arrangement, a customer can rent an aircraft for a specific trip or can purchase a block of flight time with the charter company.

[f] USITC, hearing transcript, September 28, 2011, 276 (testimony of David Strauss, UBS Investment Research).

[g] Forecast International, "The Market for Business Jet Aircraft," December 2010, 16–17.

[h] USITC, hearing transcript, September 28, 2011, 83 (testimony of Bob Blouin, HBC). Raytheon also owned U.S. business jet manufacturer HBC until selling it to Goldman Sachs and Canadian investment firm Onex in 2007.

[i] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 9.

[j] USITC, hearing transcript, 143–144 (testimony of Ed Bolen, NBAA) and 274–275 (testimony of David Strauss, UBS). According to industry representatives, many fractional customers have moved on to purchase their own business aircraft.

[k] TRB, Light Commercial and Business Aviation Committee—Business Aviation Subcommittee, meeting notes, June 2, 2011.

Demand Factors

As noted, the market demand for business jets is influenced by certain macroeconomic factors. These factors include a country's rate of GDP growth and its level of wealth creation (i.e., the increase in the number of individuals or corporate entities that have the financial resources to purchase business jets).[30] The increasing decentralization, or globalization, of business is another factor influencing business jet demand, especially where the timeliness and flexibility required of business travel is not met by commercial aviation.[31]

At the microeconomic level, customer demand for business jets is also affected by several factors, among which are a customer's desire to increase corporate productivity; replacement demand for used aircraft; brand loyalty; and the introduction of newer, more technologically sophisticated aircraft models. The potential linkage between business aviation and corporate productivity is often a strong impetus for a first-time customer to purchase a business jet or, as is the case for charter and fractional ownership users, to substitute business aviation for commercial air transport. Several studies have been conducted by, or in conjunction with, the business aviation community in an effort to measure the relationship between corporate productivity and business jet travel. Overall, these studies found that companies that used business jets received certain productivity benefits—arising, for example, from reduced travel time, the ability to move key staff efficiently between hard-to-reach locations,[32] and the ability to work while in flight. Such benefits, in turn, were estimated to have a positive effect on company profitability.[33]

Business jets are typically replaced every 5 to 10 years, and demand for a replacement aircraft is stimulated by the introduction of manufacturer updates to existing aircraft models. These so-called "block point" changes are less time-consuming and less costly to produce than newly designed (i.e., clean sheet) aircraft, but are nonetheless an important driver of business jet purchases.[34] The replacement market typically consists of customers looking for business jets with longer range, larger cabins, and upgraded avionic and engine systems—i.e., the latest version of the aircraft model they already fly. At the same time, charter and fractional ownership firms replace aircraft with particularly high utilization rates to preserve the quality of their service and to lower operating costs.[35] In a replacement transaction, a customer may trade in an older aircraft as a down payment on the purchase of a new one. Those "secondary" aircraft that are in good condition (and that have complete maintenance records) then populate the used, or pre-owned, business jet market, and may be especially attractive to price-sensitive buyers.[36]

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[30] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 7. Wealth creation is measured by a country's GDP growth rate.

[31] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 8; "Business Aviation: An Enterprise Value Perspective," Fall 2009, 6.

[32] Such staff may include, for example, corporate executives and managers, as well as technical, sales, and service personnel.

[33] Forecast International, "The Market for Business Jet Aircraft," December 2010, 12; USITC, hearing transcript, September 28, 2011, 98 (testimony of Ed Bolen, NBAA).

[34] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011.

[35] "Honeywell Aerospace Business Aviation Outlook," October 22, 2010; Frank, "Note to Obama: $250,000-a-Year Earners," June 29, 2011. Annual operating costs for a business jet can reach hundreds of thousands of dollars, and may include pilots' and mechanics' salaries (if aircraft maintenance is taken care of by the owner/operator), fuel, and hangar fees.

[36] Bombardier, "Bombardier Input to ITC Section 332 Investigation," September 2011, 10.

Customers that purchase replacements for existing aircraft often do so from the same manufacturer of their current business jets because of familiarity with the OEM and its aircraft. Brand loyalty is thus another important dimension of business jet demand—reinforced by the OEM's ability to add value to its product line through upgrades, as well as through the introduction of new aircraft models. For example, U.S.-based business jet manufacturers Cessna, HBC, and Learjet offer at least three models of aircraft in the light to medium segments (figure 4.2). Some of these aircraft models are derivatives of the OEM's existing products; others are completely new, clean-sheet designs.[37] Such extensive product offerings enable an OEM not only to appeal to a broad base of potential users but, perhaps more importantly, to "grow" with their existing customers by meeting their evolving needs for larger, more sophisticated aircraft.[38]

Brand loyalty is also maintained through aftermarket support. Once a customer has purchased a business jet, the reliability of that aircraft becomes the most important product attribute and the basis for an OEM's reputation with its customers.[39] OEMs ensure the reliability of their aircraft by establishing a global network of service centers, some of which are operated directly by the manufacturers themselves, others of which are outsourced to third-party providers. For instance, U.S.-based HBC owns 10 proprietary service centers—eight in the United States and one each in Mexico and the United Kingdom—and provides customer support through another 90 authorized service centers worldwide.[40] Similarly, U.S.-based Cessna operates eight company-owned service centers in the United States and one in France. In addition, it has nearly 40 authorized service facilities, most of which are located overseas.[41] For all manufacturers, the location of these centers guarantees that an aircraft can be serviced virtually anywhere that it flies.[42]

[37] USITC, hearing transcript, September 28, 2011, 83 (testimony of Bob Blouin, HBC); industry representatives, interviews with USITC staff, Wichita, KS, July 2011.

[38] USITC, hearing transcript, September 28, 2011, 160–161 (testimony of Bob Blouin, HBC) and 311 (testimony of Heidi Wood, Morgan Stanley).

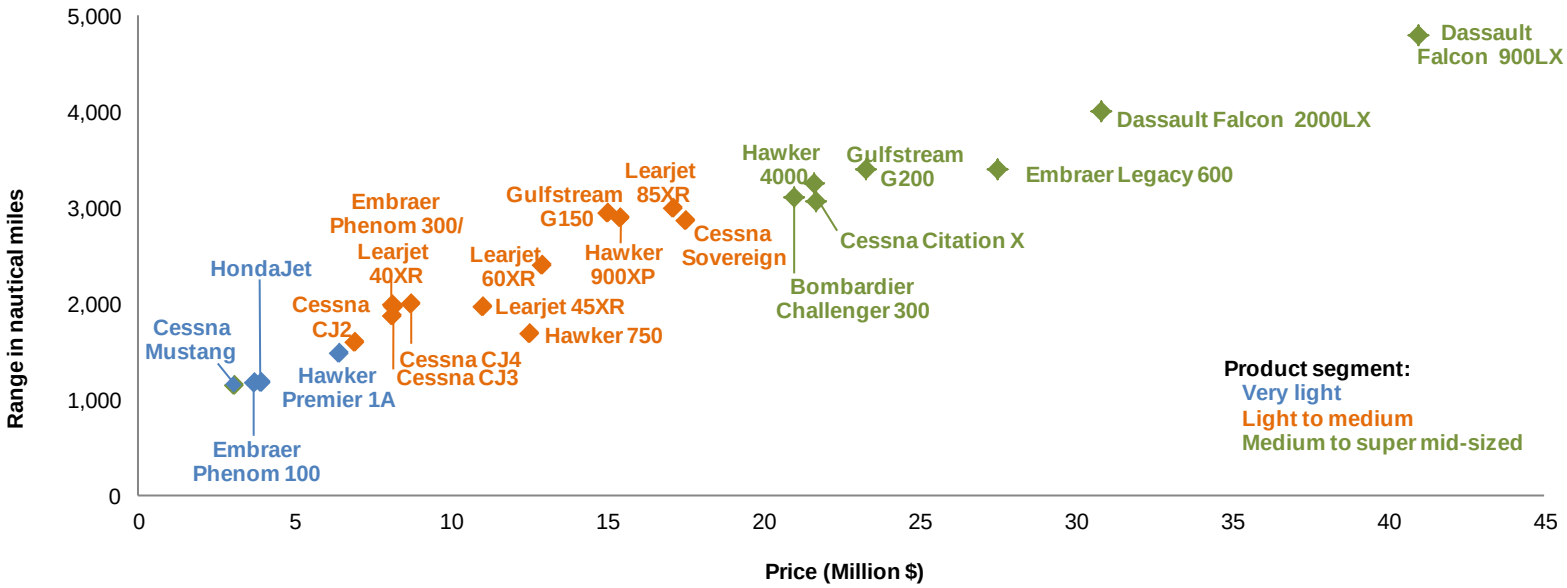
[39] USITC, hearing transcript, September 28, 2011, 304 (testimony of Heidi Wood, Morgan Stanley).

[40] USITC, hearing transcript, September 28, 2011, 160 (testimony of Bob Blouin, HBC); industry representatives, interviews with USITC staff, Wichita, KS, July 2011. Some of these service centers are also sales venues, where customers may be encouraged to purchase an updated version of the current aircraft they own.

[41] Cessna, "Cessna Aircraft Company: Citation Authorized Service Facilities," n.d.; Cessna, "Citation Service Centers," n.d. (accessed October 19, 2011).

[42] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011.

FIGURE 4.2 The business jet market is highly competitive as indicated by the number of aircraft models available within each product segment[a]



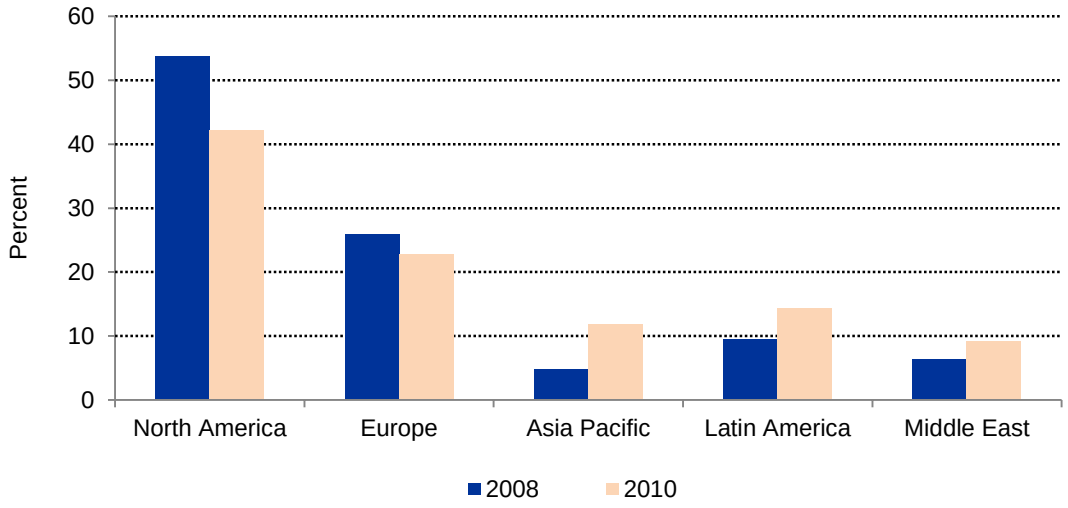
Source: Forecast International, "The Market for Business Jet Aircraft," December 2010; HBC product brochure, n.d.; and aircraftcompare.com, http://aircraftcompare.com/manufacture-aircraft/Bombardier/ (accessed March 6, 2012).

[a]The figure includes many but not all models available within each product segment. Prices are approximate values only.

Emerging-Market Demand

While the United States and Europe remain the largest markets for business jets, emerging economies represent an important source of new business jet demand. The increase in business jet demand in markets other than from North America and Europe became especially evident after the 2008 recession, the adverse effects of which were distributed unevenly among developed and developing markets.[43] For example, North America's share of new business jet deliveries decreased by more than 10 percentage points during 2008–2010, whereas shares in the Asia Pacific region and Latin America increased by nearly 7 percentage points and 5 percentage points, respectively (figure 4.3).[44] Within the next 5 to 10 years, emerging markets are forecasted to account for as much as 50 percent of new business jet demand.[45]

FIGURE 4.3 Between 2008 and 2010, business jet deliveries declined in North America and Europe but increased in Asia, Latin America, and the Middle East[a]



Source: General Aviation Manufacturers Association, *2010 Statistical Databook & Industry Outlook*.

[a]Includes business jets over 50,000 lbs. MTOW.

At present, the customer base for business jets in the emerging markets is somewhat less diverse than in the United States or Europe—and it is primarily comprised of individuals

[43] Elightglobal, "BRIC Economies Withstand Global Financial Crisis," *Euromonitor International*, November 2008; "Bombardier Business Aircraft—Market Forecast 2010–2029," 29–33. The United States, for example, was more adversely affected by the recession than Europe. Among emerging markets, Brazil and Russia experienced declines in GDP at the beginning of the recession in 2008, though their economies rebounded thereafter; China and India have sustained strong, but relatively lower, GDP growth throughout the recessionary period.

[44] GAMA, *2010 Statistical Databook & Industry Outlook*. table 1.3, "Delivery by Region (in Percent of Total) for General Aviation Airplane Shipments by Type of Airplane Manufactured Worldwide (2007–2010)," 16. Includes business jets over 50,000 lbs. MTOW. By 2011, North America's share of all new business jet deliveries rebounded to 50.3 percent, whereas Europe's declined to 19.5 percent. In the Asia Pacific and Latin America regions, shares of new business jet deliveries were 9.7 percent and 7.1 percent, respectively. GAMA, *2011 Statistical Databook & Industry Outlook*. table 1.3, "Delivery by Region (in Percent of Total) for General Aviation Airplane Shipments by Type of Airplane Manufactured Worldwide (2007–2011)," 16.

[45] USITC, hearing transcript, September 28, 2011, 213 (testimony of David Strauss, UBS Investment Research).

or entities with significant financial resources. In many cases, these customers have a distinct preference for larger business jets because of their luxuriousness and longer range. For instance, in China, business jet demand is driven by a steep rise in the number of wealthy entrepreneurs and by an increase in business activity between China and foreign countries.[46] As a result, the market for business jets in China currently favors aircraft in the larger product segments.[47] Illustratively, U.S. firm Gulfstream, which specializes in the production of medium- to large-sized business jets, reportedly has an installed base of 58 aircraft in China, representing a 40-percent share of the Chinese market.[48] Similarly, rising affluence in Russia and increasing participation in international business has stimulated the sale of high-end business jets into the Russian market, including the Bombardier Challenger, the Dassault Falcon, and the Embraer Legacy models.[49] In addition, fractional ownership is gaining popularity in Russia, as well as in neighboring Commonwealth of Independent States (CIS) countries. In 2008, U.S.-based fractional firm, NetJets, viewed Russia as one of the company's three largest markets in Europe.[50]

Despite the current preference for larger business jets in the emerging markets, demand for smaller aircraft in these countries will likely increase as their domestic business environments mature and intra-country travel increases.[51] In Brazil, for example, very light and light business jets have already become popular in the domestic market, including the Phenom 100 and 300 models, produced by the Brazilian aerospace manufacturer, Embraer, and the Citation Mustang, produced by U.S. firm, Cessna. These business jet models are often used by Brazilian companies to transport employees between cities that are 2 to 3 hours distance by plane. Brazil is reportedly the second largest market for Embraer's Phenom series of aircraft after the United States, and represents 8 percent of the global market for Cessna's Citation Mustang.[52] Separately, in India, light to medium-sized business jets accounted for nearly 50 percent of the country's business aircraft fleet in 2009. During that year, India reportedly had 30 aircraft produced by U.S. firm HBC and 28 Cessna Citation models, with the country's remaining business jet fleet comprised mainly of larger business jets produced by Bombardier, Dassault, and Gulfstream.[53] China, too, is likely to increase its demand for light to medium-sized business aircraft as the country's air space opens up, facilitating growth in domestic business aviation.[54]

The prospects for increased business jet demand in the emerging markets are moderated by certain challenges—these challenges include inadequate general aviation infrastructure in many of the emerging economies, regulatory barriers that impose restrictions on intra-country flight, and high tariffs on imported aircraft. In China, for

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[46] "Gulfstream Aerospace Excels in Third Quarter," October 27, 2011.

[47] Jacob, "Swift Climb Leaves Plenty of Potential," May 17, 2011, 4. Customers in China have also purchased the largest of business jet models, i.e., those reconfigured from commercial aircraft produced by Airbus and Boeing.

[48] Pearson, "Business Jets Take Off in China," May 27, 2011; "China Minsheng Leasing Arm to Order 50 Gulfstream Business Jets," July 1, 2011. In addition, in July 2011, the leasing arm of the China Minsheng Banking Corp. ordered 50 business jets in the super midsize and large product categories from U.S. manufacturer Gulfstream. The order was to include the new Gulfstream 250 (now 280), as well as the Gulfstream 450, 550, and 650 (which are outside the scope of this report). By October 2011, the company had confirmed the order of 20 business jets from Gulfstream.

[49] "Russian Registry Still Short on Western Bizjets," October 27, 2011.

[50] Gethin, "Demand for Business Aviation is Growing in Russia," May 12, 2008.

[51] USITC, hearing transcript, 92 (testimony of Robert Wilson, Honeywell Aerospace).

[52] Sobie, "Brazil's Light Jet Sector Explodes," August 9, 2010.

[53] Chase, "Emerging Markets—Business Jets," September 28, 2011, 4.

[54] Industry representatives, teleconference with USITC staff, August 29, 2011.

example, only about 150 airports can be used by business aircraft, compared to 5,300 airports in the United States.[55] In addition, the China Civil Aviation Authority (CAAC) restricts the use of airspace at certain altitudes and requires that all aircraft fly within predetermined routes, or "corridors," which are often heavily trafficked by commercial airlines.[56] However, the Chinese government plans to build a large number of both commercial and general aviation airports as part of its current five-year economic plan, and has gradually begun to lift airspace restrictions in certain areas (box 4.2).[57]

BOX 4.2 China's business aviation environment and recent improvements

Though conditions are beginning to change, China has historically maintained a highly restrictive environment for air travel, which has limited the growth of the business aviation sector in the country. Currently, the Chinese military controls the majority of China's airspace and business aircraft are limited to flying at certain altitudes and in certain areas of the country.[a] In addition, flight plan approvals and airport entry permits for business jets require relatively long lead times (e.g., sometimes days instead of hours). Business jets owned by foreign entities are permitted to fly to, from, and to a limited extent, within China, but are not allowed to use China as their home base.[b] Chinese airports that provide access to business jets are few, and those that do exist generally lack important support services such as aircraft refueling and maintenance and repair facilities. There is also a shortage of trained pilots, mechanics, and technicians in China to support the business jet industry.[c]

Despite these challenges, China has taken steps to improve the market environment for business jets. For example, in November 2010, China's State Council and the Central Military Commission announced a five-year plan to gradually open China's low-altitude airspace (below 13,000 feet) to general aviation aircraft.[d] Further, based upon projections of future growth in the demand for business jet travel in China, the CAAC has announced that it will build 65 new airports over the next five years, including additional airports to serve major Chinese cities, and will upgrade 90 other existing airports.[e] At present, two of China's largest airports—Beijing Capital International Airport and Shanghai Hongqiao International Airport—have business jet facilities, and a third, Tianjin Binhai International Airport, has near-term plans to offer business jet management and maintenance services.[f]

[a] Simpson, "Emerging Markets—Opportunity or Challenge for Business Aviation?" September 2010; and Wines, "Flights of Fancy: Super-rich Find Ways Around China's Airspace Restrictions," May 18, 2011.

[b] Brian Foley and Associates, "Making Sense of Market Changes," June 8, 2011.

[c] Wines, "Flights of Fancy: Super-rich Find Ways Around China's Airspace Restrictions," May 25, 2011.

[d] TRB Light Commercial and Business Aviation Committee—Business Aviation Subcommittee, meeting notes, June 2, 2011. For flights below 13,000 feet, pilots must submit their flight plans to Chinese aviation authorities but are not required to receive government approval before commencing their flight. For flights above 13,000 feet, pilots must submit a flight plan and receive government approval before flying. In November 2011, the Chinese government announced that, beginning in January 2012, it would further loosen restrictions on low-altitude flights by opening up airspace below 1,000 meters (about 3,300 feet) in the northeastern, central, and southern areas of China, as well as above six pilot cities, including Hangzhou, Kunming, Ningbo, Qingdao, Tangshan, and Xi'an. "China Opens More Airspace for GA," August 17, 2011; "China to Further Open Up Low-Altitude Airspace," November 17, 2011.

[e] Perret, "Growth Engine," March 28, 2011, 20–23.

[f] "Business Jets to Get Service Center at Shanghai Airport," November 15, 2011; Kolesnikov-Jessop, "Private Aviation Industry Sees New Horizons in China," May 16, 2011.

[55] Simpson, "Emerging Markets: Opportunity or Challenge for Business Aviation?" September 2010; Chase, "Emerging Markets: Business Jets," September 28, 2011, 6–7; Central Intelligence Agency (CIA), *The World Factbook*, updated January 10, 2012. Here, 5,300 refers to the total number of public-use airports in the United States. These airports are accessible to both business and commercial aircraft. By contrast, in China, there were a total of 502 airports in 2010. Some industry reports suggest that only a fraction of these (about 150 airports) are accessible to business aircraft.

[56] Simpson, "Emerging Markets: Opportunity or Challenge for Business Aviation?" September 2010.

[57] Pearson, "Business Jets Take Off in China," May 27, 2011; TRB, Light Commercial and Business Aviation Committee—Business Aviation Subcommittee, meeting notes, June 2, 2011.

In India, the business aviation sector is hampered by an inadequate number of general aviation airports, a dearth of maintenance and repair facilities for business jets, and tight government control over the country's airspace. India also imposes a 25 percent import tax on general aviation aircraft and high tariffs on imports of aircraft parts.[58] Nonetheless, as in China, the Indian government has taken certain steps to improve the business aviation environment, including plans to build additional airports as well as to establish service centers that maintain inventories of spare parts for business aircraft operating in the country.[59]

Effects of the Recession on the Business Jet Market

As noted, the global recession that began in 2008 had a substantial effect on the demand for business jets: that effect was felt most deeply in the market for light jets in the United States and, to a lesser extent, in Europe.[60] U.S. purchases of very light jets were particularly hard hit by the recession and the accompanying financial crisis, as the smaller firms that tend to purchase these jets faced declining revenues and found it difficult to borrow from commercial banks. These companies postponed the purchase of new business jets and, in some cases, canceled pre-existing orders.[61] Fractional ownership firms, which had in the past driven market growth even during recessionary periods, also held back on purchases of new jets, uncertain of future demand for their services. Order cancellations, particularly among manufacturers of very light, light, and certain medium to midsize jets (those priced between $4 million and $25 million) increased, as did the inventory of used business aircraft.[62] By contrast, the sale of larger business jets (those priced above $25 million), the majority of which are outside the scope of this report, continued to rise during the period buoyed, in part, by consumer demand in the emerging markets whose economies were less affected by the global recession.[63] The end result of these events was what some industry analysts termed a "bifurcation," or division, in the market for business aircraft, in which demand for smaller business jets trended downward while demand for larger aircraft trended upward. Historically, these two market segments have responded in tandem to economic cycles.[64]

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[58] Chase, "Emerging Markets: Business Jets," September 28, 2011, 4; NBAA, "Studies Point to Business Aviation Potential in India," April 25, 2011.

[59] NBAA, "Studies Point to Business Aviation Potential in India," April 25, 2011.

[60] Purchases of medium to super midsize jets were also affected, though less severely, by the recession. For more information, see table 6.2 in chapter 6, "Financing."

[61] USITC, hearing transcript, September 28, 2011, 44 (testimony of Robert Morin, U.S. Ex-Im Bank) and 166–67 (testimony of Ed Bolen, NBAA). For further discussion on how the recession and financial crisis affected the ability of certain customers to purchase business jets, see chapter. 6, "Financing."

[62] USITC, hearing transcript, September 28, 2011, 200 (testimony of Richard Aboulafia, Teal Group Corporation); Solon, "In Business Jet Industry, a Downturn That Was Not Evenly Shared," May 16, 2011; Bombardier Business Aircraft, *"Market Forecast 2011–2030,"* 2011. http://www.bombardier.com/files/en/supporting_docs/BA-BBA_2011_Market_Forecast.pdfup (accessed March 12, 2012).

[63] Jaworski, "Key Indicators Point to Business Aviation Rebound," January 25, 2010, 99. The ability of customers purchasing larger business jets (i.e., those above $25 million) to "self-fund" such purchases using their own financial assets rather than relying on commercial loans (as purchasers of jets below $25 million often do) is cited as another important reason for market bifurcation during the recession. USITC, hearing transcript, September 28, 2011, 202 (testimony of Richard Aboulafia, Teal Group Corporation).

[64] Aboulafia, "Bifurcated, Torn, and Conflicted: The Business Aircraft Industry's Difficult Recovery," PowerPoint presentation before the USITC, September 28, 2011; USITC, hearing transcript, September 28, 2011, 200 (testimony of Richard Aboulafia, Teal Group); and Solon, "In Business Jet Industry, a Downturn That Was Not Evenly Shared," May 16, 2011. In this context, "smaller" business jets are those that are priced at approximately $25 million or less, whereas "larger" business jets are priced above $25 million.

The near-term outlook for the business jet market remains uncertain. Although U.S. corporate profits began recovering in 2009,[65] fears of a second recession and the lasting effects of the financial crisis reportedly have caused many companies to continue to defer the purchase of high value items such as business aircraft. In addition, reports in the U.S. media that portrayed business jet users in a negative light may have further dampened aircraft demand among corporate customers.[66] Furthermore, U.S. government policies regarding aircraft tax depreciation and user fees,[67] as well as proposed environmental regulations in Europe that affect both business and commercial aircraft, all have potential adverse impacts on the business jet market.[68] In particular, some suggest that government policies that erode current tax benefits for business aviation or impose additional costs on aircraft usage create an uncertain economic environment for business jet owners and operators—and could hinder growth in the demand for business jets.[69] Where increasing demand for business jets has already occurred, such demand has largely been generated by the introduction of new business jet models. For instance, Embraer delivered nearly 200 units of its newly-launched, very light Phenom 100 business jet between 2009 and 2011, and Dassault sold more than 50 units of its new, super midsize Falcon 2000LX during the same period.[70] Looking ahead, industry experts forecast a measured rather than a rapid recovery in business jet demand, tempered by the availability of credit in the financial markets, the rate at which aircraft purchases increase in emerging economies like China, and the influence of government policies that affect business jet users.[71]

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[65] Econoday, "Econoday Report: Corporate Profits," August 26, 2011.

[66] Jaworski, "Key Indicators Point to Business Aviation Rebound," January 25, 2010, 99.

[67] TRB, Light Commercial and Business Aviation Committee—Business Aviation Subcommittee, meeting notes, June 2, 2011; EAA, "EAA Briefing on User Fees," 2011.

[68] "NBAA: U.S. House Soundly Rejects European Emissions Trading Scheme," NBAA Press Release, October 25, 2011. The European Emissions Trading Scheme, which took effect on January 1, 2012, requires that the operator of any aircraft flying through or landing in an EU country pay a "carbon tax" based on the aircraft type and distance flown. In October 2011, the U.S. House of Representatives passed legislation ("The European Emissions Trading Scheme Prohibition Act of 2011" (H.R. 2594)), which exempts U.S. business and commercial aircraft from participating in the program.

[69] USITC, hearing transcript, September 28, 2011, 244–245 (testimony of Richard Aboulafia, Teal Group Corporation). For a different perspective on the efficacy of air traffic control (ATC) user fees, see, for example, Poole, *Business Jets and ATC User Fees: Taking a Closer Look*, Reason Foundation Policy Study, August 2006.

[70] GAMA, *2010 Statistical Databook & Industry Outlook*, table 1.4, "Worldwide Business Jet Shipments by Manufacturer (1998–2010)," 16–17.

[71] Industry representatives, teleconference with USITC staff, August 29, 2011; Reuters, "Bombardier Sees Biz Jet Market Recovery, Slow 2011," May 19, 2011.

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CHAPTER 5
Technological and Business Innovation in Business Aviation

Summary

The business jet industry[1] is characterized by substantial technological and business innovation supported by large investments in R&D (box 5.1). Innovative product attributes are important competitive differentiators; without them, products can become "stale" in comparison to competitors and even obsolete, given the steady stream of innovation in the technologies that make up a business jet. OEMs' product innovation strategies are directed at maintaining a balanced portfolio of products incorporating large-scale and incremental innovations. To reduce the substantial costs and risks of innovation, OEMs increasingly rely on the R&D investments of risk-sharing suppliers. Indeed, major suppliers' R&D expenditures as a portion of sales often exceed those of OEMs, particularly as the responsibilities of suppliers have grown to include not only new product development and integration but also regulatory certification. OEMs rely as well on business innovations, including lean management principles that focus on maximizing value and minimizing waste in all phases of design and production.

Governments also contribute to the innovation process, although the business jet sector reportedly has the least government involvement of the entire aircraft industry. The four countries that host business jet OEMs—Brazil, Canada, France, and the United States—have institutions and programs in place to support basic and applied research and product development. Those that provide collaborative opportunities such as the National Institute for Aviation Research (NIAR) in Wichita, Kansas, are considered particularly useful by industry; so is government research into innovations that are at a technology readiness level (TRL)[2] high enough to justify follow-on investment. Another important government function is the review and certification of new products. Unreasonable delays or inconsistent decision making in the certification and approval process can undermine the competitive ability of OEMs by prolonging the time it takes for them to bring new aircraft innovations to market.

[1] As identified in the request letter from the House Ways and Means Committee, the focus of this investigation is on business jets at or below 50,000 pounds MTOW.

[2] The TRL is a measure developed by NASA, and used by other government agencies and industry, to assess the maturity of a technology. See box 5.1 for further information.

BOX 5.1 Defining innovation, R&D, and TRLs

This chapter relies on internationally recognized definitions of innovation, R&D, and technology readiness levels (TRLs). The Organisation for Economic Co-operation and Development (OECD) definition of innovation includes new or significantly improved products, as well as changes in product design, business practices, and production methods.

The OECD defines R&D as creative work undertaken on a systemic basis to increase the stock of knowledge, and the use of this stock to devise new applications. R&D generally covers three activities:

- Basic research: experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application in view.
- Applied research: original investigation to acquire new knowledge that is directed primarily towards a specific practical aim or objective.
- Development: systematic work, drawing on knowledge gained from research and/or practical experience, which is directed to producing new materials or products, to installing new processes or systems and service, or to improving substantially those already produced.

NASA introduced the concept of TRLs in the 1990s to explain the evolution of an idea from the basic research level to the full deployment of a product in the marketplace. TRLs follow a scale from 1 (basic principles observed and reported) to 9 (mission proven). In general terms, TRLs 1 to 6 encompass the basic and applied research phases, while TRLs 7 to 9 reflect the development steps.

Sources: OECD, *Oslo Manual*, 2005; OECD*, Frascati Manual, 2002*; Mankins, "TRLs," April 6, 1995.

Innovation and R&D Investments

Business aircraft are composed of a number of complex systems, encompassing thousands of components and a range of diverse technologies in such areas as electronics, engines, communications systems, hydraulics, new materials, and aerodynamics (box 5.2). Because the technologies that make up a business jet are constantly evolving, OEMs are pressed to continually improve their products or risk consumers considering them stale.[3] However, designing and bringing new products to market is costly and subject to substantial uncertainty. Interactions between the different technology areas on the aircraft may be difficult to anticipate in advance, and problems may be discovered late in the regulatory process.[4] Given these uncertainties and their attendant costs, OEMs also are under pressure to reuse fielded technologies and postpone major innovations.

Product Innovation

The competing pressures to innovate while also managing costs and risks are reflected in two approaches to the design of a new aircraft: clean sheet or derivative.[5] The Hawker Beechcraft Corporation (HBC) 4000 aircraft, which incorporates a carbon fiber fuselage,

[3] Bombardier, "Business Aircraft Market Forecast," 2011, 18; Wilson (Honeywell Aerospace), written testimony to the USITC, September 28, 2011, 5; Tyson and Chin, "Industrial Policy," 1992, 12; Mowery and Rosenberg, "Commercial Aircraft Industry," 1982, 103.

[4] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Bombardier, "Business Aircraft Market Forecast," 2011, 18; Tyson and Chin, "Industrial Policy," 1992, 12–13; Mowery and Rosenberg, "Commercial Aircraft Industry," 1982, 103.

[5] As discussed in chapter 2, a clean sheet aircraft is newly designed, i.e., it starts from a "clean sheet" of paper and is not based on an existing airframe. By contrast, a derivative aircraft is one that is a variant of an existing product. HBC, posthearing brief to the USITC, October 5, 2011, 6.

is a recognized example of a clean sheet product. By contrast, Embraer describes the Legacy 600 as a "classic example" of a derivative design because it is based on the Embraer regional jet (ERJ) 135 platform.[6] The cost and time required to bring a new aircraft to market can vary significantly depending on whether it is a clean sheet or derivative aircraft.

BOX 5.2 New technologies and business jet innovation

In recent years, a steady stream of innovations in the technologies that make up a business jet has emerged:

Cockpit technologies. These include flight control systems, performance monitoring, and pilot interface systems for communication, navigation, and weather forecasting. Heads-up displays, synthetic vision systems, and touchscreen capabilities are important new developments in cockpit technologies. The cross-linking of cockpit systems with general air-traffic guidance and other ground systems is a focus of next-generation improvements that drive cockpit innovations in the United States and other major markets.

Fly-by-wire systems. OEMs are increasingly replacing mechanical flight control systems with digital flight systems which are lighter in weight. Lowering an aircraft's weight increases its ability to carry more payload, fly greater distances with the same payload, or improve engine performance and fuel consumption. They are also researching new fly-by-light and fly-by-wireless systems.

Engine technologies. New engine design has focused on improving propulsion efficiency while also reducing noise and emission levels. Open rotor engines, geared turbofans, the latest in carbon fiber composite materials, and new configurations, such as HondaJet's over-the-wing engine mount, are contributing to substantial improvements in fuel efficiency and engine performance.

New materials. The increasing use of composite materials, such as carbon fiber, and new aluminum alloys enable the design of aircraft structures that are more fuel efficient, lighter, stronger, and safer than traditional materials, while allowing for more passenger comfort features.

Upgraded cabins. The business jet cabin environment includes new high-level video and audio capabilities and wireless and wired communication options tailored to executive travel.

Sources: Industry representatives, telephone interview by USITC staff, November 2011; industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Bombardier, "Input to Investigation," August 2011; Honda Aircraft Company, written submission to the USITC, October 2011; ECORYS, *Competitiveness of the EU*, 2009, 185; Aviation International, "Business Aviation," September 2010.

A clean sheet generally has higher project costs and risks due to more extensive engineering and development tasks. Clean sheet development of a new business jet reportedly can cost as much as $1 billion, whereas derivative designs generally cost much less.[7] Clean sheets also may take longer to certify because the new technologies incorporated and the aircraft design may be untested. For example, the HBC 4000 was "launched" in 1996.[8] However, it did not take its first flight until August 2001, and it was not certified until 2006—having taken more than 10 years from launch to certification.[9] By contrast, the Legacy 600, which relied on the ERJ 135 platform, was launched in

[6] Embraer, written submission to the USITC, October 5, 2011, 6; Rolls-Royce North America, written submission to the USITC, October 3, 2011, 10.

[7] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interviews by USITC staff, Bordeaux, France, October 2011; industry representative, telephone interview by USITC staff, November 2011; USITC, hearing transcript, September 28, 2011, 154 (testimony of Bob Blouin, HBC).

[8] An aircraft generally is considered "launched" when the company management decides there is a business case for an aircraft, the design of the aircraft is frozen, and it is offered for sale to the public.

[9] Peaford, Nichols, and Thomas, *2011 Pocket Guide*, 2010, 96.

2000, took its first flight in 2001, and was certified in Brazil that same year and in the United States and Europe in 2002—a total of about 2 years.[10]

Both clean sheet and derivative aircraft may be modified with incremental innovations. OEMs often make incremental improvements to the product to incorporate technological upgrades—for example, in avionics, engines, interiors, or winglets—or exploit new market niches. Such improvements typically cost the OEM less to implement, and the regulatory path is easier than bringing a completely new product to market. Thoughtful planning for incremental improvements reportedly is an important competitive differentiator, particularly in periods when resources and markets are strained.[11]

While these incremental strategies may be necessary to stimulate product sales, they generally are not seen as sufficient over the long term. Industry representatives consider it important to bring a completely new product to market at least every 10–15 years to incorporate large-scale technological changes and remain competitive.[12] For example, despite difficult economic circumstances, Cessna recently announced the launch of a new business jet, the Latitude, which reportedly will be a clean sheet design offering a flat floor and substantially increasing the "stand up" aisle height over other models, among other new features.[13]

The decision to initiate a clean sheet product has been described as "betting the company."[14] The bet is generally based on the OEM's analysis of the market, particularly whether there are any "holes" not being well served by competitors; the OEM's financial capabilities and those of its risk-sharing partners; and the regulatory environment.[15] However, these factors are volatile; predicting what the market will look like when the product is certified years down the line can be challenging. Successful OEMs manage a balanced portfolio of clean sheet, derivative, and incrementally improved products to maximize their appeal to customers in a volatile market.[16]

Role of Risk-Sharing Suppliers

Business jet OEMs increasingly rely on risk sharing by suppliers to pick up part of the high costs and risks associated with new product development, as discussed earlier. Risk-sharing suppliers may be called on to more fully develop their own design capabilities, assume integration, engineering, and certification responsibilities, make capital and human resource investments, and partially fund the development costs of a new aircraft

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[10] Embraer, posthearing brief to the USITC, October 5, 2011, 2 n.2; Peaford, Nichols, and Thomas, *2011 Pocket Guide*, 2010, 80.

[11] Wilson (Honeywell Aerospace), written testimony to the USITC, September 28, 2011, 5; industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[12] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[13] Croft, "Cessna Gets Attitude," October 10, 2011. Cessna's last clean sheet design was the C510 Mustang, announced in 2002 and FAA certified in 2006. Peaford, Nichols, & Thomas, *2011 Pocket Guide*, 2010, 80.

[14] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Tyson and Chin, "Industrial Policy," 1992, 17 (noting that the capital required to launch a new product may exceed the capitalization of an OEM).

[15] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interviews by USITC staff, Montreal, Canada, September 2011; industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

[16] Rolls-Royce North America, written submission to the USITC, October 3, 2011, 10; Wilson (Honeywell Aerospace), written testimony to the USITC, September 28, 2011; HBC, posthearing brief to the USITC, October 5, 2011, 6–7; industry representatives, interview by USITC staff, Melbourne, FL, September 2011; Tyson and Chin, "Industrial Policy," 1992, 17–18.

program. Increased supplier responsibilities reportedly enable OEMs to focus on their core competencies of aircraft design, integration, and assembly, and to bring products to market more quickly.[17]

As previously discussed, Bombardier and Embraer were early adapters of the risk-sharing model through their regional aircraft programs in the 1990s,[18] gaining the benefits of reducing their supply base, shifting commercial risk, and leveraging technology relationships across platforms. Other OEMS, including Dassault, have been more vertically integrated, producing many components themselves and customizing major systems to fit their particular platforms.[19] According to some industry representatives, this type of vertical integration can be a competitive advantage compared to risk-sharing partnerships, in which OEMs may cede the ability to monitor essential elements of the aircraft design and production in delegating more responsibility to suppliers. At low rates of production, however, vertical integration also can be inefficient and costly. The industry trend is away from vertical integration and toward more risk sharing and delegation of responsibilities to suppliers.[20]

For all of the OEMs, relationships with key suppliers are intensive, proactive, and built on long-term cooperation.[21] Suppliers also enter into risk-sharing relationships with their peers when a project exceeds the ability of a single company to cover the necessary investment, such as Honeywell's partnership with General Electric to design a turbofan engine.[22] Major suppliers also outsource more responsibility and risk to lower-tier firms as the market becomes increasingly competitive for all firms in the supply chain.[23]

R&D Investments

Substantial R&D investments support the innovation strategies of OEMs and suppliers. As HBC's representative testified at the Commission's hearing: "Without R&D and without new products, our industry will die, so we are constantly innovating, constantly updating."[24] The ratio of company-funded R&D to sales provides a gauge of the relative importance of R&D across industries and among firms in the same industry.[25]

Some business jet makers reported targeting R&D spending ratios of approximately 5 percent of sales, with variations depending on where they are in the product development cycle—for example, disproportionately large investments may be made

[17] Bombardier, "Bombardier Input," August 2011, 14–15; industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011; industry representative, telephone interview by USITC staff, November 2011.

[18] Bombardier, "Bombardier Input," August 2011, 15; Embraer, posthearing brief to the USITC, October 5, 2011, 7–8.

[19] For further discussion, see chapter 3, "Global Industry."

[20] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interviews by USITC staff, Bordeaux, France, October 2011; industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

[21] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Niosi and Zhegu, "Multinational Corporations," October 2010, 118; Aerostrategy, "Winds of Change," March 2007, 5.

[22] USITC, hearing transcript, September 28, 2011, 173 (testimony of Robert Wilson, Honeywell Aerospace).

[23] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[24] USITC, hearing transcript, September 28, 2011, 159–60 (testimony of Bob Blouin, HBC).

[25] National Science Board, *Science and Engineering Indicators*, 2011, table 4-5 (2007 data).

during the certification process—and whether a clean sheet, derivative, or incremental innovation strategy is on the table.[26]

Major suppliers of complex technologies often report larger R&D spending ratios than business aircraft OEMs; suppliers' R&D investments may range from millions of dollars for airframe components to hundreds of millions of dollars for propulsion or integrated avionics plants.[27] For example, reported R&D expenditures ranged from 7 percent for Meggitt plc (braking systems) and 8.5 percent for Rolls-Royce (engines) to 10.3 percent for Garmin and 18.5 percent of sales for Rockwell Collins (avionics) in 2010.[28] These R&D investments may support business jet products, as well as those for other aircraft and commercial sectors.[29]

For the aerospace and defense manufacturing industry more broadly, the National Science Foundation reported a company-funded R&D-to-sales ratio of 5.1 percent in 2007 for companies performing R&D in the United States, up from 4.9 percent in 2006.[30] Similarly, the Canadian aerospace industry reported R&D expenditures of approximately 5.5 percent of revenues in 2008.[31] By contrast, reported R&D expenditures of firms in the French aerospace industry are generally higher; according to the French aerospace industry association, Groupement des Industries Françaises Aéronautiques et Spatiales (GIFAS), the industry had R&D spending ratios of 7.6 percent in 2010. When government contributions to R&D spending are accounted for, R&D spending ratios rise to 11.5 percent for aerospace firms in the United States, and 14.1 percent for those in France.[32]

OEMs and their major suppliers rely on intellectual property (IP) protections to obtain returns on these substantial R&D investments. Thus, for example, Cessna notes that it has patented 27 parts and processes over the last 15 years, and other OEMs also report active patent portfolios.[33] However, formal IP instruments such as patents protect only a fraction of an organization's knowledge in product design, complex systems integration, and efficient processes that is the core competence of business jet makers. As one OEM

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[26] Although R&D spending is publicly reported by most OEMs, this spending generally is not limited to business jets but encompasses other lines of business as well (aircraft- and non-aircraft-related). OEMs also appear to have different accounting treatments for contributions to R&D spending made by suppliers or customers. Thus, comparisons of R&D spending ratios of OEMs based on publicly available data are not meaningful.

[27] The clean sheet design and development of an engine, for example, costs approximately $200-300 million, compared to approximately one-tenth of this amount to modify an existing engine. Industry representatives, interviews by USITC staff, Montreal, Canada, September 2011.

[28] Mergent Online database, http://www.mergentonline.com/login.php (accessed October 26, 2010). R&D expenditures apply to all lines of business of these companies, not just business jet-related R&D.

[29] Garmin, for example, has developed avionics products for business jets that use Global Positioning Systems (GPS) technologies initially developed for non-aviation uses. Garmin, *2011 Annual Report*, 16 (accessed April 9, 2012).

[30] By comparison, the company-funded R&D-to-sales ratio for all industries performing U.S. R&D in 2007 was 3.5 percent. National Science Board, *Science and Engineering Indicators*, 2010, table 4-5 (2007 data).

[31] AIAC, "Canadian Aerospace Industry," June 2009.

[32] National Science Board, *Science and Engineering Indicators*, 2010, table 4-5 (2007 data); GIFAS, *2010–2011 Annual Report*, July 2011, 52 (2010 data). Comparable figures were not located for the Canadian and Brazilian aerospace industries.

[33] Cessna Aircraft Company Web site, "Awards and Patents," http://www.cessna.com/about/awards-patents.html (accessed December 5, 2011); industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

noted, "Patents are a band-aid; the most important thing is continuous innovation."[34] Business jet firms rely on first-mover advantages, internal protections for their trade secrets, and their expertise in obtaining timely regulatory approval of new products to provide them with a brief window of advantage before competitors are able to match their offerings.[35]

Business Innovation

Business innovation, particularly lean management principles that emphasize waste minimization and responsiveness to change, is an important focus of OEMs and their suppliers. Beginning in the 1990s, aircraft firms have been implementing lean principles emerging from Japanese auto producers, particularly Toyota, to improve how they organize and execute their activities.[36] As described by HBC at the Commission's hearing: "We use the lean process to look at everything that we do, how we do it, how much time it takes us to do it, how much it costs us to do, and whether or not another company could do that as well if not better than us."[37]

Based on the Commission's fieldwork, all business jet OEMs rely on lean management principles.[38] With lean engineering, they design products that can be efficiently produced and that meet the customer's value expectations for price, performance, quality, reliability, and schedule.[39] Lean manufacturing initiatives focus on making production lines more efficient, improving quality, and building better communication across all company functions. To accomplish this, production workers may interact with suppliers and manufacturing engineers on multifunctional product teams to jointly determine the best technical designs and the most efficient means of sharing work. Customer focus groups may also provide critical information—for instance, by identifying their preferences vis-à-vis the cabin experience.[40]

An example of this approach is the design process for the Citation X. The lean principles Cessna used included: integrated design teams employing 3-D solid CATIA design tools; a high degree of "design reuse" to reduce engineering and costs and improve reliability; the co-location of team employees to shorten communication lines; and the use of customer advisory councils to assist in key decisions.[41] Similarly, Embraer stresses the importance of the customer surveys and advisory panel discussions that assisted in the design of its Phenom products, citing as an example the spacious cabin design implemented through its collaboration with BMW Group DesignworksUSA.[42]According

[34] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[35] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representative, telephone interview by USITC staff, November 2011.

[36] Murman, Walton, and Robentisch, "Challenges in Better, Faster, Cheaper," 2006, 481.

[37] USITC, hearing transcript, September 28, 2011, 180 (testimony of Bob Blouin, HBC).

[38] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011; industry representative, telephone interview by USITC staff, November 2011.

[39] Haggerty and Murman, "Lean Engineering," 2006, 5.

[40] Industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011; Bombardier, *2010–11 Annual Report*, n.d., 87–89 (accessed October 2011); Embraer, posthearing brief to the USITC, October 5, 2011, 2–3.

[41] Haggerty and Murman, "Lean Engineering," 2006, 9.

[42] Embraer, posthearing brief to the USITC, October 5, 2011, 2–3; BMW Group DesignworksUSA, written submission to the USITC, October 4, 2011.

to industry representatives, the successful implementation of lean management principles can provide a valuable competitive edge to business jet makers and suppliers.[43]

Government Agencies and Innovation

The governments of the business jet-producing countries—the United States, France, Canada, and Brazil—carry out two main functions that affect business jet innovation: they provide R&D support, and they provide oversight, including certification of new aircraft and their systems, to ensure aviation safety. Across countries, industry representatives advocate for the government to target more resources to R&D that is mature enough to be commercially useful, as well as the dedication of more resources to the timely review and certification of aircraft technologies.

Government R&D Support for Aeronautics[44]

Government R&D support for aeronautics is generally viewed as fostering important national goals in such areas as economic growth, technology development, aviation safety and security, defense, skilled employment, and the need to meet environmental challenges.[45] This support is considered necessary for various reasons: aeronautics R&D is costly and often takes a long time to reach commercial application and "break-even" returns; such R&D yields significant opportunities for synergies with other high-technology sectors, such as advanced materials and design technologies; and the lack of government funding could put domestic aircraft industries at a disadvantage with competitors in other countries that provide such support.[46] Notwithstanding, the business jet sector reportedly has received substantially less government research support than other sectors of the aircraft industry.[47]

Government-supported R&D in the United States

The United States established its first policy to guide federal aeronautics R&D in 2006.[48] According to the policy, the federal government should play a key role in three aspects of aeronautics R&D:

- R&D to support national defense and homeland security;
- Long-term, fundamental aeronautics R&D that will provide the basis for future technology development;

[43] Industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011; industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[44] The following discussion describes government support for nonmilitary aircraft R&D; to the extent information is available, it focuses on efforts of particular relevance to the business jet industry. See USITC, *Competitive Assessment*, 2001, 7-5 (limiting the scope of the R&D discussion to nonmilitary aircraft); USDOC, ITA, *U.S. Jet Transport Industry*, 2005, 73 (same as above).

[45] USITC, *Competitive Assessment*, 2001, 7-5; USDOC, *U.S. Jet Transport Industry*, 2005, 63; Executive Office of the President, "National Aeronautics R&D Policy," December 2006, 7.

[46] USDOC, *U.S. Jet Transport Industry*, 2005, 63; USITC, *Competitive Assessment*, 2001, 7-5; Rolls-Royce North America, written submission to the USITC, October 3, 2011, 12.

[47] Rolls-Royce North America, written submission to the USITC, October 3, 2011, 11; industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[48] See "National Aeronautics Research and Development," Executive Order 13419 (2006). The policy also provides for an ongoing series of associated R&D and infrastructure plans to chart progress and challenges. The latest R&D plan was issued in 2010. See Executive Office of the President, "Biennial Update," February 2010. The latest infrastructure plan was issued in 2011. See Executive Office of the President, "National Aeronautics RDT&E Infrastructure Plan," January 2011.

- Advanced civil aeronautics R&D that does not compete with or unfairly subsidize commercial ventures including R&D that benefits the public by improving safety and security, promoting energy efficiency, or protecting the environment; R&D that address gaps where market factors limit private investment; and R&D that supports government infrastructure and regulations.[49]

NASA and the FAA are the two government agencies principally involved in U.S. civil aeronautics R&D. NASA provides an overarching vision for U.S. aeronautics R&D; creates and supports the foundational research that industry and others build upon; and maintains the core infrastructure (such as wind tunnels) necessary for carrying out aeronautics R&D.[50] For its part, the FAA is charged with conducting predominantly applied foundational research in areas that support safety, air traffic management, and the environment. FAA's R&D initiatives tend to target technologies at a higher TRL than those of NASA because of the agency's focus on applied rather than basic research.[51]

NASA

NASA has made decades of R&D contributions to the safety, efficiency, and performance of business jets. Many of NASA's most prominent discoveries date back to the 1970s and 1980s. Particular examples of R&D supported by NASA and incorporated into business jets are provided in table 5.1.

NASA's aeronautics R&D budget has been cut significantly in recent years, falling from a peak of about $1.5 billion in FY1994 to $569.4 million in FY2012, which represents about 3 percent of NASA's overall budget of $18.7 billion.[52] In light of its reduced resources and the guidance provided by the 2006 R&D policy, NASA has prioritized fundamental research of broad applicability over technology demonstration programs that are closer to commercialization but narrower in scope.[53] Business jet industry representatives report that the limited relevant NASA research available to them is generally not at a TRL sufficient to justify the substantial follow-on R&D investment necessary to bring a product incorporating that research to market.[54] They note that although there have been valuable collaborations with NASA in the past, in recent years new research relevant to business jets has essentially "dried up."[55]

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[49] Executive Office of the President, "National Aeronautics R&D Policy," December 2006, 7–13.

[50] Executive Office of the President, "National Aeronautics R&D Policy," December 2006, 12; government officials, interviews by USITC staff, Washington, DC, January 2012.

[51] Executive Office of the President, "National Aeronautics R&D Policy," December 2006, 13; government officials, telephone interviews by USITC staff, December 2011.

[52] Rand, *Advancing Aeronautics*, 2011, 24; NASA, *2012 Budget Estimate*, n.d. (accessed October 24, 2011). However, accounting changes at NASA make it difficult to compare aeronautics budgets across years. For example, the current budget reportedly is not subject to certain maintenance and operations burdens, and some aeronautics research is performed on the space accounts. Rand, *Advancing Aeronautics*, 2011, 24; government official, interview by USITC staff, Washington, DC, January 2012.

[53] Rand, *Advancing Aeronautics*, 2011, 49; DeKeyser, "NASA Restructures," January 14, 2006; industry representative, interview by USITC staff, Washington, DC, November 2011; industry representative, telephone interview with USITC staff, November 2011.

[54] Industry representative, interview by USITC staff, Washington, DC, November 2011; industry representative, telephone interview with USITC staff, November 2011.

[55] USITC, hearing transcript, September 28, 2011, 173–74 (testimony of Robert Wilson, Honeywell Aerospace); industry representative, interview by USITC staff, Washington, DC, November 2011; industry representative, telephone interview with USITC staff, November 2011.

TABLE 5.1 Selected NASA R&D applicable to business jets

R&D area	Description of use
Airborne wind-shear detection	During the 1980s and 1990s, NASA led a research effort to identify and test technologies to predict wind-shear. Today, business aircraft are equipped with sensors to alert pilots of wind-shear hazards.
Composite structures	Beginning in the 1970s, NASA began partnering with industry to develop high-strength non-metallic composites as an alternative to heavy metal. Today, business jet OEMs are using composites on components including the tail, wings, rudders, engine cowlings, landing gear doors, and floor panels. Composites can reduce weight and improve operational efficiency.
Computational fluid dynamics (CFD)	In the 1970s, NASA began developing computer codes that could predict the flow of air or fluids, for example over the wing or the engine. This coding became CFD, today considered essential for the development of new aircraft as it greatly reduces the time and expense needed to design and test the plane.
Digital fly-by-wire (DFBW)	During the 1960s and 1970s, NASA helped develop and flight test DFBW, a flight control system that uses a digital computer and electric wires rather than a heavier hydraulic system to send signals from the pilot to the plane's control surfaces. Today, DFBW technologies help reduce weight and improve fuel efficiency in business jets.
Glass cockpits and highway-in-the-sky	In the 1970s, NASA began developing and testing a cockpit configuration that uses advanced flat-panel display rather than what had been a large number of gauges and dials. During the 1990s, NASA worked on advanced electronic displays to provide point-to-point communication, navigation, and weather data. Technology coming out of these efforts is used in today's cockpits.
Quiet jets	Beginning in the 1990s, NASA has tested different technologies to find out which best reduced the noise generated by turbofan engines used on business jets. The research contributed to the development of engines with lower decibel levels.
Synthetic vision systems	Starting in the 1970s, NASA developed and tested systems combining "heads-up" displays (at the pilot's eye level) and other avionics to create a full picture of the world outside. Today, business jet avionics suppliers like Honeywell, Garmin, and Rockwell Collins and business jet OEM Gulfstream offer advanced synthetic vision displays that have their roots in this foundational NASA R&D.
Winglets	During the 1970s and 1980s, NASA research and tests proved that vertical extensions attached to wing tips could improve airflow and fuel efficiency. The Learjet 28 added winglets in 1977 based on this research, prior to their introduction in commercial aircraft. Today, many business aircraft models include winglets.

Source: NASA, "Aeronautics Research on Board," http://www.aeronautics.nasa.gov/aero_onboard/flash_index.html (accessed November 3, 2011).

In part to address these concerns, in 2010 NASA set up an Integrated Systems Research Program (ISRP) to concentrate on testing and validating proven technologies for use in practical applications.[56] ISRP has two main projects: Environmentally Responsible Aviation (ERA) and Unmanned Aircraft Systems (UAS). ERA focuses on advancing environmental technologies to a higher TRL in such areas as airframe configurations, composites, and propulsion technologies. While ERA projects to date have focused on commercial aviation, in the future advances may carry over to similar technologies in business aviation.[57]

Table 5.2 provides highlights of NASA's other aeronautics R&D programs, including research to advance fundamental aeronautics, aviation safety, and the air traffic management needs of the Next Generation Air Transport System (NextGen). The NextGen program is described in Box 5.3.

FAA

The FAA's mission is to "provide the safest, most efficient aerospace system in the world."[58] Funding for FAA research, engineering, and development (R,E&D) activities has held relatively steady over the last 10 years, ranging from $147.5 million in FY2003 to the $167.6 million appropriated in FY2012 (figure 5.1). According to industry representatives, the main resource challenge for FAA has been the lack of predictable multiyear funding. From 2007 to February 2012, when the FAA Modernization and Reform Act of 2012, a four-year funding package, was signed into law, the FAA operated with 23 stopgap budget extensions in the absence of a multiyear reauthorization bill.[59] Funding uncertainty has given rise to industry concerns about the government's commitment to NextGen and other long-term R&D programs.[60]

As at NASA, a substantial portion of the FAA's R&D resources is directed to the NextGen program. The FAA also funds R&D in the following areas: fire research and safety, propulsion and fuel systems, advanced materials research, aging aircraft, and the development of clean and quiet aircraft technologies and sustainable fuels.[61] One example of FAA's environmentally related R&D is the Continuous Lower Energy, Emissions, and Noise (CLEEN) program to improve the environmental efficiency of aircraft through research into promising new engine technologies, airframe and materials research, and alternative fuels. Under this program, the FAA recently entered into five-year agreements with Boeing, General Electric, Honeywell, Pratt & Whitney, and Rolls-Royce to develop environmentally promising aircraft technologies.[62]

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[56] Rand, *Advancing Aeronautics*, 2011, 24; NASA, "Integrated Systems Research Program," n.d (accessed January 14, 2012); government officials, interviews by USITC staff, December 2011 and January 2012.

[57] Government officials, interviews by USITC staff, Washington, DC, December 2011 and January 2012; NASA, "Integrated Systems Research Program," n.d. (accessed January 9, 2012).

[58] USITC, hearing transcript, September 28, 2011, 15 (testimony of Dorenda Baker, FAA).

[59] USITC, hearing transcript, September 28, 2011, 123 (testimony of Robert Wilson, Honeywell Aerospace); Smolenski, "FAA Reauthorization Bill," February 16, 2012.

[60] Bunce (GAMA), written testimony to Space and Aeronautics Subcommittee, February 16, 2011, 4; Bunce (GAMA), written submission to the USITC, September 9, 2011, 8.

[61] FAA, *FY 2012 President's Budget Submission*, n.d., 2 (accessed October 27, 2011).

[62] FAA, "Continuous Lower Emissions, Energy, and Noise (CLEEN) Program" (accessed October 26, 2011). The total federal investment is expected to be $125 million over five years; the companies will match or exceed that investment.

TABLE 5.2 NASA's current aeronautics R&D programs

Program	Brief description	2012 budget request (millions $)
Fundamental aeronautics	Carries out fundamental research to improve aircraft performance and minimize environmental impacts including new aircraft configurations, propulsion systems, and noise reduction for subsonic aircraft. Also conducts research into supersonic and hypersonic flight.	186.3
Integrated systems research	Conducts technology research at an integrated systems level in the areas of ERA and UAS.	104.2
Airspace systems	Addresses the air traffic management research needs of the Next Generation Air Transportation System (NextGen).	92.7
Aviation safety	Develops technologies to improve the safety of current and future aircraft operating in NextGen.	79.6
Aeronautics test	Ensures availability and capabilities of ground test facilities including wind tunnels, propulsion, and flight test assets.	79.4
Aeronautics strategy & management	Explores novel concepts that have the potential to create new capabilities in aeronautics research.	27.2
Aeronautics R&D total		569.4

Source: NASA, *FY 2012 Complete Budget Estimates*, n.d. (accessed January 2012).

BOX 5.3 NextGen and business jets

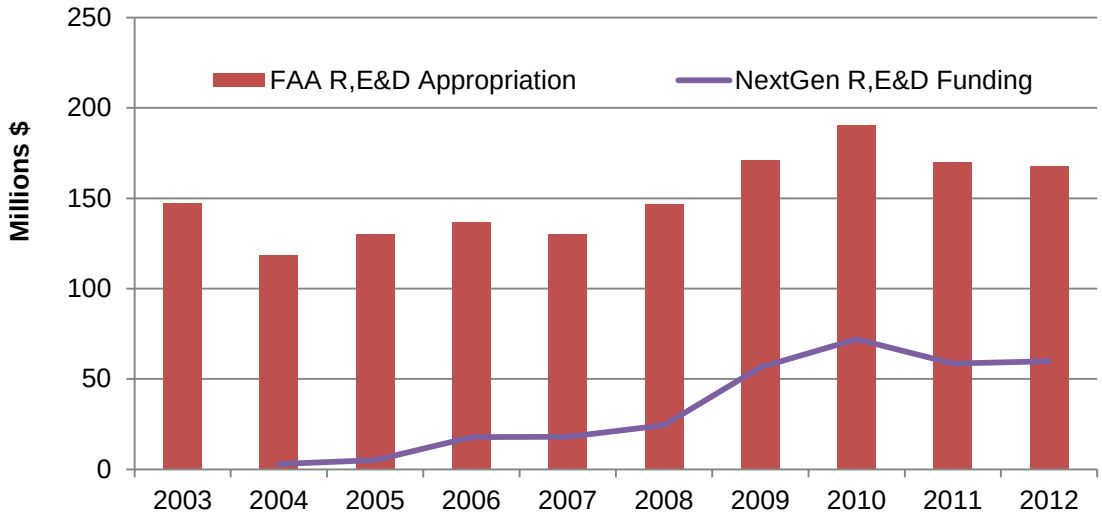
NextGen is a program designed to modernize the entire U.S. air traffic control system, to be implemented in stages between 2012 and 2025. It represents a wide-ranging transformation away from ground-based systems to satellite-based technologies to meet future air transportation demands. It is intended to address the gridlock that has been particularly challenging to the commercial airline industry and passengers. NextGen consists of five basic elements.

- *Automatic dependent surveillance-broadcast (ADS-B)* will use GPS satellite signals that will enable pilots and air-traffic controllers to see the same real-time display of air traffic, substantially improving safety.
- *System-wide information management* (SWIM) will provide a single infrastructure and information management system to deliver high-quality, timely data to many users and applications. SWIM is intended to reduce data redundancy and enable new modes of decision making.
- *Next Generation Data Communications* will provide an additional, data-based means of two-way communication for air traffic control clearances, instructions, and reports to improve capacity and safety.
- *Next Generation Network-Enabled Weather* will combine thousands of global weather observations and sensor reports from ground-, airborne- and space-based sources into a single national weather information system, with the goal of cutting weather-related delays at least in half.
- *National Airspace System (NAS) voice switch* will replace 17 different voice-switching systems with a single air/ground and ground/ground voice communications system.

Industry representatives advocate greater attention to the implications of NextGen for business aviation. For example, in the area of software, NextGen initiatives will lead to more complexity in aircraft systems that distribute and integrate multiple functions. Existing methods for verifying and validating software do not readily address these increased levels of complexity. According to industry representatives, the dedication of more government R&D resources to review and validate software and digital systems is critical to the timely implementation of NextGen technologies by business jet OEMs.

Sources: FAA, "Fact Sheet: NextGen," February 2007; Bunce (GAMA), written submission to the USITC, September 9, 2011; Bunce (GAMA), written testimony to Space and Aeronautics Subcommittee, February 16, 2011; industry representative, interview by USITC staff, Washington, DC, November 2011; Executive Office of the President, "Biennial Update," February 2010, 30–31.

FIGURE 5.1 FAA R,E&D appropriation and NextGen R,E&D funding, 2003–12



Source: FAA.

The CLEEN program is intended to accelerate the movement of energy-efficient technologies from TRLs 3–4 (research to prove feasibility) to TRLs 6–7 (technology demonstration and system development). Targeted technologies include lighter and more efficient gas turbine engine components, open rotor and geared turbofan engines, low nitrogen oxide combustors, noise reducing engine nozzles, adaptable wing trailing-edges, advanced onboard flight management systems for optimized flight trajectories, and sustainable alternative aviation fuels.[63] Although not focused on business jets, the technologies developed may prove useful across all aircraft sectors.

Business jet industry representatives note that there are a number of areas in which sustained R&D support from the government would be helpful. They cite, for example, the critical need for government R&D to facilitate more efficient regulatory review of software and digital systems on aircraft.[64] In general, industry representatives are concerned that the pace of innovation delivery to the business jet market has been slowed by gaps in the ability of regulatory agencies to understand and regulate new and emerging technologies.[65] FAA works with industry and standards setting organizations, including SAE International and RTCA (formerly known as the Radio Technical Commission for Aeronautics), to address the challenge of regulating new technologies, albeit through a process that can be long.[66] Industry representatives advocate more sustained efforts in this regard, as well as a greater focus on the R&D needs of business aviation.[67]

[63] Brown et al., "The U.S. Strategy," 2010, 4-5.

[64] Industry representative, interview by USITC staff, Washington, DC, November 2011; industry representative, telephone interview with USITC staff, November 2011.

[65] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representative, interview by USITC staff, Washington, DC, November 2011; industry representative, telephone interview with USITC staff, November 2011.

[66] USITC, hearing testimony, September 28, 2011, 37–38 (testimony of Dorenda Baker, FAA).

[67] Bunce (GAMA), written testimony to Space and Aeronautics Subcommittee, February 16, 2011; industry representative, interview by USITC staff, Washington, DC, November 2011; industry representative, telephone interview by USITC staff, November 2011; industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

FAA Centers of Excellence and Research Institutions

Industry representatives value the R&D support provided by FAA Centers of Excellence (COEs), which were established by Congress to leverage academia's resources in support of research priorities.[68] For example, the FAA has created a COE for composites and advanced materials (CECAM) that is co-led by the National Institution for Aviation Research (NIAR) at Wichita State University and the University of Washington. OEMs Bombardier, Cessna, and HBC, among others, are advisory board members.[69] NIAR reportedly is unique among U.S. aviation research institutions in its focus on applied research for use by the aeronautics industry. NIAR carries out a large part of the FAA's composites research program, focusing on the safety and certification of emerging applications of composites.[70]

Working with the National Center for Aviation Training (NCAT) of the Wichita Area Technical College, NIAR also conducts research and trains students in essential technologies for the business jet and civil aircraft industries. NIAR's research focuses include: advanced coatings; advanced joining and processing and the use of robotics for friction stir welding; design software programming, including CATIA; crash dynamics; environmental testing; full-scale structural testing; and mechanical testing, including static and fatigue testing for composites. NIAR also makes available research, design, and test equipment and facilities for the industry, including a virtual reality center and a wind tunnel for supersonic and subsonic testing. NIAR's $45.4 million budget in 2010 came from private firms that contracted for its R&D and testing services (49 percent), federal agencies such as FAA and NASA (37 percent), and the State of Kansas (1 percent).[71]

NIAR's location in Wichita, the center of the U.S. business jet industry, makes it a particularly important resource for business jet OEMs. Other U.S. universities and research institutions also conduct substantial R&D in the area of aeronautics, with different specialties than those of NIAR.[72] Wichita State and NIAR, however, reportedly are unique in their focus on aeronautics research with commercial applications for business and civil aviation and their growing capability in certification and testing services.[73] Another FAA Center of Excellence, the Center for General Aviation Research (CGAR), is a consortium of leading aviation universities including Embry-Riddle, Florida A&M, the Universities of North Dakota and Alaska, and Wichita State University. CGAR projects have supported safety in the general aviation sector through the development of training and testing standards for the latest avionics; the use of Automatic Dependent Surveillance Broadcast (ADS-B) technology to track training flights; the development of safety management systems concepts and accident trend

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[68] Bunce (GAMA), written testimony to Space and Aeronautics Subcommittee, February 16, 2011, 4.

[69] FAA, "Joint COE for Advanced Materials" (accessed October 27, 2011); NIAR, "CECAM" (accessed October 28, 2011).

[70] NIAR, "Capabilities Guide," 2011, 25; industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[71] NIAR, "Capabilities Guide," 2011, 3; industry representatives, interviews by USITC staff, Wichita, KS, July 2011. The remaining 13 percent comes from universities and aviation research.

[72] For example, Johns Hopkins' Applied Physics Laboratory focuses on R&D to support defense and security operations. Johns Hopkins Applied Physics Laboratory Web site, http://www.jhuapl.edu/ (accessed October 30, 2011). Utah State University operates the Space Dynamics Laboratory, which focuses on atmospheric research. Space Dynamics Laboratory Web site, http://www.sdl.usu.edu/programs (accessed November 7, 2011). Johns Hopkins and Utah State had the largest aeronautics and astronautics R&D expenditures in 2009, with Wichita State in third place. NSF, "Academic R&D Expenditures," 2011.

[73] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

analysis for general aviation; and the evaluation of the use of data recorders in general aviation flight operations at flight schools.[74]

Government-supported R&D in the European Union

Aeronautics R&D in the EU receives support from governments at all levels, from the European Commission to national and regional programs. The EU's Framework Programs (FP) for research and technological development are its chief instrument for funding aeronautics R&D.[75] Recent framework programs have focused on strengthening the competitiveness of EU firms.[76] Industry representatives note the usefulness of EU technology demonstration programs that target technologies at higher TRLs and assist in moving products to market.[77]

European Union R&D Programs

The current research initiative, FP7, covers the period 2007–13. R&D funding focuses on reducing the environmental impact of aviation, improving the competitiveness of EU firms, and ensuring the efficiency and safety of the EU air transport system.[78] FP7 also provides for longer-term joint technology initiatives, including the "CleanSky" public-private partnership program and the Single European Sky Air Traffic Management research program (SESAR). SESAR, analogous to the U.S. NextGen initiative, is dedicated to the development and deployment of next-generation air traffic management systems and technological solutions for aircraft.[79]

FP funding for aeronautics research has increased steadily from modest beginnings to reach $2.9 billion (€2.1 billion)[80] in FP7 (figure 5.2). Collaborative R&D projects between industry, universities and research centers, and/or public authorities constitute 45 percent of the FP7 budget allocation to aerospace, followed by 38 percent to the Clean Sky initiative, and 17 percent to SESAR and the development of next-generation systems.[81]

The EU's CleanSky activities are organized around "integrated technology demonstrators" (ITDs) that are designed to assist in the development and deployment of technologies into concrete aircraft configurations, including two business jet concept aircraft. Selected ITDs potentially applicable to business jets are described in table 5.3.

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[74] Bunce (GAMA), written testimony to Space and Aeronautics Subcommittee, February 16, 2011, 4.

[75] ECORYS, *Competitiveness of EU Aerospace Industry*, 2009, 213.

[76] European Commission, *Aeronautics and Air Transport Research*, 2010, 11 (projects funded under FP6 focused equally on industrial competitiveness and issues of public interest); ECORYS, *Competitiveness of EU Aerospace Industry*, 2009, 213 (FP6 funded 34 projects under the topic "Strengthening Competitiveness"); Weber, Gellman, and Hamlin, "European Government Support," 2005, 10 (top-level research goals under FP6 include winning global leadership for European aeronautics).

[77] AIAC, "Future Major Platforms," June 2009, 14–15.

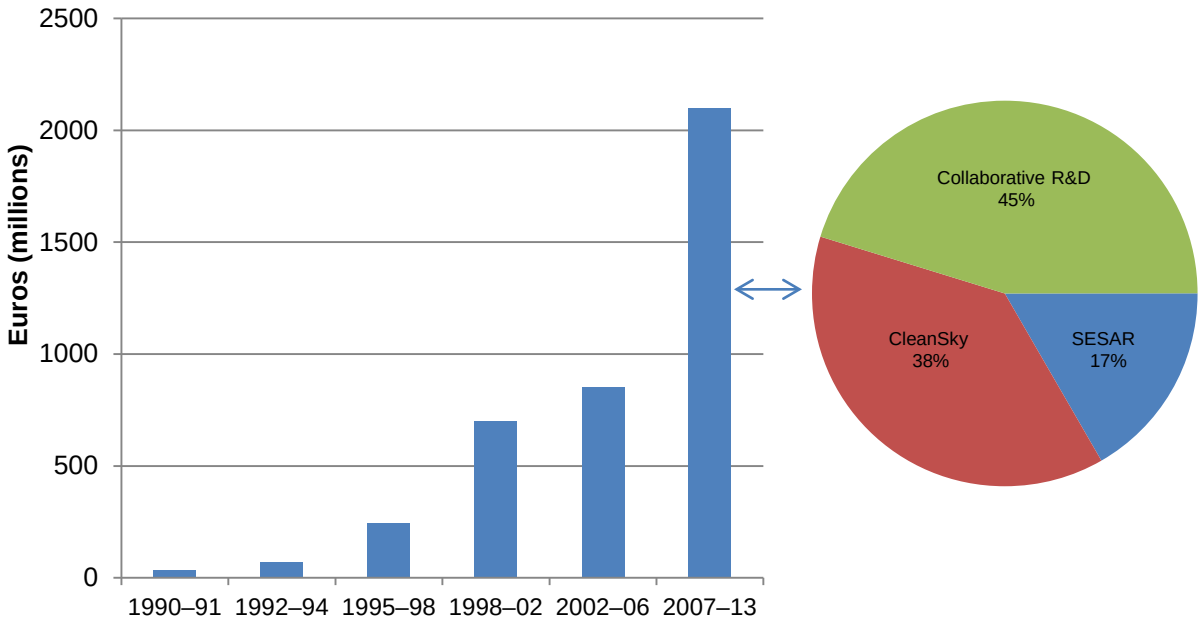
[78] European Commission, *Aeronautics and Air Transport Research*, 2010, 11.

[79] ECORYS, *Competitiveness of EU Aerospace Industry*, 2009, 214.

[80] IMF Web Site, "Representative Exchange Rates for Selected Currencies," November 2, 2011 (1 euro = $1.381), http://www.imf.org/external/np/fin/data/rms_rep.aspx (accessed November 2, 2011).

[81] FP7 requires inter-European collaboration; project proposals must have at least three entities established in different EU countries. Funding rates under FP7 are typically high, ranging from 50 to 75 percent of the project cost depending on whether the beneficiary is a large company or SME. EU Seventh Framework Programme, "Guide for Applicants," July 2011, 3.

FIGURE 5.2 EU funds for aeronautics R&D, 1990–2013



Source: European Commission, *Aeronautics and Air Transport Research*, 2011, 11.

TABLE 5.3 Selected EU Clean Sky Programs

Program	Purpose	2011 budget (Million $)	Major recipients
Single fixed-wing aircraft	Deliver innovative wing technologies and aircraft configurations	42.4	Airbus, Saab, Deutsches Zentrum, Dassault
Systems for green operations	Improvements to electrical aircraft equipment and systems architectures	28.3	Thales, Liebherr, Airbus, Zodiac, Messier–Bugatti
Sustainable and green engines	Design and build engine demonstrators to integrate environmental technologies	25.5	Rolls-Royce, MTU Aero Engines, Turbomeca, Snecma
Eco-design	Environmentally friendly aircraft design and production, withdrawal, and recycling	10.7	Fraunhofer, Dassault, Israel Aerospace Industry, Eads, Alenia Aeronautica

Source: Clean Sky, "Clean Sky at a Glance," October 2011.

Technology demonstrator programs are considered particularly valuable because they show how technologies may be operationally integrated for a specific application or platform. [82] Thus, the program can help a major supplier to secure a spot on an OEM's new program by giving the supplier an opportunity to demonstrate the value and fit of the supplier's technology. Without investment in this critical demonstration phase, basic and

[82] AIAC, "Future Major Platforms," June 2009, 14–15.

applied research supported by the government may never actually be commercialized, getting stuck in the so-called "valley of death" in the innovation value chain.[83]

French R&D Programs

The French government supports pre-competitive research, as well as research directed to near-term products, with the goal of ensuring the long-term competitiveness of the French industry.[84] This support reportedly flows mainly to industry, including to firms focused on engines and avionics, and to national research institutions, particularly France's aerospace research institution, ONERA.[85] According to the French aerospace industries association, GIFAS, French aerospace firms spent 14.1 percent of their revenues on R&D in 2010, of which 7.6 percent came directly from the firms' own cash flow and the remainder from the government and other sources.[86]

ONERA had an annual budget of $313 million (€227 million) in 2010.[87] ONERA's scientific specialty areas potentially relevant to the business jet industry include fluid mechanics and aerodynamics; physics; materials and structures; information processing and systems; and computing, engineering, and testing facilities. For example, ONERA is investing heavily in materials research, ranging from studies of structures at the microscopic level to complete aircraft assemblies of new metallic and composite materials, to support the characterization and certification of materials offering better aircraft performance.[88]

At the regional level, the French government also supports "competitiveness clusters" to stimulate innovation and cooperation between industry, public research, and education. The "Aerospace Valley" cluster, which extends between the regions of Midi-Pyrénées and Aquitaine, was created in 2005.[89] Major OEMs and systems suppliers all have locations there, including Dassault, Goodrich, Latécoère, Liebherr, Messier-Dowty, Honeywell, Rockwell Collins, and Thales, as well as two of France's aerospace engineering schools, Ecole Nationale de l'Aviation Civile (ENAC) and Institut Supérieur de l'Aéronautique et de l'Espace (ISAE), and numerous specialized training programs.[90]

Firms in Aerospace Valley organize themselves within nine subject matter groups to identify innovative technologies suitable for collaborative R&D funded with the government's assistance. These groups include energy and propulsion systems; aeromechanics, materials and structures; navigation, positioning, and telecommunications; embedded systems; and architecture, integration, and industrial performance. As of 2010, Aerospace Valley has obtained government and private funding commitments valued at approximately $1.38 billion (€1 billion) for 44 projects involving cooperation between large firms, SMEs, and research laboratories.[91] Aerospace

[83] Ibid. The "valley of death" concept refers to the difficulty of successfully commercializing proven technologies.

[84] Weber, Gellman, and Hamlin, "European Government Support," 2005, 23.

[85] Weber, Gellman, and Hamlin, "European Government Support," 2005, 22–23.

[86] GIFAS, *2010-2011 Annual Report*, July 2011, 52.

[87] ONERA, *Annual 2010 Report*, 2011, 8.

[88] ONERA, *Annual 2010 Report*, 2011, 8, 14.

[89] Jouaillec, "Aerospace Valley," n.d., 1 (accessed November 2011); industry representatives, interviews by USITC staff, Toulouse, France, October 2011.

[90] Aerospace Valley, Aerospace Valley brochure, n.d. (accessed November 2011); industry representatives, interviews by USITC staff, Toulouse, France, October 2011.

[91] Aerospace Valley, "Types of projects," n.d. (accessed November 2011).

Valley is being emulated by other countries seeking to maintain vibrant aerospace clusters, including Brazil.[92]

Government-supported R&D in Canada

Numerous R&D funding programs operate at the federal and provincial levels to support Canada's aerospace sector (table 5.4). In response to industry concerns that government R&D has in the past been too focused on basic and applied research, the Canadian government appears to be increasingly focused on R&D projects that target higher TRLs and that provide opportunities for technology demonstration.[93] Prominent among government R&D programs is the Strategic Aerospace and Defence Initiative (SADI), which has provided funding for approximately 20–25 projects since its initiation and focuses on supporting R&D that has advanced to a TRL of 7–9 (technology demonstration and integration into existing systems).[94] SADI funds up to 30 percent of costs incurred over the life of the project, with contributions repayable over a 15-year period starting at the end of the project.[95] Selected examples of SADI projects include research into lighter aircraft engines and next-generation cockpit technologies (table 5.5).

As in Europe and the United States, government R&D funding increasingly targets environmental technologies that are more fuel-efficient, produce fewer emissions, and are more sustainable, as reflected in Canada's Aerospace Environmental Technology Road Map (CAETRM). For example, the Green Aviation Research and Development Network (GARDN), created in 2009, brings together government, academic, and industrial partners to fund demonstration projects and technologies to reduce the environmental impact of aviation.[96]

[92] Industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

[93] ECORYS, *Competitiveness of EU Aerospace Industry*, 2009, 248; AIAC, "Future Major Platforms," June 2009, 14–15.

[94] Government officials, interviews by USITC staff, Ottawa, Canada, September 2011; Industry Canada, "Overview," March 2011.

[95] Ibid.

[96] NRC, "Canadian Aeronautics Innovation," April 2011. Projects in the start-up phase include six led by Pratt & Whitney and three by Bombardier. GARDN Web Site, http://www.gardn.org/ (accessed December 20, 2011).

TABLE 5.4 Selected Canadian federal and provincial aeronautics R&D programs

Program	Brief description	Examples
Strategic Aerospace and Defence Initiative (SADI)	Provides repayable contributions, generally equal to about 30 percent of the project's cost, to support strategic R&D.	$294 million provided to Pratt & Whitney Canada for aircraft engine development.
Industry Canada C-Series Program	Provides repayable contributions to support strategic technologies for Bombardier's C-series regional jets. Strategic technologies may also apply to the business jet platform.	Up to $343 million may be paid out over the life of the project (2009–15) to Bombardier and supply chain partners.
National Research Council (NRC) Canada	The NRC has over 5,000 employees and numerous labs and facilities. The NRC Aerospace Institute has five main research programs—aerospace manufacturing, aerodynamics, flight research, performance of aerospace structures and materials, and gas turbine engines.	Recent research achievements in engine icing issues, composites, and fly-by-wire technologies.
Industrial and Regional Benefits Program (IRB)	Framework for Canada's offset program under which a foreign contractor who successfully bids on a Canadian defense program commits to undertake activities in Canada equal to 100 percent of the contract's value.	Increased focus on obtaining contractor commitments to activities that provide for technology transfer or collaborative technology development. Approximately $20 billion currently under contract.
Consortium for Research and Innovation in Aerospace in Quebec (CRIAQ)	Quebec government agency that matches universities and firms together for research collaborations.	CRIAQ has 96 active projects with a total value of more than $108 million.

Source: Government representatives, interviews by USITC staff, Ottawa, Canada, September 2011; NRC, "Canadian Aeronautics Innovation," April 2011; Industry Canada, "Overview," March 2011.

Note: Dollar amounts are in U.S. dollars. Currency conversions based on IMF representative exchange rates for selected currencies. IMF Web Site, http://www.imf.org/external/np/fin/data/rms_rep.aspx (accessed November 1, 2011) (1 C$ = $1.02).

TABLE 5.5 Selected R&D projects funded by SADI

Recipient	Project length	Brief description	Funding (million $)
Pratt & Whitney Canada	2010–15	Lighter aircraft engines for improved power, fuel efficiency, durability	294.1
CAE	2009–14	Innovative aircraft simulator systems	245.1
Esterline	2009–13	Cockpit technologies for next-generation business jets and other aircraft	51.3
Bristol Aerospace	2008–14	New processes for composite manufacturing and complex assemblies	42.5
Heroux Devtek	2008–14	Improving performance of landing gear systems	26.4
Diamond Aircraft	2008–10	All-composite, single-engine, five-passenger jet	19.2
Mechtronix Systems	2010–15	Flight simulator training products	18.2
Thales Canada	2010–14	Innovative flight control systems	12.7
ASCO Aerospace Canada	2010–15	Manufacturing technologies for aircraft bulkheads and components	7.5
AeroMechanical	2011–13	Next-generation data communication systems	1.9

Source: Industry Canada, Industrial Technologies Office, "Project Portfolio," n.d. (accessed November 1, 2011).

Note: Values are in U.S. dollars. Currency conversions based on IMF representative exchange rates for selected currencies. IMF Web Site, http://www.imf.org/external/np/fin/data/rms_rep.aspx (accessed November 1, 2011) (1 C$ = $1.02).

Government-supported R&D in Brazil

Brazil has government research facilities focused on both military and civilian aeronautics R&D, and has provided R&D support to Embraer. A technology cluster located near Embraer headquarters in São José dos Campos is in early stages of development. It is intended to emulate more established clusters in the other business jet-producing countries.[97]

In 1946, the Brazilian government established the Aerospace Technical Center (CTA), an umbrella organization for aeronautics research modeled on the Massachusetts Institute of Technology.[98] Government research institutions connected to CTA include:

> *The Technological Institute of Aeronautics (ITA)*: founded in 1950, ITA trains graduates and undergraduates, in aeronautics and aerospace, aeronautical mechanics and infrastructure, and electronics and computation. ITA has its own wind tunnel and advanced manufacturing equipment for teaching and research.[99]
>
> *Institute of Aeronautics and Space (IAE)*: founded in 1969, IAE conducts R&D in aeronautics, defense, and space.
>
> *Institute for Industrial Fostering and Coordination (IFI)*: founded in 1971, IFI handles certification and quality assurance functions for military aircraft, technology transfer and intellectual property management, and industrial coordination, including the identification of technology transfer and other valuable offset opportunities when the Brazilian government makes defense purchases from foreign contractors.[100]

As discussed in chapter 3, Brazil has provided R&D funding assistance to Embraer. For example, BNDES (the Brazilian Development Bank) and FINEP (Financiadora de Estudo e Projetos, part of the Ministry for Science and Technology) contributed 22 percent of the development costs of the ERJ-145/135 family of regional jets and 100 percent of the development costs of the company's AL-X light-attack jet fighter.[101] Although direct funding reportedly has diminished since the privatization of Embraer in 1994, the Brazilian government continues to be an important source for R&D debt financing through BNDES and FINEP.[102] As of December 2010, Embraer had total outstanding loans with BNDES of $347 million and with FINEP of $53.4 million. The FINEP loans were extended primarily to fund R&D expenses related to the Phenom aircraft.[103]

More generally, FINEP has a dual role in supporting Brazilian innovation: it provides grants to nonprofit institutions, such as universities and research centers, and makes

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[97] Industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

[98] Goldstein, "Embraer: From National Champion," 2002, 99; government officials, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

[99] Government officials, interviews by USITC staff, São José dos Campos, Brazil, September 2011; ITA Web site, http://www.ita.br/ingles/ingles.htm (accessed December 20, 2011).

[100] Government officials, interviews by USITC staff, São José dos Campos, Brazil, September 2011; industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

[101] ECORYS, *Competitiveness of EU Aerospace Industry*, 2009, 256; Goldstein, "Embraer: From National Champion," 2002, 111; FINEP, "Brazilian Innovation Agency," 2005.

[102] ECORYS, *Competitiveness of EU Aerospace Industry*, 2009, 256; Embraer, "Form 20-F," April 18, 2011, 86.

[103] Embraer, "Form 20-F," April 18, 2011, 86.

reimbursable and nonreimbursable funds available to firms to promote R&D at all stages, from basic research to product innovations. In 1999, Brazil created a Science and Technology Sectoral Fund to finance R&D and innovation in targeted sectors managed by FINEP, including aeronautics. Each sectoral fund has a steering committee composed of members of academia, government, and industry who guide project selection and financing decisions.[104] In 2010, FINEP funded three aeronautics sector projects—in biofuels in aviation, network security systems, and air traffic control—for approximately $2.73 million (4.75 million BR). Projects funded in 2009 totaled approximately $3.85 million (8.96 million BR).[105] FINEP also manages a portfolio of loan, grant, investment, and tax reduction programs to support the innovative activities of firms and research institutions.[106]

BNDES is the main provider of long-term financing to Brazilian firms as well as a key instrument for industrial development and infrastructure programs in Brazil.[107] BNDES also has a diversified portfolio of programs to fund firms' investments in innovation, including nonrefundable resources; credit to firms; venture capital-type equity investments; and participation via seed money and other funds.[108] These various programs have been made available to Embraer and to firms in its supply chain. BNDES also has a sectoral program targeting aeronautics firms; however, few firms reportedly have taken advantage of it.[109]

The aeronautics cluster around São José dos Campos is in early stages of development. SMEs are setting up in the cluster, participating in training and outreach activities, and exploring collaborations to obtain the scale necessary to compete for work from Embraer and other large multinational companies.[110] In the meantime, Embraer has undertaken to improve the capabilities of its workforce with an engineering specialization program, cooperative agreements with eight Brazilian universities, and its own high school, the Embraer Juarez Wanderley School. Under these arrangements, Embraer trains engineers from universities throughout the country in the specialized knowledge required for its aircraft programs.[111]

Government Regulation and Its Impact on Innovation

National aviation authorities—including the FAA, Transport Canada, the European Aviation Safety Agency (EASA), and Brazil's Agência Nacional de Aviação Civil (ANAC)—are responsible for monitoring aviation safety to ensure compliance with prescribed safety standards. In general, the process for aircraft certification is

[104] FINEP, "Brazilian Innovation Agency," 2005; government officials, interviews by USITC staff, Rio de Janeiro, Brazil, September 2011.

[105] FINEP, "Approved Projects," n.d (accessed November 8, 2011); IMF Web Site, "Representative Exchange Rates for Selected Currencies," January 4, 2010 ($1 = 1.74 Brazilian *real* (BR)) and January 6, 2009 ($1 = 2.33 BR)). http://www.imf.org/external/np/fin/data/rms_rep.aspx (accessed November 7, 2011).

[106] FINEP, "Incentives to Support Innovation," April 2007.

[107] Government officials, interviews by USITC staff, Rio de Janeiro, Brazil, September 2011.

[108] Schapiro, "Development Bank," 2010, 97.

[109] Government officials, interviews by USITC staff, Rio de Janeiro, Brazil, September 2011.

[110] Industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

[111] Embraer, *Annual Report 2010*, n.d., 73 (accessed November 2011); Embraer, "Embraer Signs Agreement," November 18, 2002; industry representatives, interviews by USITC staff, São José dos Campos, Brazil, September 2011.

"multifaceted and highly technical."[112] The FAA's certification processes related to business jets are described in box 5.4.

BOX 5.4 Certification and approval procedures at the FAA

The FAA's Aircraft Certification Service is responsible for issuing design and production approvals and for developing and implementing standards to ensure the safety of the fleet. It issues approvals in three basic areas:

Design. Type certificates for new aircraft, propeller, or engine designs are issued when the applicant demonstrates that the design complies with applicable regulations. Amended type certificates cover derivative models, and supplemental type certificates cover major changes to existing designs.

Production. Production certificates certify a manufacturer's ability to build an aircraft, engine, or propeller in accordance with an approved design. The manufacturer must show that it has a quality control system that will reliably duplicate the aircraft or part.

Flight Approval. Airworthiness certificates for new aircraft, engines, propellers, and parts confirm that the product conforms to the approved design and is in safe operating condition.

In order to focus its resources on safety-critical issues, the FAA delegates most of its regular certification activities to designees. Designated Engineering Representatives (DERs) are non-FAA employees authorized to approve information on behalf of the FAA, such as test data and analyses related to the aircraft and its systems. In 2005, the FAA created the Organization Designation Authorization (ODA) program. The ODA program enables the FAA to take advantage of the knowledge and experience inherent in the manufacturer's entire organization. Because the aircraft industry is expanding at a rate that substantially exceeds FAA resources, effective delegation programs are essential.

The FAA and industry agree, however, that the ODA program is still in its early stages and that the full benefits of the program have not been realized. Business jet OEMs generally have ODA authority; however, in practice, delegations are not always permitted by particular regulators, despite being authorized by the ODA program. The FAA is working with industry stakeholders to better realize the gains both sides seek from effective implementation of the program.

Sources: FAA (Baker), written testimony to the USITC, September 28, 2011; GAO, *Aviation Safety*, 2010, 20; industry representatives, interviews by USITC staff, Wichita, KS, July 2011; government representatives, telephone interviews by USITC staff, January and February 2012.

Aviation authorities across countries cooperate to facilitate the reciprocal acceptance of approvals, avoid duplication of efforts, and help pave the way for consistent international regulation.[113] Bilateral Aviation Safety Agreements (BASAs) establish a framework for aviation authorities to cooperate across countries by validating each other's certifications. The BASAs include detailed implementation procedures that identify the scope and terms of the cooperation between the regulating agencies. For example, the scope of the BASAs between the FAA and Canada and Europe is broad, covering all aircraft as well as engines and propellers, while the BASAs with Brazil and other countries are more limited in scope.[114] Despite these agreements, OEMs and suppliers have noted challenges in interactions with their own aviation authorities, as well as those of other countries, including the timeliness and consistency of decision making, particularly with regard to new technologies.[115]

[112] USITC, hearing transcript, September 28, 2011, 16 (testimony of Dorenda Baker, FAA).

[113] Baker (FAA), written testimony to the USITC, September 28, 2011, 4; government officials, interview by USITC staff, Ottawa, Canada, September 2011; government officials, interview by USITC staff, São Paulo, Brazil, September 2011.

[114] Baker (FAA), written testimony to the USITC, September 28, 2011, 4; government official, telephone interview by USITC staff, February 2012.

[115] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; Bunce (GAMA), written submission to the USITC, September 9, 2011, 8.

The most pressing problem reported by industry, particularly in the United States, is with the timeliness of review.[116] According to the FAA, resource constraints at the FAA have required the institution of a "sequencing policy" in 2005 to ensure that enough resources are available for operational safety before they are allocated to certification activities.[117] Under this policy, the FAA prioritizes which certification projects will be worked on immediately and which will be delayed. According to a recent U.S. Government Accountability Office (GAO) survey of industry stakeholders and experts, delay is the number one reported problem with the certification process, and the prioritization system and lack of resources are the leading factors contributing to the problem.[118] As the General Aviation Manufacturers Association (GAMA) noted in its submission to the USITC:

> The lack of FAA engineering and technical resources necessary to support aircraft certification programs in a timely manner significantly impacts manufacturer and supplier company decisions to invest in new projects, expand facilities and increase employment. Not knowing when or even if the FAA can start a new certification project is a significant problem because these development programs require financial commitments and planning long before, sometimes even years before, a formal application is made to the FAA. . . . In addition, delays in FAA certification put U.S. manufacturers at a competitive disadvantage as foreign companies can obtain more efficient certification from their national authorities and get their products to market sooner.[119]

According to FAA data, since 2001 it has taken, on average, 43 months to complete the certification of a business jet in the United States.[120] However, the regulations that govern a particular project are only locked in place for 36 months. When the certification process exceeds 36 months, the FAA must determine if new rules have come into play such that the OEM must comply with additional (and unplanned for) requirements.[121] Delays in the certification process are not confined to the United States. Regulatory authorities in Brazil, France, and Canada also may take a long time to certify aircraft produced in their countries.[122] The timeliness of certification is a competitive concern for OEMs and their suppliers across aviation authorities.[123]

The consistency of certification decisions both within the United States and across countries is another concern articulated by OEMs.[124] According to the GAO survey, the inconsistent interpretation of regulations is the second most significant reported problem

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[116] Bunce (GAMA), written submission to the USITC, September 9, 2011, 8; industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[117] USITC, hearing transcript, September 28, 2011, 21–22 (testimony of Dorenda Baker, FAA).

[118] GAO, *Aviation Safety*, 2010, 30.

[119] Bunce (GAMA), written submission to the USITC, September 9, 2011, 8.

[120] FAA, written submission to the USITC, October 11, 2011.

[121] USITC hearing testimony, September 28, 2011, 38–39 (testimony of Dorenda Baker, FAA).

[122] For example, the Phenom 100 took 43 months from launch to certification in Brazil. Peaford, Nichols, and Thomas, *2011 Pocket Guide*, 2010, 148. As discussed earlier in this chapter, whether a plane is a clean sheet or a derivative can substantially affect certification times.

[123] Industry representatives, interview by USITC staff, Bordeaux, France, October 2011; industry representative, interview by USITC staff, São José dos Campos, Brazil, September 2011; industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[124] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representative, telephone interview by USITC staff, August 2011; industry representatives, interviews by USITC staff, Bordeaux, France, October, 2011.

with the FAA's certification system.[125] Although variation in FAA's interpretation of standards is a long-standing concern, the actual extent of the problem has not been quantified in the industry as a whole. In fact, most industry stakeholders surveyed by GAO reported positive experiences in obtaining certification and that serious problems occurred less than 10 percent of the time.[126] Consistency in decision making across regulatory agencies is also a challenge for OEMs. Differences arise not only with established regulatory agencies in Europe, Canada, and Brazil but also with countries new to globally accepted standards of aircraft certification. For example, OEMs have noted that China is increasingly "flexing its regulatory muscle" by requiring the production of test data and proprietary information that exceeds what is normally required and raises concerns about the loss of valuable intellectual property.[127]

The FAA has in place mechanisms that encourage consistency within the agency and across aviation authorities.[128] For example, within the FAA, business jet standards are developed in a single office and experts from that office train others to administer and interpret the regulations. The FAA also receives regular feedback from industry, has multilevel programs in place with stakeholders to improve the delegation and decision making processes, and takes steps to remedy particular problems in individual cases.[129] Across aviation authorities, the FAA uses "validation improvement teams" and regular communications to foster consistent decision making and address situations in which appropriate deference is not being given to actions taken by regulators from other countries.[130] Regulatory consistency is particularly challenging in emerging technology areas when new standards must be developed or standards originally written for other things must be applied in new ways. Regulators rely on collaboration and assistance from industry stakeholders, standards setting organizations, research institutions, other government agencies, and aviation authorities to meet these challenges.[131]

[125] GAO, *Aviation Safety*, 2010, 31.

[126] Ibid.

[127] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representative, telephone interview by USITC staff, November 2011.

[128] USITC, hearing testimony, September 28, 2011, 35 (testimony of Dorenda Baker, FAA).

[129] USITC, hearing testimony, September 28, 2011, 28 (testimony of Dorenda Baker, FAA); government official, telephone interview by USITC staff, February 2012.

[130] Ibid.

[131] USITC, hearing testimony, September 28, 2011, 37 (testimony of Dorenda Baker, FAA); industry representatives, interviews by USITC staff, Wichita, KS, July 2011; government officials, interviews by USITC staff, São Paulo, Brazil, September 2011; government officials, interviews by USITC staff, Ottawa, Canada, September 2011.

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CHAPTER 6
Financing

Summary

Financing issues influence competitiveness in the business jet industry[1] in two principal ways. First, business jet customers often need financing to buy aircraft, given the high price tag. Customer demand is therefore likely to be affected by the availability of financing. Second, a manufacturer's ability to invest in new aircraft development programs will, in part, depend on how easily the company can source funding for such large investments. The cyclicality of business jet demand, and therefore business jet OEMs' revenue streams, makes the issue of corporate funding even more challenging. This is because business jet OEMs need to maintain their steady investment in aircraft development programs over long periods, even in years when the business cycle has turned negative, as in 2008–10.

Customer Financing

Customer Segments

Although the decision to purchase a business jet is necessarily complex, buyers usually focus on the aircraft's performance capability (range, cabin capacity, speed, etc.) relative to the cost. Additional criteria considered include cabin comfort, aftersales service, and customer support. Different customer groups give greater or lesser weight to different selection criteria, depending on how they expect to use the aircraft and how easily they can access financing. In calculating total cost, buyers consider not only the asking price of the aircraft, but also the financing cost, the sales or import taxes payable, and any tax depreciation benefits, as well as the recurring costs associated with owning the asset (i.e., fuel, pilot salaries, hangar fees, maintenance, and inspections).[2]

Creditworthiness is normally judged by financial services providers to reflect a prospective borrower's level of liquid assets (cash and other assets that can be converted easily into cash) and the degree to which they have already borrowed against these assets. Therefore, customers who are more likely to need financing to make a purchase are at the same time generally less likely to have easy access to new financing (table 6.1). For these customer segments (Group I)—high net worth individuals (HNWIs), small private companies,[3] and small and medium-sized enterprises (SMEs), as well as air taxi companies and air charter companies—the purchase decision is likely to depend on whether financing is available and whether it is at a reasonable cost.[4]

[1] As stated in the request letter from the House Ways and Means Committee, the focus of this investigation is on business jets at or below 50,000 pounds MTOW.

[2] Phelps, "How to Buy a Business Jet," February 2009.

[3] For example, medical practices or self-employed accounting, financial advisory, or consulting firms.

[4] For purposes of this discussion, HNWIs are persons with net worth greater than $1 million, while persons with net worth greater than $100 million are considered "very high net worth individuals" (VHNWIs). The Teal Group, "Business Aircraft," April 2011, 5.

TABLE 6.1 Importance of financing by customer segment and aircraft type

Type of aircraft customer	Type of business jet aircraft purchased: Very light jets	Light jets	Medium up to 50,000lbs. MTOW
Group I. Less access to capital and aircraft financing			
High net worth individuals and owner-pilots	X	x	
Small private companies	X	x	
Air taxi companies	X		
SMEs	X	X	x
Charter companies		X	X
Group II. Greater access to capital and aircraft financing			
Fractional share operators	x	X	X
Large corporations		X	X
Group III. Do not require access to capital or financing			
Governments			X
Very high net worth individuals			x

Sources: Harris Interactive Inc., "Survey of Companies Using General Aviation Aircraft," October 15, 2009; Teal Group, "Business Aircraft," April 2011; *Financial Times,* "Special Report on Business Aviation," May 4, 2010; *Flightglobal*, "NBAA Special: 2011 Census," http://www.flightglobal.com/Features/NBAA/census/ (accessed January 10, 2012); USITC staff interviews with industry representatives.

Note: "X" = A significant proportion of purchases are in this category; "x" = A small proportion of purchases are in this category.

Small business customers are very important to the business jet industry, as they are the biggest consumer group. According to the National Business Aviation Association (NBAA), 85 percent of business jet owners are SMEs.[5] According to a 2009 NBAA/General Aviation Manufacturers' Association (GAMA) survey of business jet users, about 70 percent of companies operating business aircraft have fewer than 1,000 employees and about 60 percent have fewer than 500 employees.[6] For most SMEs, their ability to borrow for capital investment tracks the health of their business performance. As a result, during the recent economic downturn, SMEs were especially exposed to the contraction in demand for their own products and saw their borrowing capacity shrink significantly.

Air taxi companies and charter operators, other customer segments in Group I, are also likely to have a more difficult time accessing financing than other types of buyers because they use their aircraft very intensively compared to other types of owners, and the residual value of one of their aircraft at the end of a loan period will be relatively low compared with aircraft that have had only one owner/operator.[7]

Larger corporations, including large fractional share operators (Group II), have more access to aircraft financing and to capital in general. Large companies have established credit lines with banks and are more likely to be able to absorb the cost of a business jet as one more expense of doing business.[8] When deciding whether to finance an aircraft purchase with their own funds or with a commercial bank loan secured on the aircraft or

[5] NBAA presentation to USITC staff, Washington, DC, July 15, 2011.
[6] Harris Interactive Inc., "A Survey of Companies Using General Aviation Aircraft," October 15, 2009, 5.
[7] Industry representative, interview by USITC staff, Montreal, Canada, September 2011.
[8] Alasdair Whyte, editor, *Corporate Jet Investor*, telephone interview by USITC staff, August 17, 2011.

with a leasing arrangement, they will use whichever route minimizes the cost of funding, including the impact of tax depreciation of owned assets.[9]

Although they are harder for banks to assess for creditworthiness than major public companies, fractional share operators are likely to access credit more easily than small companies because they are fleet purchasers.[10] Their business model is to sell "shares" of business jet ownership and to charge separate fees for ongoing trip-related costs. Customers of fractional operators benefit from being able to own only a share of a business jet rather than having to finance the entire investment from their own resources. Fractional share operators' profitability depends on their ability to recoup the cost of buying, financing and operating the aircraft (e.g., fuel, pilots, hangars, maintenance) in their "share" pricing. As a result, financing costs are very important to these purchasers as well.[11]

Very high net worth individuals (VHNWIs), in Group III, maintained a nearly steady demand for new aircraft during the 2008–11 period, although they generally purchase heavier aircraft outside the scope of this report. This group is better able to afford aircraft without borrowing to finance the purchase.[12] In fact, the financial crisis is likely to have encouraged the very wealthy to accumulate cash holdings and to reduce their exposure to more risky asset types such as equities. Therefore, many individuals in this group had cash available if they were considering an aircraft purchase.[13]

Government buyers are also included in Group III, as they need not consider financing issues. Government purchases are paid for out of public funds, and the decision to purchase is a reflection of budget priorities and public service requirements. National governments regularly buy business jets for a variety of missions, including flight training and VIP transport.

Effect of the Financial Crisis

The credit collapse during the recent economic downturn had important implications for the pattern of demand in the business jet market, as discrete customer segments were affected very differently.[14] The credit crunch hurt smaller companies and owner-operators much more than larger public companies, VHNWIs, and government buyers. Therefore, the demand for business jets among the more vulnerable customer segments fell more precipitously.[15] Since the revenue streams of fractional share and charter operators, like those of many SMEs, are very sensitive to the business cycle, demand from these customers also collapsed.[16]

Because of their wider range of funding sources, larger public companies generally fared better than many SMEs during the recession, but this group also reduced its demand for business jets, not least because of public relations considerations. At a time when

[9] Accelerated depreciation of business aircraft is a helpful way to reduce a corporation's tax bill, as long as the company has enough profits for the depreciation expense to be set against. This is usually not an issue for large companies. Hennig, "Business Aviation 101," GAMA presentation to USITC staff, June 7, 2011.
[10] Alasdair Whyte, editor, *Corporate Jet Investor*, telephone interview by USITC staff, August 17, 2011.
[11] Industry representative, interview by USITC staff, Wichita, KS, July 2011.
[12] Sarsfield, "Business Aircraft Census 2011," October 5, 2011.
[13] Banking industry representative, telephone interview by USITC staff, August 2011.
[14] The Teal Group, "Business Aircraft," April 2011, 5.
[15] Sarsfield, "Business Aircraft Census 2011," October 5, 2011.
[16] The Teal Group, "Business Aircraft," April 2011, 5.

corporate profits were under severe pressure, the use of corporate jets was perceived by the public as an unnecessary luxury.[17]

Only in the VHNWI segment did demand hold up during the economic downturn, as affordability is less of an issue in the decision to purchase for this group. Also, many of these buyers were located in emerging markets where economic growth was stronger and business jets sales were growing quickly. VHNWIs experienced a short-lived period of restricted credit during the downturn, but attractive bank financing is once again readily available to them, although not often needed.[18]

During the financial crisis, as financing became unavailable for many potential borrowers, a larger share of purchases were made with cash (possibly raised by the buyer's own credit lines) and via loans to the more creditworthy types of buyer.[19] Before the downturn, 45–50 percent of business jet purchases were financed with loans secured on the aircraft and a similar proportion were purchased with cash. In 2009–10, however, only 25–30 percent of business jet purchases were made with aircraft financing and 65–70 percent were purchased with cash (the 5–10 percent remainder was purchased by leasing companies).[20] The higher proportion of "cash" buyers is likely attributable to (1) banks reining in lending, and (2) buyers, especially SMEs, becoming relatively less creditworthy during the recession.[21]

By 2011, according to market participants, bank lenders were once again undertaking business jet financing deals; the share of purchases completed with financing increased and was estimated to be about 35 percent by year-end. As the economy and the stock market continue to recover, bank lending for aircraft is likely to increase, although possibly with shorter loan maturities and higher risk adjustment in the pricing.[22] The due diligence banks now require on both customers and the aircraft asset is lengthier, creditworthiness standards are higher, the required initial down payment is a larger percentage of the total aircraft cost, and more scrutiny is being applied to asset recovery provisions in the event of foreclosure.[23] Also, for many business jet customers, obtaining financing requires a significant banking relationship, as a bank's willingness to lend is often tied to the wider wealth management business revenue generated by the customer.[24]

Despite tighter lending requirements, in 2011, corporations started once again to purchase business jets as their business conditions improved and their transport requirements increased.[25] For example, one major bank reported that the number of business jet

[17] This perception was reinforced when the senior executives of the Big Three U.S. auto companies each took separate company airplanes to attend congressional hearings on the auto industry. *Aviation International News*, "General Aviation Rallies to Burnish Its Image," October 8, 2011.

[18] Whyte, "It's Great at the Top," June 17, 2011.

[19] Moody's Investors Service, "Moody's Revises the Aerospace and Defense Industry Sector Outlook," February 23, 2009; Whyte, "It's Great at the Top," June 17, 2011.

[20] Hennig, "Business Aviation 101," June 7, 2011; Alasdair Whyte, editor, *Corporate Jet Investor*, telephone interview by USITC staff, August 17, 2011.

[21] Banking industry representative, telephone interview by USITC staff, August 2011.

[22] Banking industry representative, telephone interview by USITC staff, August 2011; Epstein, "Lenders 'Reset' Expectations," December 2010.

[23] See app. D, Summary of Position of Interested Parties, for a summary of information provided by the Equipment Leasing and Finance Association.

[24] Labrozzi et al., "Identifying and Overcoming Business Challenges," June 9, 2011; Epstein, "Lenders 'Reset' Expectations," December 2010.

[25] Banking industry representative, telephone interview by USITC staff, August 2011.

financings arranged for corporations was higher than for HNWIs in 2011, the reverse of the pattern in 2010.[26]

Implications for Business Jet Producers

The relationship between customer financing requirements and the type of aircraft purchased has implications for the competitive positions of the major manufacturers. Those OEMs that produce very light and light business jets in larger numbers were more exposed to the downturn in sales during the recession because smaller aircraft are mostly purchased by Group I and Group II customers, who were more affected by the credit crunch than those in Group III. As shown in table 6.2, deliveries of very light jets fell most sharply from 2008 to 2011 (down 71 percent), whereas deliveries of medium to super midsize business jets fell 52 percent over the period. Although deliveries of light jets fell by 47 percent in the period, Embraer was the only producer to post an increase in deliveries with its introduction of the Phenom 300 starting in 2009.[27] Embraer was able to "buck the trend" of sharp declines in sales during the downturn because initial sales typically bulge when a new aircraft (with new technology) comes to market. Embraer's sales were further enhanced by the competitive pricing of the Phenom 100 in the very light jet segment and by Embraer's marketing success with fleet operators.[28]

Limited availability of customer financing for aircraft purchases during the downturn was of particular importance to Cessna, HBC, and Learjet (a subsidiary of Bombardier). These producers' output is concentrated in the light jet sector, and their sales are more heavily weighted to the North American and European markets, where declines in demand were greatest.[29]

Dassault was less affected since its smallest business jets, the Falcon 900 and Falcon 2000 series, are in the medium to super midsize category, where customer demand is not as sensitive to the availability of financing.[30] Sales of the two Gulfstream jets discussed in this report, the G150 and the G200, declined significantly during the downturn, but these models represented only a small share of the company's total business jet production.[31] As one industry expert notes, "The credit collapse is the biggest difference between this downturn and previous downturns, and therefore is the best explanation for the unique bifurcation [between sales of very light and light jets on the one hand, and sales of medium and heavy jets on the other] the market is seeing today."[32]

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[26] Ibid.

[27] See table 3.3 in Chapter 3, "Global Industry," for global delivery data.

[28] GAMA, *2011 General Aviation Statistical Databook & Industry Outlook*, 16–17, table 1.4. Prices of aircraft in the very light jet category in 2010 were $3.1 million for the Cessna Mustang, $3.7 million for the Embraer Phenom 100, $6.6 million for the Hawker Beechcraft Premier 1A, and $6.9 million for the Cessna CJ2+.

[29] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011.

[30] The Teal Group, "Business Aircraft," April 2011, 5.

[31] GAMA, *2011 Statistical Databook & Industry Outlook*, 16–17; Wynbrandt, "Gulfstream Strong in the Middle East," November 14, 2011.

[32] The Teal Group, "Business Aircraft," April 2011, 5.

TABLE 6.2 Percentage change in global business jet deliveries and segment market shares, 2006–11

	2008 vs 2006	2011 vs 2008	Jet segment share, 2006	Jet segment share, 2008	Jet segment share, 2011
			Percent		
Very light jets					
Cessna	181	–66			
Eclipse	16,000	–100			
Embraer	–[a]	1,950			
HBC	35	–84			
Subtotal	326	–71	12	33	22
Light jets					
Bombardier Learjet	4	–42			
Cessna	12	–48			
Embraer	–[a]	–[a]			
Emivest	–100	–[a]			
Gulfstream	106	–40[b]			
HBC	5	–85			
Subtotal	12	–47	52	38	46
Medium to super midsize jets					
Bombardier	23	–22			
Cessna	35	–76			
Dassault	–16	–37			
Embraer	33	–64			
Gulfstream	36	[b]			
HBC	–[a]	17			
Subtotal	21	–52	36	29	32
Total deliveries < 50,000 lbs. MTOW	53	–57	100	100	100

Sources: General Aviation Manufacturers Association, *2011 Statistical Databook & Industry Outlook*, n.d. (accessed February 22, 2012); Gulfstream deliveries for models G100/150 and G200 provided in UBS analyst David Strauss' presentation to the NBAA Business Aircraft Transactions Conference, June 9, 2011, 27.

Note: Underlying data are shown in table 3.3. Because of rounding, figures may not add to totals shown. Data for 2011 are preliminary.

[a]Undefined change because there were no deliveries in the base year.
[b]Deliveries for Gulfstream G150 (light jet) and G200 (medium to super midsize jet) are consolidated.

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OEM Assistance in Arranging Sales Financing

Since arranging financing is a critical requirement for sales in certain customer segments, OEMs try to help these customers locate loan sources as part of their sales process. OEMs sometimes offer financing themselves, or introduce their customers to local financial institutions that are active in business aviation finance.

Because their customers are more likely to require financing, the OEMs competing in the very light jet and light jet sectors have well-developed customer finance strategies. In the case of Cessna, for example, Textron Financial Inc. is a captive financing company whose role is to finance sales of Textron's Cessna and Bell Helicopter units. As a result, Cessna is the only major business jet OEM that can send customers to its own financing unit if they require a loan to purchase an aircraft, and Textron financed a significant share of Cessna's 2010 sales.[33]

Although they do not have in-house finance units to turn to, the other major OEMs work hard to help their customers arrange sales financing. Both Bombardier (including Learjet)

[33] Industry representative, telephone interview by USITC staff, July 2011.

and HBC have very experienced sales finance teams with good banking relationships in all key markets. They often assist customers seeking loans by introducing them to the local bank most interested in aviation finance, acting as a conduit for information about the customer's creditworthiness, and supplying the bank with all the necessary information about the aircraft being sold.[34]

Given its product line of medium to heavy business jets, Dassault's customer base is weighted more towards VHNWIs and private firms. Its finance team has well-developed relationships with the major French banks and other global banks that are important providers of wealth management services (for example, UBS and Credit Suisse), and it has particular expertise in assisting VHNWI customers who wish to use their own relationship banks for their purchase. These European banks have a strong presence in international markets, especially Latin America and Asia, which helps Dassault to reach new customers in emerging markets. Dassault's role is to facilitate rather than to arrange new aircraft financing; the OEM works with its customer's primary bank, providing data about the asset's likely residual value, for example, in case this information is needed when the customer raises funds from existing credit lines.[35]

Financing by Export Credit Agencies in Foreign Markets

Over the past few years, business jet OEMs have increasingly begun to work with government-sponsored export credit agencies (ECAs) to secure export sales financing. For qualifying export transactions, these agencies can provide a source of financing when private sector credit is restricted, as in some emerging markets, or when private sector credit is prohibitively expensive, as during 2008–10. Although only a small number of ECA transactions for business jets were completed previously, in the last three years export credit has been used to finance over $1 billion in business jet and helicopter transactions.[36] ECA support can take several forms: direct loans to customers of the country's exporters; loans to the exporting company so that it can extend trade finance to its customers; export credit insurance against nonpayment by customers because of commercial or political risks; guarantees of private sector bank loans to export customers, which insure the lender against nonpayment by the customer; and working capital guarantees to finance export-related inventory and accounts receivables.[37]

The Organisation for Economic Co-operation and Development (OECD) Arrangement on Guidelines for Officially Supported Export Credits (known as "the Consensus"), and its associated Aircraft Sector Understanding (ASU) agreement, provide a framework for government financing of export credit in the business jet industry. The purpose of these agreements is to establish conditions for fair competition for exporters selling in global markets.[38] The terms of ECA-supported sales financing are standardized; thus, no one country's exporters have an advantage when competing for a sale in a third market. In 2007, the ASU was overhauled and new rules were agreed on. At that point, Brazil, as an important aircraft-producing nation, agreed to become a signatory to the ASU, although it

[34] Any lender would need full information about the aircraft involved in a transaction, as the aircraft is the asset securing the loan. Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interviews by USITC staff, Montreal, Canada, September 2011; Alasdair Whyte, editor, *Corporate Jet Investor*, telephone interview by USITC staff, August 17, 2011.

[35] Alasdair Whyte, editor, *Corporate Jet Investor*, telephone interview by USITC staff, August 17, 2011.

[36] Ex-Im Bank, *Report to the U.S. Congress on Export Credit Competition*, June 2011, 31; Whyte, "Airlines vs. business jets," *Corporate Jet Investor One Minute Week 49* (email newsletter), October 21, 2011.

[37] Ex-Im Bank, "Products and Policies" (accessed December 21, 2011).

[38] Murphy, "Export Credit Agency Support," 1998, 47–48.

is not an OECD member and did not sign the more general ECA Arrangement.[39] Another revised ASU came into force in early 2011, with Brazil once again joining OECD countries in signing the agreement. Because of Brazil's participation, virtually all global export sales that are financed with ECA support are completed on ASU terms. However, these agreements only apply to export sales financing; no specific multilateral framework exists for state supported financing of sales by an aircraft manufacturer in its home market.[40]

The U.S. Export-Import Bank

The U.S. Export-Import Bank of the United States (Ex-Im Bank) is an independent federal agency tasked with supporting U.S. jobs by providing sales financing for exports (directly or through loan guarantees), especially in situations where commercial banks are unable or unwilling to lend.[41] In fiscal year 2011, preliminary figures show that Ex-Im Bank extended over $32 billion of export financing, which supported about $41 billion of U.S. exports ($12.4 billion in the transportation sector alone).[42]

In many ways, providing financing for business jets tends to be more complex for Ex-Im Bank than its financing of Boeing's international sales to commercial airlines. Foreign business jet customers of the U.S. OEMs are often smaller companies, operating in a broad range of industry sectors and often located in countries with less stringent financial reporting requirements. It is therefore often more difficult and time-consuming to complete the necessary credit checks for these customers than for the typical commercial airline customer, while at the same time the value of the loan is likely to be small relative to a commercial jet loan.[43] The likely smaller size of a business jet financing transaction presents a challenge to Ex-Im Bank and other ECAs supplying financing in this industry, as it may take nearly as much time to structure a $10 million business jet loan as to finance the sale of a $200 million aircraft to an airline.[44]

Since the sharp fall in business jet sales starting in 2009, Ex-Im Bank has been increasingly active in the business jet sector, stepping in as a source of finance when private sector sources were scarce. It is by far the most active ECA (in terms of number of deals and the value of financing) in the business jet market, notwithstanding its more restrictive domestic content rules and the fact that a sizable share of aircraft sales by U.S. OEMs are in the domestic market and thus do not qualify for export credit financing. Including the $500 million Textron credit facility (discussed below), Ex-Im Bank lending to "ASU Category 3" aircraft (all smaller aircraft, such as helicopters, business jets, and agricultural aircraft) jumped to $700 million in 2009 before falling back in 2010 to

[39] Embraer, written submission to the USITC, October 5, 2011, 22.

[40] Ex-Im Bank, *Report to the U.S. Congress on Export Credit Competition*, June 2011, 29–30; USITC, hearing transcript, September 28, 2011, 48-50 (testimony of Robert Morin, Ex-Im Bank); banking industry representative, interview by USITC staff, Washington DC, August 2011; Embraer, written submission to the USITC, October 5, 2011, 22; BNDES *Annual Report 2009*, 103; OECD, *Sector Understanding on Export Credits for Civil Aircraft*, February 1, 2011.

[41] In lieu of an appropriation from the U.S. Congress, Ex-Im Bank charges interest and fees to fund its transactions. Ex-Im Bank, *Report to the U.S. Congress*, June 2011, 15.

[42] Ex-Im Bank, "Ex-Im Bank Export Financing Sets Record High," October 13, 2011.

[43] Ex-Im Bank, *2010 Annual Report*, 6; USITC, hearing transcript, September 28, 2011, 51 (testimony of Robert Morin, Ex-Im Bank); banking industry representative, interview by USITC staff, Washington DC, August 2011.

[44] *Corporate Jet Investor*, "Data: Helicopter and Business Jet Export Credit Deal Survey," July 19, 2011.

$237 million, close to the 2008 level.[45] Business jet and helicopter financings arranged by Ex-Im Bank in 2011 totaled only $250 million, but this is expected to increase in coming years.[46]

The best example of Ex-Im Bank's recent financing activity is the $500 million lending facility organized in 2009 for Cessna's parent, Textron Inc.[47] As the economic downturn deepened and the credit markets came under extreme pressure, Ex-Im Bank stepped in to provide liquidity when Textron Financial Corp., Textron's captive finance arm, could not fund its sales finance operations in the short-term commercial paper market (the typical funding avenue used by financial institutions).[48] Ex-Im Bank provided a line of credit to Textron Financial Corp. to fund the company's sales financing to customers of Cessna and Bell Helicopter, both Textron subsidiaries. Funds may be disbursed under this lending facility until June 30, 2012, although the facility is expected to be fully drawn several months beforehand. A $50 million lending facility is also available for financing the sale by Cessna and Bell of used aircraft taken in through trade-ins.[49]

Under the Ex-Im Bank facility, the specific credit risk of each aircraft customer is assumed by Textron, while Ex-Im Bank's credit risk exposure is to Textron. The aircraft sold under the facility act as collateral for Ex-Im Bank's lending. This transaction was characterized by industry participants as an innovative response to very difficult circumstances in both credit markets and customer markets, and its success is evidenced by Cessna's above-average sales performance in 2011. Cessna's new business jet and turboprop aircraft deliveries increased 35 percent in the first six months of 2011, compared with the same period a year earlier; it was the only U.S. OEM to see an increase in deliveries in this period.[50]

HBC also stated that it benefited from Ex-Im Bank's expanded role. In one of its largest transactions for HBC to date, in August 2011 Ex-Im Bank approved the provision of a $76 million direct loan to support the export of 10 HBC business jets and turboprop aircraft to a buyer in China.[51] In 2009, Ex-Im Bank guaranteed the $60.5 million bank loan taken out by HBC's customer, the National Private Air Transport Services Company Limited (NAS), for the purchase of six Hawker 750 aircraft, which are included in the study scope. NAS, which is based in Riyadh, Saudi Arabia, is a fractional operator of business jets and was investing to expand its core fleet.[52] This transaction is noteworthy not only for its size but also for the fact that the UK export credit agency, the Export Credits Guarantee Department (ECGD), provided a $7 million counter-guarantee to Ex-Im Bank covering the UK-sourced content in the aircraft,[53] thus reducing Ex-Im Bank's

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[45] Each national government imposes specific rules governing how the national ECA may operate. In the United States, Ex-Im Bank's maximum loan amount is the lesser of 85 percent or the percentage of U.S. domestic content in the total value of the qualifying export. Other G7 ECAs are not restricted in this way and can lend up to the 85 percent ceiling imposed under the OECD ECA Arrangement, even if the percentage of domestic content is lower. Ex-Im Bank, *Report to the U.S. Congress*, June 2011, 1–2, 15, and 31–33; Alasdair Whyte, editor, *Corporate Jet Investor*, telephone interview by USITC staff, August 17, 2011.

[46] Sanders, "Ex-Im Bank Predicts Golden Age for Business Jet Finance," February 10, 2012.

[47] Ex-Im Bank, "Ex-Im Bank Authorizes $500 Million Facility," May 21, 2009.

[48] Textron Financial Corporation, SEC Form 10-K 2009 (accessed January 10, 2012).

[49] U.S. government official, telephone interview with USITC staff, October 2011.

[50] Ex-Im Bank, "Ex-Im Bank Authorizes $500 Million Facility to Textron," May 21, 2009; banking industry representative, telephone interview with USITC staff, October 2011; USITC hearing transcript, September 28, 2011, 209 (testimony of Michael Chase, Chase & Associates); Chase, "JETNET Releases July 2011 Pre-owned Market Information," August 31, 2011.

[51] Ex-Im Bank, "Chairman's Update," Volume 6, October 2011.

[52] Ex-Im Bank, "Hawker Beechcraft Grows its Exports," May 19, 2009.

[53] HBC could access ECGD financing because of its manufacturing facilities in Chester, England.

exposure to an extent. When the transaction was announced, HBC noted that Ex-Im Bank support was "essential," especially in a tough economy.[54]

Export Development Canada (EDC)

Like the Ex-Im Bank, EDC has provided significant support to Canada's general aviation sector. EDC has a similar governance structure to Ex-Im Bank and is also self-financing. In 2010, transportation equipment was a key sector for EDC lending; at C$9.8 billion (US$9.5 billion), the sector represented almost 12 percent of EDC's total business volume.[55]

Although EDC has helped to provide financing for Bombardier's regional jet sales over the years, EDC has not supplied significant unilateral export sales financing for Bombardier's Challenger business jets or Learjets. However, EDC was involved in business jet financing as co-financier, alongside Ex-Im Bank, for 11 business and agricultural aircraft transactions in 2009 and 14 similar transactions in 2010.[56] In addition, EDC has been very active in providing financing for Pratt & Whitney Canada's engine exports, many of which are destined for use on business jets, and for other smaller suppliers to the aerospace industry. With EDC support, in 2009 Pratt & Whitney Canada won the contract to supply Cessna with "green" engines, and sold engines and spare parts valued at C$50–$100 million (US$44–$88 million) to Embraer. EDC also helped the company make a similar sale to HBC in 2010.[57]

Brazil's Banco Nacional de Desenvolvimento Econômico e Social (BNDES)

BNDES, the state bank that acts as Brazil's ECA, provides export credit financing to Brazilian exporting firms, as well as domestic loans to industry for infrastructure development, with funding from Brazil's Ministry of Finance.[58] BNDES supports its major aerospace OEM, Embraer, as part of its economic development mission: in 2010, 53 percent of Embraer's total aircraft deliveries were financed by BNDES.[59] However, this rate of support was significantly above the long-term average, as BNDES was responding to industry needs during the global economic downturn.[60]

Although it has long experience in assisting Embraer with its global regional jet sales, BNDES completed its only two business jet export financings for Embraer in 2010–11.[61] In 2010, BNDES financed Embraer's sale of a Lineage 1000 business jet (an aircraft not covered by this report) to a Middle Eastern customer. More notably, in 2011 BNDES provided $167 million of financing for the first deliveries of Embraer Phenom 300

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[54] Ex-Im Bank, "Hawker Beechcraft Grows its Exports," May 19, 2009; *Corporate Jet Investor*, "Data: Helicopter and business jet export credit deal survey," July 19, 2011.

[55] EDC, *Annual Report 2010*; EDC, "EDC facilitates record $24.7 billion of Canadian trade in emerging markets in 2010," March 9, 2011.

[56] Learjet sales may also be financed by Ex-Im Bank as they are produced in the United States, but the lack of a captive financing arm at Bombardier has meant that Learjet has had difficulty taking advantage of ECA financing. Ex-Im Bank, *Report to the U.S. Congress on Export Credit Competition*, June 2011, 33; banking industry representative, telephone interview with USITC staff, October 2011; banking industry representatives, interview with USITC staff, Washington DC, July 2011.

[57] Siegel, "EDC and Canadian Aerospace: Working together to Address the Challenges and Opportunities of Global Trade," October 14, 2009; EDC, "Individual Transactions Disclosure" (accessed October 28, 2011).

[58] BNDES, "Management Report – The BNDES System," December 31, 2010, 2.

[59] Embraer, *Annual Report 2010* (accessed October 26, 2011), 12.

[60] From 2004 through 2010, approximately 18.1 percent of the total value of Embraer's export deliveries had associated BNDES financing support. Embraer, *SEC Form 20-F 2010*, 11.

[61] Embraer, *Annual Report 2010* (accessed October 26, 2011), 12.

aircraft to Flight Options LLC, a U.S. fractional operator based in Cleveland, Ohio. Flight Options placed an order in 2007 for 100 to 150 Phenom 300s to be delivered over 10 years, starting in late 2009, but the delivery schedule was pushed back by the intervening economic downturn. However, even if this first tranche of about 20 aircraft (delivered over three years starting in 2011) is not followed by further purchases, it still represents a significant proportion of sales[62] for the newly introduced Phenom 300. For BNDES, this was its first financing of sales to a fractional operator.[63]

Reportedly, structuring the Flight Options transaction was much more complex for BNDES than a typical aircraft purchase by a commercial airline, but the fact that Flight Options was making a fleet purchase made it worthwhile. Some analysts suggest that BNDES is unlikely to undertake export financing for business jets in the future unless it involves selling multiple jets to a large fleet operator, such as Flight Options or NetJets, because of the time and cost involved in structuring such a transaction. At this time, no BNDES export financing has been arranged for the recently announced NetJets' order for 50 Phenom jets (with options for an additional 75 aircraft), but this could be done closer to the time of delivery.[64]

France's Compagnie Française d'Assurance pour le Commerce Extérieur (COFACE) and the U.K.'s ECGD

Unlike the U.S. Ex-Im Bank, the European ECAs such as COFACE in France and ECGD in the United Kingdom generally supplied no financing for business jet sales during the recent economic downturn. The ECGD counter-guarantee, previously mentioned in connection with Ex-Im Bank's assistance to HBC, is the only example of a European ECA transaction for light or medium business jet sales in recent years. A likely explanation for these ECAs' different response is that the major European OEM, Dassault, produces in the medium and heavy business jet segments, where financing is not as important for sales. Dassault has regularly tapped export credit financing from COFACE for its military aircraft exports, but not for its business jet sales.[65] The ECGD is in a position to support both HBC and Bombardier products because of the significant UK domestic content in certain of their aircraft. However, the ECGD has not been particularly active in the business jet market, presumably because these OEMs can also approach the U.S. Ex-Im Bank or EDC, where the OEMs have strong working relationships and the ECAs are more familiar with this industry.[66]

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[62] In 2010, 26 Phenom 300s were delivered globally.

[63] *Corporate Jet Investor*, "Deal Analysis: BNDES Provides $167 Million," July 22, 2011.

[64] *Corporate Jet Investor*, "Deal Analysis: BNDES Provides $167 Million," July 22, 2011; *Aviation International News*, "Flight Options Secures $167M in Financing," July 14, 2011; *Corporate Jet Investor*, "Data: Helicopter and Business Jet Export Credit," July 19, 2011; Embraer, *Annual Report 2010* (accessed October 26, 2011), 10.

[65] Alasdair Whyte, editor, *Corporate Jet Investor*, telephone interview by USITC staff, August 17, 2011; *Corporate Jet Investor*, "Data: Helicopter and Business Jet Export Credit," July 19, 2011.

[66] Dassault is the only OEM whose business jets do not have enough U.S. domestic content to qualify for Ex-Im Bank assistance. All the other major OEMs have the option to access Ex-Im Bank assistance, subject to Ex-Im Bank's domestic content rules. Alasdair Whyte, editor, *Corporate Jet Investor*, telephone interview by USITC staff, August 17, 2011; *Corporate Jet Investor*, "Data: Helicopter and Business Jet Export Credit," July 19, 2011.

Financing by ECAs in Domestic Markets

In countries where there is a national development bank coordinating industrial policy spending, the state might assume a role in providing aircraft sales financing in the home market. This does not occur in the United States because Ex-Im Bank's activities are restricted to export sales finance. As the United States is the largest national market for business jet sales, aircraft that are both made and sold in the United States represent a large percentage of global business jet deliveries and are not able to draw on ECA financing. However, the United States has a well-established, deep banking market with a wide range of financing sources, making it unlikely that U.S. business jet OEMs' sales in the domestic market are hindered by a lack of credit alone.

In Canada and Brazil, however, the national ECA also has authority to extend sales financing to domestic sales. In 2010, EDC financed the sale of 15 aircraft (all types) for domestic delivery in Canada, worth a combined total of $300 million, which was significantly less than its total financing for aircraft exports during the period (81 aircraft worth $1.6 billion). Most of the aircraft financed are likely to have been Bombardier commercial jets, however, rather than business jets. In any case, EDC has declared explicitly that it does all financing on ASU terms, even in Canada, so as to avoid concerns about unfair subsidies to domestic industries.[67] [68]

BNDES also arranges customer financing for sales of aircraft in the domestic Brazilian market. In 2010, BNDES and its export credit affiliate, Seguradora Brasileira de Crédito à Exportação (SBCE), provided financing for 55 aircraft sold in the Brazilian market, totaling $2.2 billion.[69] Again, the majority of these transactions are likely to have been for Embraer's regional jet sales; for example, BNDES financed the sale of six Embraer 195s to Brazilian regional carrier Azul in 2010.[70] However, Embraer noted that demand for light jets in Brazil in 2010 was accelerated by the availability of new government financing alternatives,[71] and BNDES indicated that it has assisted the sale of approximately 25 Phenom 100s and 300s in its domestic market over the past two years.[72] Access to ECA financing was likely helpful in the difficult market environments seen in 2009–10 when Embraer first delivered Phenom jets, especially if government-assisted financing were priced favorably, as has been suggested by other industry participants.[73] The terms of BNDES' domestic sales financings are not available because they are not formally covered by the multilateral ASU agreement and thus are not publicly reported. However, Embraer suggests that Brazilian customers receiving financing from BNDES are likely to have paid interest rates similar to or higher than rates typically charged by

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[67] Ex-Im Bank, *Report to the U.S. Congress*, June 2011, 33; Siegel, "EDC and Canadian Aerospace: Working Together," October 14, 2009; banking industry representatives, interview with USITC staff, Washington DC, August 2011.

[68] The ECAs in the United States and European Union have followed the unwritten "home market rule" whereby an ECA of one country will not step in to provide financing of its domestic OEM's sales in a foreign market where other ECAs cannot finance competing aircraft. For example, Ex-Im Bank would not finance Boeing sales to EU airlines and COFACE would not finance Airbus sales to U.S. airlines. However, as Canada does not recognize the home market rule, the U.S. and European ECAs will have the opportunity to match EDC's funding when Bombardier aircraft are competing against Boeing or Airbus. *Airfinance Journal*, "The New ASU: What to Expect," February 1, 2011; *Airfinance Journal*, "Ex-Im Bank's Expanding Role," September 10, 2009.

[69] Ex-Im Bank, *Report to the U.S. Congress*, June 2011, 33.

[70] Alasdair Whyte, editor, *Corporate Jet Investor*, telephone interview by USITC staff, August 17, 2011; *Airfinance Journal*, "Azul Gets $224m Financing for Embraer Jets," September 22, 2010.

[71] Embraer, *Annual Report 2010*, 10 (accessed October 26, 2011).

[72] Brazilian government officials, interview with USITC staff, São Paolo, Brazil, September 2011.

[73] USITC hearing transcript, September 28, 2011, 48–60 (testimony of Robert Morin, Ex-Im Bank).

Ex-Im Bank on their financing of U.S. exports to Brazil.[74] BNDES has declared its intention to arrange any future domestic market aircraft financings on ASU terms; although it has not confirmed that this was the case for past transactions.[75]

The Future Role of ECAs in the Business Jet Industry

Having gained some experience with business jet industry OEMs and customers, ECAs are likely to play an increasing role in providing sales finance to the industry in coming years. Innovative solutions to the problems of credit assessment and asset valuation, such as Ex-Im Bank's $500 million facility for Textron, appear to have significantly supported U.S. business jet export sales during the economic downturn, helping Cessna make sales in emerging markets where business jet demand was growing. As sales move increasingly to emerging markets from the mature markets in North America and Europe, a greater share of sales will likely be exports qualifying for ECA assistance. In particular, Ex-Im Bank's emerging-markets expertise will be helpful to U.S. OEMs, as many of the banks they use in the U.S. market are often smaller, regional banks with less experience in emerging-markets transactions than Ex-Im Bank or global private sector lenders such as Bank of America or Citibank.[76]

In addition to the industry trend towards emerging markets, where ECAs are well placed to provide assistance, it is also likely that customer financing from the government-sponsored ECAs will be sought because private sector lending is restricted or unavailable. Credit conditions are likely to improve along with the global economic recovery, but more stringent banking regulations, such as the impending Basel III framework with its tighter capital requirements and risk limits for banks, will remain in place going forward.[77] Given the moves towards a stricter regulatory environment in many countries, banks' appetite for risk is likely to remain somewhat constrained. ECAs are therefore likely to play an important role in providing export sales finance to the business jet industry, filling in gaps in the provision of credit left by the private sector.[78]

Corporate Funding of Operations

OEM Funding Requirements for Aircraft Development Programs and Service Capacity Investment

To remain competitive, OEMs require significant investment capital at various times to fund aircraft development. OEMs note that both incremental and clean sheet product development are necessary to ensure a product offering that preserves or increases sales and/or market share. The sums of money involved are large, both in absolute terms and relative to the size of the company. As previously described, to design, develop, certify, and bring to market a new business jet costs an estimated $500 million to $1 billion,

[74] Embraer, posthearing submission to USITC, October 5, 2011, 23.

[75] Ex-Im Bank, *Report to the U.S. Congress*, June 2011, 1; Brazilian government officials, interview with USITC staff, São Paolo, Brazil, September 2011.

[76] Alasdair Whyte, editor, *Corporate Jet Investor*, telephone interview by USITC staff, August 17, 2011.

[77] In the wake of the global financial crisis of 2007–09, all major countries are placing tighter regulations on banks. The effort was spearheaded by the G-20 agreement and the approval of the Basel Committee at the multilateral Bank for International Settlements of a new set of regulations on bank capital and liquidity, the so-called "Basel III" regulations. *Airfinance Journal*, "Feature: The Black Box That Is Basel III," June 6, 2011.

[78] EDC, "Corporate Plan 2011–2015," 7.

typically over a period of five to seven years, depending on the complexity of the technology being introduced. A major upgrade (a derivative or block point change) to extend the market life of an existing aircraft model is generally less expensive, ranging between $200 million and $400 million, with a shorter timeline of normally about three to five years, but this also represents a significant commitment of corporate resources. As mentioned earlier, to re-engineer an engine alone is an investment of $200–$300 million.[79] In order to stay in business, OEMS thus have to make large strategic investments on a continuing basis even though demand may be highly cyclical and, in some periods, elusive.[80]

At the same time, business jet OEMs highlight the need to invest in service capacity to retain their customers over the long term. Tough competitive conditions in mature markets and increased demand in emerging markets in recent years have led OEMs to build up their local service networks and increase their investment in repair and maintenance facilities around the world.[81]

Securing adequate financing for operations is thus a significant issue for business jet OEMs, and each of these companies has developed extensive expertise and relationships with the financial community and government agencies to obtain corporate funding at the lowest possible cost. In general, when a company raises capital from shareholders or bondholders, this would represent general funding for the parent, and would not be earmarked for specific subsidiaries or operational areas. However, government assistance (discussed below) is sometimes targeted at specific business activities to achieve a desired public policy goal. For example, governments may aim to support economic growth by retaining a technology advantage or maintaining a given number of skilled jobs in a locality. In such a case, government support may be provided specifically for basic R&D or for tooling and equipment investment in a specific facility.[82]

Sources of Funding

Companies typically turn first to their own internally generated cash resources, essentially retained earnings, when funding product development, but also rely on their ability to raise capital from their lenders or their shareholders.[83] Risk-sharing agreements with key suppliers are another source of funding for product development. In addition, all the aircraft manufacturing companies access government funding to some degree,

[79] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interviews by USITC staff, Bordeaux, France, October 2011; industry representatives, interviews by USITC staff, Montreal, Canada, September 2011; USITC hearing transcript, September 28, 2011, 154 (testimony of Robert Blouin, HBC); industry representatives, telephone interview with USITC staff, November 9, 2011.

[80] Simpson, "Flying People, Not Planes," March 2011.

[81] Embraer, *2010 Annual Report* (accessed February 3, 2012); Bombardier, *2010 Annual Report* (accessed February 3, 2012); HBC, 2010 Form 20-F(accessed February 3, 2012); Textron Inc., *2010 Annual Report* (accessed February 3, 2012).

[82] Government officials in the United States, Canada, France, and Brazil, interviews by USITC staff, July–October 2011.

[83] Bombardier, *2010 Annual Report*, 151 (accessed February 3, 2012); Guenther, "Section 179 and Bonus Depreciation Spending Allowances," CRS Report RL31852, January 19, 2012, 11.

whether in the form of grants for R&D and economic development or in the form of tax incentives for capital investment and maintaining jobs in a locality.[84]

Debt

As noted earlier, the business jet OEMs are all subsidiaries of larger corporate groups, and their ability to borrow in the public capital markets for investment funding depends on the parent company's overall cost of capital and credit rating, as well as whether there are competing investments being made elsewhere in the group. Credit ratings give potential bond investors information about the creditworthiness of a borrower and therefore give an indication of the risk of investing in a particular company.[85] Except for Dassault's parent, Groupe Industriel Marcel Dassault (GIMD), which is unrated, most of the business jet OEMs' parent companies currently have credit ratings close to BBB on the Standard & Poor's scale or Baa on the Moody's scale (table 6.3). These companies are seen to have moderate credit risk arising from their business mix and financial condition, implying that they are able to access public debt markets to fund major investment programs. Of the six business jet OEMs, General Dynamics Corporation, Gulfstream's parent, has the strongest credit rating (A by Standard & Poor's or A2 by Moody's) because of the company's large presence in defense markets where governments are the main customers.[86] HBC's credit rating is non-investment grade (CCC by Standard & Poor's or Caa3 by Moody's), which implies that it would have difficulty raising funds in the public capital markets, but as a privately held company it does not regularly access these sources of funding in any case. The ratings agencies perceive higher credit risk for the HBC group because it is highly leveraged and because it is focused solely on its aerospace and related service operations, and therefore is especially exposed to the volatile swings in business jet demand.[87]

As the credit ratings show, the degree of leverage is a key indicator of a company's borrowing capacity.[88] Credit agencies note that since HBC's operations are effectively

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[84] Embraer, 2010 Form 20-F, F-23 and F-43 (accessed February 3, 2012); Bombardier, *2010–11 Annual Report*, 146 (accessed February 3, 2012); HBC, 2010 Form 10-K, 19 (accessed February 3, 2012); Textron Inc., *2010 Annual Report*, 77 (accessed February 3, 2012); Dassault Aviation, *2010 Annual Report*, 74 (accessed February 3, 2012); industry representatives, interviews by USITC staff, Wichita, KS, July 2011; industry representatives, interviews by USITC staff, Bordeaux, France, October 2011; industry representatives, interviews by USITC staff, Montreal, Canada, September 2011;

[85] Standard & Poor's, "How to Analyze an Aerospace & Defense Company" (accessed December 9, 2011).

[86] Tortoriello, "Aerospace and Defense Industry Survey," Standard & Poor's, July 28, 2011.

[87] Dassault Aviation is jointly owned by the Dassault family company Groupe Industriel Marcel Dassault (GIMD) (51 percent) and the European Aeronautic Defence and Space Company (EADS), the holding company for Airbus and other European aerospace businesses (46 percent). Dassault Aviation and GIMD do not have public credit ratings from either S&P or Moody's. Credit ratings are sought by companies borrowing in the public capital markets, and as both GIMD and Dassault Aviation have not sought funding through this route, they have not needed to obtain ratings. EADS, whose shares are publicly traded, has sought credit ratings from Standard & Poor's (A-, as of September 22, 2010) and Moody's (A1, as of March 9, 2007). Standard & Poor's, "Issuer Rankings: Global Aerospace and Defense Companies," November 1, 2011; Moody's Investors Service, individual company ratings; EADS, "Credit Ratings," n.d., http://www.eads.com/eads/int/en/investor-relations/Debt-and-access-to-funding/credit-ratings.html (accessed April 11, 2012).

[88] As Standard & Poor's explain, "A high debt-to-equity ratio would indicate that a company is highly leveraged and thus generally more vulnerable to economic downturns, when interest and debt payments might take up a significant portion of income." Standard & Poor's, "How to Analyze an Aerospace & Defense Company" (accessed December 9, 2011).

TABLE 6.3 Credit ratings of parent companies of business jet OEMs, year-end 2011

Issuer company	Moody's Long-Term Debt Rating	Standard & Poor's Corporate Credit Rating	Standard & Poor's Business Risk	Standard & Poor's Financial Risk
Bombardier Inc.	Ba2	BB+/Stable/–	Satisfactory	Significant
Groupe Industriel Marcel Dassault	Unrated	Unrated	Unrated	Unrated
Embraer S.A.	Baa3	BBB–/Stable/–	Satisfactory	Intermediate
General Dynamics Corporation	A2	A/Stable/A–1	Strong	Modest
Hawker Beechcraft Inc.	Caa3	CCC/Negative/–	Weak	Highly leveraged
Textron Inc.	Baa3	BBB–/Stable/A–3	Satisfactory	Intermediate

Sources: Standard & Poor's, "Issuer Rankings: Global Aerospace and Defense Companies," November 1, 2011, and individual company debt ratings (accessed February 3, 2012); Harrison, "HBC Credit Downgraded," January 4, 2012; Moody's Investor Service, individual company debt ratings (accessed February 3, 2012).

100 percent debt-financed, the company has little ability to borrow additional funding should it be required. The company explains that its ability to service and refinance its existing debt and to fund planned capital expenditures in the coming periods will depend on its ability to generate cash from the business, which in turn will depend on an upturn in the economy as well as many other financial, competitive, legislative, and regulatory factors.[89] The other OEMs' parent companies are less leveraged, in line with their credit ratings. In 2010, Bombardier's ratio of long-term debt to capital (i.e., long-term debt divided by the sum of long-term debt, common stock, and preferred stock) was 51.6 percent,[90] while Textron's ratio was somewhat higher at 63.9 percent, notwithstanding significant debt reduction efforts during 2009 and 2010.[91] General Dynamics, Gulfstream's parent, is the least leveraged of the publicly held parent companies considered, with a debt-to-capital ratio of only 15.2 percent in 2010. Data for GIMD, Dassault's parent, were not available. However, Dassault recorded a debt-to-capital ratio of only 6 percent in 2010, as the company is funded mostly with equity rather than long-term debt.[92] Embraer, with a debt-to-capital ratio of 36.1 percent in 2010, is less leveraged than any of its North American counterparts except for General Dynamics.[93]

Equity

The world's six business jet companies have a variety of corporate ownership structures. The type of ownership for a corporate group—whether it is publicly or privately owned, or whether there is family or government ownership—is likely to be relevant to an evaluation of a company's financial stability.[94] Calls for additional capital from shareholders may be necessary during periods of deep downturn in demand (as seen in 2009), when earnings are under pressure and the availability of bank credit is limited.

[89] Hawker Beechcraft Acquisition Company, LLC, Form 10-K for fiscal year ended December 31, 2010, 33 (accessed November 2, 2011).

[90] At FY year-end January 31, 2011. Bombardier Inc. *2010–11 Annual Report*, 57, 59, and 166; Standard & Poor's, "Balance Sheet Ratios: Aerospace and Defense" (accessed December 9, 2011).

[91] Standard & Poor's, "Balance Sheet Ratios: Aerospace and Defense" (accessed December 9, 2011).

[92] Dassault, *2010 Annual Report*, 73.

[93] Standard & Poor's, "Balance Sheet Ratios: Aerospace and Defense" (accessed December 9, 2011); Embraer, *2010 Annual Report*, 13.

[94] Standard & Poor's, "How to Analyze an Aerospace & Defense Company" (accessed December 9, 2011).

This will be the case especially if the company is in the midst of a multiyear aircraft development program. Given factors such as complex labor contracts and supplier commitments, and the long lead times required for product development, it is often impractical to stop an aircraft development program midway and then restart once demand recovers.[95]

Shareholders with a long-term investment view may be less willing than typical stock market investors to reduce their investment during the lean times and might even be willing to make additional investments when other sources of funding are unavailable. Parent companies that are privately owned, or in which there is a significant family ownership stake, are likely to experience less turnover in share ownership than public companies that are fully exposed to short-term variations in stock prices and investor confidence.

Two of the six major OEMs have significant family stakeholders. Dassault Aviation is 51 percent owned and controlled by GIMD, a privately held conglomerate owned by the Dassault family.[96] The Bombardier family is the controlling shareholder of the Bombardier group, with more than 50 percent of shareholder voting rights.[97] Bombardier company executives noted that the family shareholding represents an important source of continuity for the company.[98]

HBC was taken private in 2007 by two private equity investors, Canada-based Onex Partners and U.S.-based Goldman Sachs & Co., which bought the company from Raytheon. They each own approximately 49 percent of the company and have demonstrated a long-term commitment to the business, retaining their stakes over a very difficult market period when a series of losses pushed shareholders' equity into negative territory.[99]

Governments are also long-term investors in some business jet OEMs, namely Embraer and Dassault. Since its privatization in 1994, Embraer has been a publicly traded private-sector company, although initially its ownership was concentrated among only five shareholders, including the Brazilian government. Embraer's 2006 capital restructuring exercise went some way towards broadening the group's shareholder base and enabling better access to capital markets for funding. However, the Brazilian government remains an important shareholder by virtue of its "golden share," as well as an indirect 5.5 percent ownership stake through BNDESPAR (a BNDES subsidiary). The golden share preserves the right of the government to veto changes in name and ownership and any measures affecting military programs, thereby enabling the government to enforce the 40 percent foreign ownership maximum limit imposed at privatization. Also, the Brazilian government has a permanent seat on Embraer's 11-member board of directors.[100]

As previously noted, Dassault Aviation is partially government-owned, albeit indirectly, through the 46 percent share of the company that is owned by EADS.[101] Direct and

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[95] Industry representatives, interview by USITC staff, Wichita, KS, July 2011.

[96] Dassault Aviation, *2010 Annual Report*, 37; Dassault Aviation company Web site, "Profile," http://www.dassault-aviation.com/en/aviation/group/presentation/profile.html?L=1 (accessed July 6, 2011).

[97] Bombardier, *2010 Annual Report*, 192 (accessed February 7, 2012).

[98] Industry representatives, interview by USITC staff, Montreal, Canada, September 2011.

[99] Hawker Beechcraft Acquisition Company, LLC, Form 10-K for fiscal year ended December 31, 2010, 10, 22 and 78–79.

[100] Embraer, Form 20-F 2010, April 19, 2011, Note 15, and *2010 Annual Report*, 7 (accessed February 3, 2012); IFC and OECD, "Case Studies of Good Corporate Governance Practices," 30–34.

[101] Dassault, *2010 Annual Report*, 37 (accessed February 7, 2012).

indirect government shareholdings in EADS total 20 to 30 percent, including stakes held by the French state, the Spanish state, and other European public sector entities.[102] EADS itself is no longer governed by a public-private consortium and is a publicly traded company. However, its government shareholders have declared their long-term commitment to EADS and its subsidiary businesses, and, by extension, EADS' significant investments, such as Dassault. Indeed, the level of government ownership in EADS is scheduled to increase in 2012, as Daimler AG transfers some of its shareholding to the German state development bank. Investment from public sector entities assists companies' creditworthiness and lowers their cost of funding because investment in the companies is then perceived as government-backed credit.[103]

In contrast, Textron and General Dynamics, owners of Cessna and Gulfstream, respectively, are both large public companies, whose shares are owned by a wide range of institutional investors and the public. As such, they are able to raise capital in the public share markets, if necessary, to tap a very deep potential investor base. Nearly 50 percent of Textron's shares are owned by its 10 largest institutional investors, but no one investor owns more than 10 percent.[104]

Risk Sharing

Risk-sharing partnerships are another avenue for OEMs to obtain funding. As previously noted, some of the burden for funding R&D, product development and testing, and parts certification of a business jet is often shifted onto major suppliers through risk-sharing partnerships. In these arrangements, the supplier will often assume responsibility and associated cost for R&D, product engineering, tooling, and part certification with respect to a specific component or system, in exchange for exclusive supply rights. Thus they share the sales volume risk with the OEMs. In addition, suppliers may agree to make financial contributions to the OEM's aircraft development program to enhance the likelihood of the aircraft's successful introduction to market.[105] Such contributions from suppliers are accounted for as "intangible assets" by the OEMs, as they reduce the costs incurred in developing new aircraft.[106]

National Government Assistance and Other Forms of Public Funding

In the United States, Canada, France, and Brazil, OEMs have also tapped into economic development assistance funding from state, local, and national government sources, where available. Government assistance is usually targeted at one or all of the following areas: infrastructure development, R&D, workforce training, and maintaining jobs in the locality. In the United States, economic development assistance is largely at the state and

[102] EADS 2010 Registration Document, 52 and 114–115 (accessed February 7, 2012).

[103] It has recently been announced that the German government, through its state-owned development bank, KfW, will purchase a 7.5 percent stake in EADS in 2012 from Daimler AG to secure the German share in the management of the company. Of note, Dassault Aviation has made a small (0.9 percent) but strategic investment in Embraer. *Airfinance Journal*, "Germany to Buy Stake in EADS," November 11, 2011; Dassault Aviation, *2010 Annual Report*, 37 and 43 (accessed January 6, 2012).

[104] Data from June 30, 2011 to September 30, 2011, downloaded from *Financial Times* Web site (accessed November 8, 2011).

[105] USITC, hearing transcript, September 28, 2011, 193 (testimony of Robert Wilson, Honeywell Aerospace).

[106] Embraer, *2010 Annual Report*, 7 (accessed January 6, 2012).

local level. In Canada, France, and Brazil, such assistance is available from both national and regional government agencies.[107]

Business jet OEMS can also avail themselves of certain business tax expenditures in the corporate tax code of each country, state, or region, such as the R&D tax credit, accelerated depreciation of equipment investment (box 6.1), or certain exemptions from sales or income tax liability. These measures aim to encourage private-sector R&D and investment across the economy and are not sector specific. The benefits received by individual companies vary widely, depending on the local tax law, but can be significant.[108]

BOX 6.1 Accelerated depreciation for U.S. income tax purposes

Customers, when considering an aircraft purchase, consider the initial investment, the operational costs (including any flight taxes and fees), and the positive tax effect available from accelerated depreciation of their capital investment. Industry participants emphasize the importance of the U.S.'s tax depreciation rules in the purchase calculation.[a] If the aircraft are owned and operated by businesses, they are eligible under long-standing federal tax law to be depreciated over five years for income tax purposes, as set out in the schedules of the Modified Accelerated Cost Recovery System (MACRS). (Commercial aircraft, by contrast, may be depreciated over seven years under MACRS.) Under certain circumstances, business aircraft do not qualify for MACRS treatment and must be depreciated according to the less generous Alternative Depreciation System (ADS). Under ADS, depreciation must be straight-line rather than weighted towards earlier years, and the depreciation recovery period may be longer, generally six years for a business aircraft.[b] In either case, the depreciation expense recorded for income tax purposes is taken over a significantly shorter period than the useful life of the aircraft, and this tax rule therefore provides an incentive to invest.

In response to the depth of the economic downturn, Congress passed the Tax Relief, Unemployment Insurance Reauthorization and Job Creation Act of 2010, in part, to help the struggling SME sector. Provisions of this act allowed "bonus" depreciation on strategic purchases, including new business aircraft, of 100 percent in the first year of ownership for purchases made between September 8, 2010 and December 31, 2011, and of 50 percent for purchases made during 2012. "Bonus" depreciation thus allows business taxpayers to expense the cost of the aircraft investment up front, bringing forward the tax benefits that would normally be spread out over a longer recovery period. The bonus depreciation measures were seen as helpful by the U.S. business jet industry because they encouraged buyers to return to the market.[c]

However, the benefits of accelerated depreciation, whether MACRS or "bonus," may be removed in future tax law changes. In September 2011, President Obama issued his "Plan for Economic Growth and Deficit Reduction," including a reversal on accelerated depreciation for tax purposes of business aircraft. One of the measures proposed is the elimination of the five-year recovery period for business aircraft, extending it to seven years in line with the treatment of commercial aircraft investments for tax years after December 31, 2012. These government tax policy proposals are targeted at raising government tax revenue and increasing the specificity and accountability of tax measures, rather than encouraging investment spending and domestic demand.[d] Business jet industry participants are concerned that sales might suffer if these measures are implemented, as many customers use the depreciation recovery period as a basis for deciding to upgrade their aircraft.[e]

[a] Garvey and George, "Cessna Ups Its Game," October 17, 2011, 37.
[b] NBAA, "Depreciation" (accessed December 16, 2011).
[c] Spruce, "US House of Representatives Pass HR4853," December 19, 2010.; *Corporate Jet Investor*, "US to Offer Bonus Depreciation on Jets," September 23, 2010.
[d] OMB, "Living within Our Means," September 2011, 48.
[e] Bunce, written submission to the USITC, September 9, 2011, 8–9; NBAA, presentation to USITC staff, Washington, DC, July 15, 2011; Labrozzi, "Leasing Viewed as an Attractive Alternative to Cash," *SpeedNews* (accessed January 4, 2012).

[107] Government officials in the United States, Canada, France, and Brazil, interviews with USITC staff, July–October 2011.
[108] Deloitte, "Global Survey of R&D Tax Incentives," October 11, 2011, 1–35.

U.S. Federal Government Support

For the most part, government assistance to U.S. business jet manufacturers comes from entities at the state and local level, rather than from the federal government. At the federal level, some assistance is provided by the Ex-Im Bank with respect to export sales financing, but this does not constitute development finance.[109] A small amount of FAA and NASA spending is directed at collaborative R&D projects working with industry, but these agencies are not the primary source of funding for R&D for U.S. business jet OEMs.[110]

State and Local Government Support

State and municipal governments work hard to support aerospace companies that are major employers in their local area and compete for major project investments that will bring new, high-wage manufacturing jobs there. Every state has a range of tax and spending programs to assist industry, some targeting specific sectors and some more broadly focused.[111] While the economic contribution per capita of the business jet industry is significant in almost every U.S. state, it is largest by far in Kansas and Georgia, where the U.S. OEMs are based.[112] Kansas and Georgia, as well as many other states, target aviation as an industry sector deserving of support.

Kansas: Cessna, HBC, and Learjet

The three OEMs located in Wichita, Kansas have all received assistance from the State of Kansas, Sedgwick County, and the City of Wichita. Wichita State University's Center for Economic Development and Business Research (CEDBR) has calculated that aerospace jobs have a high multiplier in the local economy, with an increase or decrease of one aviation job leading to four jobs being created or lost in the local area.[113] The State of Kansas is the primary source of government assistance, while the local government entities have typically focused on funding for education and worker training.[114]

In late 2010, the State of Kansas, along with Sedgwick County and the City of Wichita, agreed to give HBC a $45 million assistance package that requires HBC to retain its headquarters in Wichita and to keep at least 4,000 jobs in the area for the next 10 years. The state's incentive package is part of two programs—Investments in Major Projects and Comprehensive Training Skills (IMPACT) and State of Kansas Investments in Lifelong Learning (SKILL)—which are financed through tax-exempt, public-purpose bonds issued by the Kansas Development Finance Authority that are retired through revenue received from statewide employer withholding taxes. About $10 million of the total is for worker training and tuition reimbursement and will be paid to HBC over a three-year period, while the remaining $30 million portion of the state package will be paid in stages ($10 million in the first year and $5 million in each year for the next four years) to fund product development, capital investment, and other operational costs. Sedgwick County and the City of Wichita also contributed to the package, each lending

[109] USITC, hearing transcript, September 28, 2011 (testimony of Robert Morin, Ex-Im Bank).

[110] For a more detailed discussion of R&D funded by NASA and the FAA, see chapter 5, "Technological and Business Innovation in Business Aviation."

[111] *Site Selection Magazine*, "State Incentive Programs," November 2010, 798–803.

[112] GAMA, *2011 General Aviation Statistical Databook & Industry Outlook*, n.d. (accessed February 23, 2012).

[113] Academic and economic development representatives, interviews with USITC staff, Wichita, KS, July 2011.

[114] Behlmann, "What's the Return on Investment? It's Complicated," June 28, 2011.

HBC $2.5 million in forgivable loans, spread over a five-year period. During 2011, HBC announced additional layoffs as demand for business jets remained weak. The company confirmed at the time, however, that its staffing levels were not at risk of breaching the agreement's minimum employment requirement.[115]

Kansas companies in specific sectors, including aerospace, that make major project investments can also receive up to $33 million in funding through the major projects program authorized by the Economic Revitalization and Reinvestment Act of 2000 (ERRA). In 2008, Cessna negotiated an ERRA package for its Columbus large business jet development program, but this was not disbursed, as the Columbus program was cancelled by the company due to the sharp downturn in business jet demand in that year. In July 2010, Learjet and the State of Kansas negotiated a similar package, also through the state's major aerospace projects program, for the company's $600 million Learjet 85 investment project. Learjet received $27 million in bond financing from the state over the multiyear project period, funded by state withholding taxes paid by new and existing Learjet employees. The company estimates that approximately 600 jobs are linked to this project in Wichita.[116] More recently, Learjet has announced that it intends to make an additional $52.7 million investment to expand its Wichita facilities, creating 450 new jobs. Reportedly, the State of Kansas is likely to contribute between $16 and $18 million in bond financing for this project. [117]

In addition to these one-off support packages for major investment projects, business jet OEMs, like other companies operating in Kansas, can benefit from sales tax exemptions (both state and county) for machinery and equipment, raw materials, and other production inputs. Companies can also take advantage of property tax exemptions for investments in land, buildings, machinery and equipment, and business inventories. The percentage of taxes abated is based on the amount of capital investment and the new full-time jobs created.[118] For example, after Learjet announced its latest expansion in late 2011, the company sought a 10-year property tax abatement from Sedgwick County and the City of Wichita, on the grounds that the expansion would add an anticipated 450 new jobs over seven years.[119]

Florida: Embraer

In an arrangement similar to the incentive packages offered in Kansas, Florida and Brevard County recently agreed on an incentive package for Embraer to locate its Phenom jet facility in Melbourne, Florida. Embraer's production facility will be used for the assembling, painting, flight-testing, and interior furnishing of the Phenom 100 and Phenom 300 business jets. Embraer's $50 million investment will be partially funded by the $12.5 million assistance package, including $8.5 million from various state programs,

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[115] Government officials, telephone interview with USITC staff, September 2011; Hawker Beechcraft Acquisition Company, LLC, Form 10-K for fiscal year ended December 31, 2010, 26 (accessed November 2, 2011); Greater Wichita Economic Development Coalition, "Hawker Beechcraft Announces Plans to Stay in Wichita" (accessed July 15, 2011); McMillin and Wilson, "Hawker Beechcraft Lays Off Total 300," November 11, 2011. The agreement stipulates penalties if HBC's staffing levels in Wichita fall below 3,600, or 10 percent below the stated minimum staffing guideline.

[116] Government officials, telephone interview with USITC staff, September 2011; Greater Wichita Economic Development Coalition, "Bombardier Learjet 85 Expanding in Wichita" (accessed July 15, 2011).

[117] McMillin, "Bombardier Learjet Cleared to Use Last $6 Million of 1994 Bond Money," December 14, 2011; *Wichita Business Journal*, "Bombardier Plans Expansion in Wichita," November 14, 2011.

[118] Government officials, telephone interview with USITC staff, September 2011; government officials, interview by USITC staff, Wichita, KS, July 2011; Greater Wichita Economic Development Coalition, "Economic Development Tax Exemption," March 24, 2011.

[119] *Wichita Business Journal*, "Bombardier Plans Expansion in Wichita," November 14, 2011.

a $1.8 million cash grant from Brevard County, $1.2 million from Melbourne, and smaller amounts from the Melbourne Airport Authority and the Brevard Workforce Development Board. The manufacturing facility is expected to create 200 new jobs directly (and many more indirectly), at a time when the local, highly skilled workforce is underemployed following NASA's downsizing of its area operations.[120]

Georgia: Gulfstream

Although most of Gulfstream's operations in Georgia develop and produce larger business jets beyond the scope of this study, significant state support for the Savannah operations is likely to be helpful to the company more generally, as it would lower the cost of these large aircraft investments and free up funds for other purposes.[121] Gulfstream announced a $300 million plant expansion in 2006, adding 1,100 jobs to its Savannah operations by the time it was completed in 2009. In late 2010, the company announced that it would spend $500 million on a second phase of plant expansion in Savannah, adding another 1,000 jobs to its area total. The State of Georgia is assisting Gulfstream in its latest expansion with a $34 million incentive package, including tax credits and benefits, while the company commits to job training. It was also announced last year that being a major employer in Georgia qualified Gulfstream to receive $7 million in rural development funding through a state program that aims to re-employ workers from the tobacco industry.[122]

Foreign Government Support

Outside the United States, national governments often have programs to provide industry sectors such as aerospace and individual companies with financial support.

Canada: Bombardier

In Canada, various government agencies at both the national and provincial levels target funds towards specific strategic industries which are seen as contributing to economic development and prosperity. Most of this assistance aims to encourage R&D spending and technological development to maintain or increase the number of high-value-added jobs in Canada.

Bombardier has made significant investments in both regional jet and business jet development. The company estimates that, since its move into aerospace in the 1980s, it has invested $5 billion cumulatively in aerospace tooling, with additional amounts invested in product development and capital assets. In connection with its commercial aircraft programs, the company has received advances amounting to $712 million cumulatively, as of January 31, 2011, from the Canadian federal government and from Canadian provincial governments. Typically, these advances are contingently repayable, usually over 10 years, once the aircraft program has surpassed a minimum agreed-upon number of deliveries. While none of these funds were specifically targeted at the group's

[120] USITC hearing transcript, September 28, 2011, 9-11 (testimony of Jennifer Carroll, Lieutenant Governor of Florida); 7; Representative Bill Posey, written submission to the USITC, September 26, 2011; Lyne, "Embraer Jets into Florida with First U.S. Plant," June 2, 2008.

[121] As noted in chapter 3, "Global Industry," Gulfstream's business jets that are included in the scope of this study are manufactured in Israel by Israel Aerospace Industries and finished in the United States.

[122] Industry representative, telephone interview with USITC staff, November 2011; State of Georgia, "Gulfstream Aerospace Expansion to Fund 1,000 jobs," November 15, 2010; Ratnam, "Gulfstream Will Add 1,000 Jobs," November 15, 2010; Montoya, "Savannah Nets Rural Development Funds," December 16, 2010.

small to medium business jet development programs, but rather focused on regional jet development, some of the funded R&D activity is likely to cross over to smaller aircraft programs. Efforts to develop composite technology, for instance, are significant for development of both the C-series regional jet and the Learjet 85.[123]

France: Dassault

In addition to the EU's "Clean Sky" programs for aeronautics R&D, the French government supports domestic aerospace companies' research activities and product development, including that of Dassault.[124] As indicated earlier, this support reportedly flows mainly to industry, including to firms focused on engines and avionics, and to national research institutions, particularly France's aerospace research agency, the Office National d'Etudes et Recherches Aérospatiales (ONERA). At the regional level, the French government supports certain industry clusters, such as the previously described "Aerospace Valley," to stimulate innovation and cooperation between private sector firms and public-sector research and educational institutions. According to one source, the scale of the funding is significant, with risk-sharing partners and government agencies at all levels (EU, France, and regional) providing funding for almost one-half of the French aerospace OEMs' R&D spending in 2010, a contribution equivalent to 6.5 percent of the sector's revenues.[125]

Brazil: Embraer

In Brazil, where there is a national development bank and a government budget for strategic industrial policy spending, the government is involved more directly in industry's business development. Brazil's development bank, BNDES, implements the government's industrial policy and is the main source of long-term financing in the Brazilian economy.[126]

As a former state-owned enterprise, Embraer has received support from the Brazilian government in a number of ways besides the export financing support by BNDES described earlier. In the years after its privatization in 1994, Embraer received direct loans from the Brazilian government, although the aid was phased out once the company was well established.[127] Currently, the Brazilian government gives Embraer financing assistance in two ways: (1) R&D grants and project development financing through the Financiadora de Estudos e Projetos (FINEP) and BNDES, the government's technology development institutions, and (2) more general short- and long-term financing through the government-sponsored Banco do Brasil. At the end of 2010, loans from FINEP to Embraer totaled $53.4 million, down from $67 million a year earlier. BNDES loans to Embraer totaled $347 million (down from $639 million a year earlier), of which $331 million related to pre-export sales financing and $16 million related to project development financing.[128]

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[123] Government officials, interview by USITC staff, Ottawa, Canada, September 2011; government officials, telephone interview with USITC staff, September 2011; Bombardier, *2010–11 Annual Report*, 146 (accessed January 6, 2012).

[124] Weber, Gellman, and Hamlin, "European Government Support," 2005, 22.

[125] GIFAS, *2010–-2011 Annual Report*, July 2011, 52.

[126] BNDES, "Management Report," December 31, 2010, 2.

[127] U.S. Department of State, "OECD Survey of Brazil's Economy (PARIS 181108Z)," October 6, 2006; De Ferranti, *From Natural Resources to the Knowledge Economy*, January 2002.

[128] Embraer, Form 20-F for the year ended December 31, 2010, April 19, 2011, F-43.

Embraer notes that the interest rate payable on its $331 million of Brazilian *real*-denominated pre-export sales financing loans from BNDES is a fixed rate of 4.5 percent,[129] well below Brazilian *real* market rates in recent years. It is likely that BNDES extended loans on improved terms equivalent to the U.S. dollar interest rates that would have been set by the OECD's ASU.[130] The interest rate charged by BNDES and FINEP on their project development loans to companies is referenced to the government's "TJLP" (Taxa de Juros du Longo Prazo) Brazilian *real* official long-term interest rate, plus or minus a percentage spread. The government has held the TJLP interest rate steady at 6 percent since June 2009.[131] The exact terms of all FINEP loans to Embraer are not available, but FINEP describes the types of loans generally available: "standard loans" at the official Brazilian *real* long-term interest rate plus a spread of 2 to 6 percent, and "interest equalization loans" where the interest rate charged is reduced by up to 100 percent of the long-term interest rate.[132] Overall, Embraer's TJLP-linked long-term debt totaled the equivalent of $69.1 million at the end of 2010, and the weighted-average interest cost on this debt during the year was 2.78 percent, implying that at least some of the loans take the "interest equalization" format.[133]

R&D Tax Credits

Tax credits and incentives for R&D are an important source of corporate funding for all major aerospace companies, as they reduce the after-tax cost of research and product development. Governments view tax incentives as justifiable because they encourage innovation, economic growth, and jobs.[134] These tax measures are available in the United States at the federal and state levels,[135] in Canada at the federal and provincial levels, and in France at the national level. The percentage of R&D expenditures which may be set against tax liability varies across countries; the basic allowed credit is 30 percent in France and 20 percent in Canada and the United States (above a base amount of incurred expenses). Brazil's corporate tax regime allows a "super deduction" for R&D expenditures equal to 160 percent of total R&D expenditures.[136] Among the four countries where business jet OEMs are based (the United States, Canada, France, and Brazil), only France has a research tax credit that is refundable to some extent for most companies. In the other countries, companies can benefit from the credit only to the extent that it offsets taxes on profits, either in the current year or in prior or future years using carry-backs and carry-forwards. The decline in taxable profits due to the economic downturn has limited use of these tax credits during the past three years.[137] In general, the tax benefits of R&D tax credits are available to all companies, as eligibility is not limited to given sectors or industries. However, the aerospace sector is ideally suited to take

[129] Embraer, Form 20-F for the year ended December 31, 2010, April 19, 2011, F-49. These loans provide pre-export financing to Embraer while awaiting payment for contracted delivery of aircraft to foreign customers, but it is not known to what extent, if any, sales of business jets are covered.

[130] Embraer, posthearing submission. October 5, 2011, 23.

[131] NASDAQ, "Brazil Holds TJLP Long-Term Interest Rate Unchanged," December 23, 2011. The TJLP is the rate on long-term bonds.

[132] Embraer, Form 20-F for the year ended December 31, 2010, April 19, 2011, 117; FINEP, "Research and Projects Financing," 2005.

[133] Embraer, Form 20-F for the year ended December 31, 2010, April 19, 2011, 117–19 and F-76.

[134] The U.S. research tax credit is due to expire at the end of 2011, and Congress is currently considering whether to extend this measure. The U.S. research tax credit has been extended 14 times since its enactment in 1981, with five significant modifications. Guenther, "Research Tax Credit," November 29, 2011, 1.

[135] *Site Selection*, "State Incentive Programs, Chart 2: Tax Incentives," November 2010, 800.

[136] Deloitte, "Global Survey of R&D Tax Incentives," October 11, 2011, 1–35.

[137] Hawker Beechcraft Acquisition Company, LLC, Form 10-K for Fiscal Year Ended December 31, 2010, 67 (accessed November 2, 2011).

advantage of such credits, as R&D costs are a significant part of product development expenses.[138]

Risk Management

Two types of risk that pose especially formidable challenges for business jet OEMs are cash flow volatility arising from operations, and the impact of fluctuations in exchange rates on both cash flows and the value of assets and liabilities. To manage these risks, companies use a number strategies, including diversifying their business lines and hedging their foreign exchange exposure.

Cash Flow Volatility

Business jet manufacturers face huge variations in cash flow during the life of each multiyear aircraft development program. In aerospace, cash flows are large and uneven because of the nature of the business, which is characterized by large payments out for investment and to suppliers, and large payments received later from each aircraft sale. At the same time, the biggest risk for any OEM is a downturn in the business cycle, as their revenues are directly related to the level of economic activity, corporate profits, and disposable income, as well as the availability of credit. In response to a sharp cyclical upswing or downturn in business jet demand, OEMs will adjust production and investment rates to some extent, but usually they will not cancel a development program that is underway unless absolutely necessary, because of the significant sunk costs involved.[139]

As previously indicated, during the recent downturn all the major OEMs (with the possible exception of Dassault) cut back investment plans, scaled back production, and reduced their workforce to respond to the sharp fall in orders and sales revenue. Such large fluctuations in production rates are very challenging for business jet OEMs to manage, and as a result, they work hard to use other tools to manage cash flow volatility, such as drawing on the resources of suppliers (through helpful payment terms) and customers (through advance payments). Establishing cash reserves and hedging foreign-exchange exposures (such as non-U.S. dollar costs) are other techniques used to smooth cash flow during the economic and product cycles.[140]

Diversification of Business Activity

Several OEMs mentioned that it is helpful to be part of a larger corporate group, especially if the other business lines are less cyclical or face different timing for their business cycles. The degree of diversification in business operations across the group is one indicator of how exposed an OEM and its parent company might be to cyclicality in the business jet market. For example, Embraer, whose activities are highly concentrated in aerospace, notes in its 2010 annual report that operational diversification into the defense/security and energy business segments will reduce the company's dependence on

[138] Deloitte, "Global Survey of R&D Tax Incentives," October 11, 2011, 1–35; Deloitte, "How Does the Canadian R&D Tax Regime Compare?" October 11, 2011, 1–2.

[139] Cessna cancelled its midsized business jet, the Columbus, on July 9, 2009, taking a non–cash charge of approximately $43 million. *Wichita Business Journal*, "Textron Canada Cancels Cessna Columbus Program," July 10, 2009.

[140] Alasdair Whyte, editor, *Corporate Jet Investor*, telephone interview by USITC staff, August 17, 2011; banking representative, telephone interview with USITC staff, July 2011.

the aerospace market and thus leave it in a better position to weather future market demand variations.[141]

Diversification is also helpful, even within the range of aerospace activities. A wide range of aircraft with buyer progression opportunities helps to ensure revenues in the long term. For example, filling out a product line to give entry points for new customers was Gulfstream's rationale for its purchase in 2000 of Galaxy Aerospace, a maker of business jets smaller than the company's offerings at the time.[142] OEMs also report that maintaining a diverse product line is important for meeting customers' changing needs. Cessna has stated that it has "no intention" of divesting the company's piston aircraft product line.[143]

Combining commercial, military, and business jet operations in the corporate group can provide some smoothing of revenue. Bombardier pursued a diversified aerospace strategy with its purchase of Learjet, adding light and medium business jets to its strong position in regional jets in order to be able to serve a wide range of aerospace customers. Regional commercial jets are also Embraer's core business, but with some diversification provided by executive jets and military aircraft. Business jets add volatility to its portfolio, while military aircraft generate much steadier cash flow.[144] Dassault's reliance on business jets is likewise balanced by its significant presence in the military jets segment,[145] and HBC's CEO also mentions the smoothing effect of having both general aviation and military aircraft businesses: "We're pleased with the diversification [military] gives us [by] sustaining revenues in a bad time."[146]

On the other hand, in a more diversified company, each investment program has to compete with many different possible investments across the company. A decision to allocate corporate resources to developing a new business aircraft would partially depend on whether better opportunities present themselves in other business areas. Embraer, for instance, has stated that it will complete the introduction of its Legacy 450 and Legacy 500 aircraft, but that its priorities will shift in future towards military aircraft development as well as re-engineering the EJet regional jet.[147]

It is also helpful that the OEMs' service businesses provide revenue streams that are significantly less volatile than revenues generated from aircraft sales. Aftercare is an important sales differentiator, and all OEMs run a customer support business to service their existing fleet of aircraft. The service business is to some extent impacted by similar demand conditions as their primary business of developing and selling new aircraft, but demand for aircraft repair and maintenance is steadier because it is mainly related to the

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[141] Embraer, "Business Principles and Risk Management Practices," *2010 Annual Report* (accessed February 3, 2012); Moody's Investor Service, "Credit Opinion: Empresa Brasileira de Aeronautica S.A.," January 20, 2011.

[142] Industry representatives, telephone interview with USITC staff, November 2011.

[143] Garvey and George, "Cessna Ups Its Game," October 17, 2011, 37.

[144] Embraer, "Business Principles and Risk Management Practices," *2010 Annual Report* (accessed February 3, 2012); Moody's Investor Service, "Credit Opinion: Empresa Brasileira de Aeronautica S.A.," January 20, 2011.

[145] Industry representatives, interview with USITC staff, Toulouse, France, October 2011; Dassault Aviation, *2010 Annual Report*, 39 (accessed February 7, 2012).

[146] Anselmo, "Does Hawker's Future Lie in China?" November 9, 2011.

[147] *Airfinance Journal*, "Embraer Scraps Plans for Larger Aircraft," November 10, 2011; Embraer, *2010 Annual Report*; Embraer SA., 2010 Form 20-F, 20–22.

size and age of the OEM's installed fleet and the technical requirements of each aircraft.[148]

Diversification away from business jets is evident in all the parent companies, but for the most part is limited to related aerospace and defense industries (figure 6.1). OEMs' exposure to swings in the business cycle in their business jet sales is offset to some extent by sales to governments for defense applications, which yields some stabilization of cash flow. A few holding companies, such as GIMD, engage in quite disparate activities, but this is not the norm. For a majority of the companies, the benefits from synergies between aerospace, other transportation equipment, and information technology (for R&D, technical know-how, and project management of major government procurement programs) appear to outweigh the portfolio diversification benefit that would be available from a conglomerate structure with a range of different, unrelated business activities.

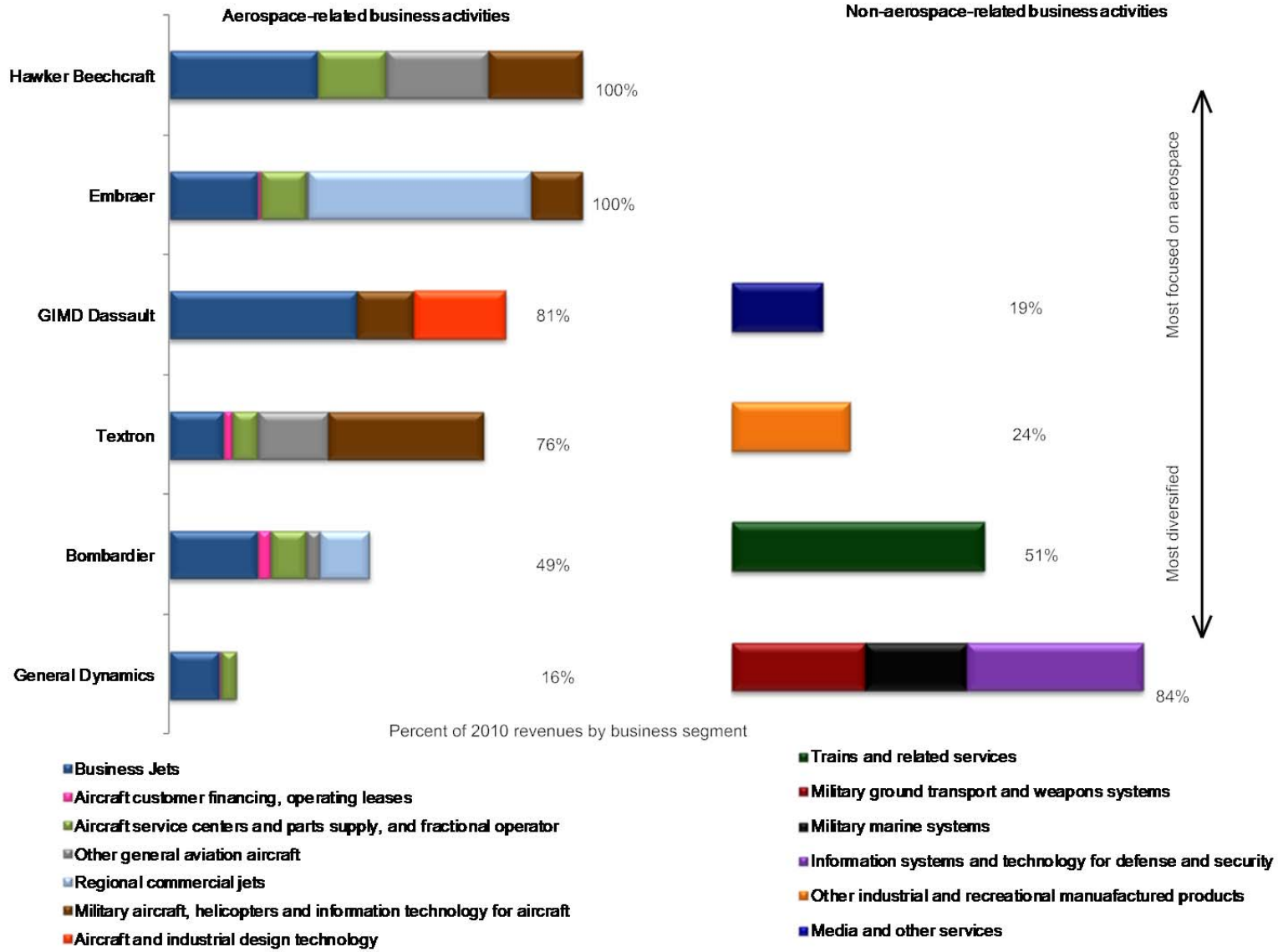
Foreign-exchange Risk and Risk Management

Currency movements represent an important risk factor for international aerospace companies. This is because the companies are likely to have a significant mismatch between the currency mix of their revenues and the currency mix of their costs. If revenues and costs arise in different currencies (for example, if revenues are denominated in U.S. dollars, while costs are incurred in a combination of currencies corresponding to the location of manufacturing facilities around the world), a company's operating profit (i.e., revenues less costs) may be affected negatively or positively merely by a movement in exchange rates. As previously discussed, virtually all aerospace revenues are denominated in U.S. dollars, even for sales to customers in non-U.S. dollar markets. At the same time, business jet OEMs often incur a share of their costs in a range of local, non-U.S. dollar-related currencies (most notably, the Brazilian *real*, the Canadian dollar, and the euro), because they have manufacturing or service facilities located in non-U.S. dollar economies such as Brazil, Canada, or Europe. Operations in these countries introduce currency risk because production costs and other local costs are paid in a different currency from that of the company's revenues. Local costs might include such items as labor costs, rents on buildings, and local taxes owed. However, an aerospace company's largest cost, the cost of purchased parts and systems, will most likely be U.S. dollar-denominated, and therefore will not present a currency risk.[149]

Currency risk is thus a significant risk factor for Embraer, Bombardier, Dassault, and, to a lesser extent, HBC, Cessna, and Gulfstream. For example, Embraer notes that in 2010, about 15 percent of its total costs were incurred in Brazilian *reais* as the large majority of Embraer's employees and operations are based in Brazil; the rest of its costs were principally in dollars. Given the sharp depreciation of the U.S. dollar against the Brazilian *real* in 2009–10, Embraer reports that it was forced to cut costs and change its product mix to hold gross profit margins relatively stable in U.S. dollar terms.[150] Bombardier has significant labor costs denominated in Canadian dollars as the result of its Canadian operations, as well as in UK pounds sterling through its Shorts subsidiary and in Mexican pesos through its Querétaro operations.[151] About two-thirds of Dassault's employees are located in France, indicating that Dassault faces a significant mismatch between its euro-

[148] Hawker Beechcraft Acquisition Company, LLC, Form 10-K 2010, 25.
[149] Industry representatives, interview by USITC staff, Montreal, Canada, September 2011.
[150] Embraer, *2010 Annual Report* (accessed February 7, 2012); Embraer S.A., Form 20-F, April 19, 2011, 15.
[151] Bombardier, *2010–11 Annual Report* (accessed February 7, 2012), 63.

FIGURE 6.1 Business portfolio diversification of business jet OEM parent companies



Source: Company 2010 Annual Reports.

denominated local costs and its U.S. dollar-denominated revenue stream from sales of Falcon business jets.[152] Finally, HBC has facilities in Chester, England, that give it UK pound sterling exposure.[153]

Business jet OEMs with significant risk exposure have put in place sophisticated foreign-exchange management procedures to hedge their foreign-currency cash flows.[154] Nevertheless, certain OEMs face currency risk to a significantly larger extent than others, especially as foreign-exchange hedging is typically limited to specifically identified and highly certain cash flows because of accounting considerations. If the U.S. dollar strengthens generally over a long period, this gives foreign producers a cost advantage, whereas if the U.S. dollar is trending down, foreign producers suffer relative to producers with nearly 100 percent U.S. dollar-based costs.

The OEMs also face foreign-exchange risk with respect to "translation" of foreign-currency-denominated assets and liabilities on their balance-sheet into their reporting currency. (All business jet OEMs report their business results in U.S. dollars, except Dassault, which reports in euros). If currency movements are large, the value of assets in other countries—for example, an overseas factory—may suddenly shrink, changing the ratio of assets to liabilities in an unfavorable direction. Such developments may cause companies particular concern because bank-lending agreements (covenants) require them to maintain specific balance-sheet ratios. Companies respond to this by taking out loans in the same foreign currencies as their foreign currency assets—and in approximately the same amounts. If the value of the assets falls, so will the value of the loans, thereby offsetting balance-sheet translation risk.[155]

[152] Dassault Aviation Web site, "Profile" (accessed July 6, 2011). www.dassault-aviation.com/en/aviation/group/presentation/profile.html?L=1; Dassault, "Note 17," *2010 Annual Report,* 107 (accessed February 7, 2012).

[153] Hawker Beechcraft Acquisition Company, LLC, Form 10-K 2010,17.

[154] Bombardier, *2010–11 Annual Report*, 175–176 (accessed February 7, 2012); General Dynamics, *Annual Report 2010*, 35 (accessed February 7, 2012)5; Hawker Beechcraft Acquisition Company, LLC, Form 10-K 2010, 42; Textron, *Annual Report 2010,* 62-63 (accessed February 7, 2012).

[155] Bombardier, *2010–11 Annual Report*, 176 (accessed February 7, 2012); Embraer, Form 20-F, April 19, 2011, 54; Textron, *2010 Annual Report*, 61-63 (accessed February 7, 2012).

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CHAPTER 7
Factors Affecting Future Competitiveness of the U.S. Business Jet Industry

Summary

In addition to the uncertain market conditions that affect U.S. industry investment and marketing strategies, the U.S. business jet industry[1] faces numerous other future challenges. While many of these challenges are discussed earlier in the report and presently affect industry performance, the challenges discussed in this chapter will likely continue to be among the most critical factors influencing the competitive position of the U.S. business jet industry in the future. They include new entrants to the market, changes in regional demand, possible diminished access to government-sponsored R&D, and workforce issues. U.S. and foreign governmental policies and regulations, both in effect and proposed, will also continue to impact the product certification process and the purchasing environment for customers. The overall outcome for the U.S. business jet industry of these long-term trends is unclear; however, the effects of certain near-term developments, such as the global recession, the difficulties faced by some purchasers in obtaining business jet financing, and increased competition in the business jet environment, are more readily identified. These developments could impede the return of business jet deliveries to their former levels, making it more difficult for U.S. manufacturers to respond to their long-term challenges.

New Entrants

As explained in chapter 2, new entrants in the business jet industry encounter high entry barriers in the form of corporate financing requirements, the need to provide aftersales support, and reluctance on the part of some customers to switch aircraft brands. The challenge for the new entrant is to offer an aircraft with a perceived higher value for a given price,[2] which will either expand the existing market by attracting new customers or place pressure on the market shares of existing producers.[3] New entrants may pose a challenge for existing U.S. manufacturers, who must find ways to compete with the added value of the new aircraft introduced into the market. On the other hand, the effect of new entrants on traditional manufacturers may be softened by the new entrant's ability to stimulate overall sales and thereby increase the customer base for business aircraft.[4]

It is likely that new entrants will come from companies not traditionally associated with general aviation as well as existing manufacturers of general aviation aircraft. As of December 2011, five companies—Cirrus Aircraft (United States); Diamond Aircraft Industries, Inc. (Canada); Eclipse Aerospace (United States); Honda Aircraft Co. (United

[1] As identified in the request letter from the House Ways and Means Committee, the focus of this investigation is on business jets at or below 50,000 pounds MTOW.

[2] USITC, hearing transcript, September 28, 2011, 158–9 (testimony of Robert Wilson, Honeywell Aerospace).

[3] USITC, hearing transcript, September 28, 2011, 156 (testimony of Robert Wilson, Honeywell Aerospace).

[4] Ibid.

States); and SyberJet Aircraft U.S.A. (United States)—had announced plans to produce or had already produced a very light or light business jet aircraft in their respective nations, competing with the current six global producers of such aircraft.[5] In addition, two additional U.S. manufacturers—Spectrum Aeronautical, LLC, and Stratos Aircraft, Inc.—are considering building very light jets (table 7.1).[6] Of these seven companies, four (Honda, Spectrum, Stratos, and SyberJet) are not currently producing general aviation aircraft.

TABLE 7.1 Potential new business jet entrants, 2011

Manufacturer	Model	MTOW, in lbs	Seating capacity	Range with NBAA reserves, in nautical miles	Weight class
Cirrus Aircraft, Inc.	Vision SF50	6,000	7	1,400([a])	Very light jet
Diamond Aircraft Industries, Inc.	D-Jet	3,670	5	1,350	Very light jet
Eclipse Aerospace, Inc.	Eclipse 550	6,000	6	1,125	Very light jet
Honda Aircraft Co.	HondaJet HA-420	9,200	7	1,400	Very light jet
Spectrum Aeronautical, LLC	Freedom S.40	9,550	8	2,250	Very light jet
	Independence S.33	7,500	6	2,000	Very light jet
Stratos Aircraft, Inc.	Stratos 714	7,213	5	1,320	Very light jet
SyberJet Aircraft U.S.A.	SJ-30	13,950	8	2,500	Light jet

Source: Corporate Web sites, except MTOW for HondaJet (http://www.flightglobal.com/landingpage/hondajet.html).

[a]Preliminary estimate.

These new OEMs will compete for a significant group of potential buyers (between 20 and 30 percent of existing customers) who are looking outside of their current aircraft manufacturer's products, in part because the current OEM may not offer an aircraft to satisfy the customer's changing preferences or missions.[7] Another market that new entrants may address is one composed of customers who now operate a turbopropeller, a high-performance piston engine, or a used business jet aircraft. Such aircraft typically are less expensive to buy and operate than a new business jet. However, if a new entrant's aircraft is priced competitively, it might spur sales to this group of customers.

The new OEMs share certain shortcomings which may limit their sales. For example, these firms lack a product line or family of aircraft that customers can "graduate" to and an established global aftersales support network, both of which are important competitive factors for the established producers.[8] In fact, producers are likely to find that one of the

[5] Diamond Aircraft Industries, GmbH. is headquartered in Austria and is the only non-U.S. proposed new entrant. Its business jet aircraft will be produced at its subsidiary, Diamond Aircraft Industries, Inc., in Canada.

[6] Company web sites for Cirrus Aircraft, http://www.cirrusaircraft.com/ (accessed March 12, 2012); Diamond Aircraft Industries, Inc., http://www.diamondaircraft.com/index.php (accessed March 12, 2012); Eclipse Aerospace, Inc., http://www.eclipseaerospace.net/ (accessed March 12, 2012); Honda Aircraft Co., http://hondajet.honda.com/default.aspx?bhcp=1 (accessed March 12, 2012); Spectrum Aeronautical, LLC, http://www.spectrum.aero/ (accessed March 12, 2012); Stratos Aircraft, Inc., http://stratosaircraft.com/ (accessed March 12, 2012); SyberJet Aircraft U.S.A., http://www.sj30jet.com/index.php (accessed March 12, 2012).

[7] Industry representative, interview by USITC staff, Wichita, KS, July 2011.

[8] USITC, hearing transcript, September 28, 2011, 304 (testimony of Heidi Wood, Morgan Stanley). This shortcoming would be more acute for companies not currently producing aircraft, such as Honda, SyberJet, Spectrum, and Stratos.

keys to continued success in this industry is the ability to offer more aftersales support and service.[9]

Changes in Regional Demand

While the United States and Europe will remain the two largest markets for business jet aircraft in the foreseeable future,[10] the emerging wealth of certain nations—particularly Brazil, Russia, India, and China—will likely fuel increased demand for business jet aircraft, as was demonstrated during 2006–10 (table 7.2).[11] The economies of these countries grew at a faster pace than those of the traditional markets, such as the United States and Europe, during this period, in part because the economic downturn was not as severe for these markets.[12]

TABLE 7.2 Business jet fleet under 50,000 lbs MTOW in selected markets (by units), 2006 and 2010

Country	2006	2010	Net increase	% change, 2006–10
Brazil	311	569	258	83
Russia	41	87	46	112
India	46	113	67	146
China	31	55	24	77
Europe	1,660	2,501	841	51
United States	8,649	9,620	971	11

Source: USITC staff calculations, based on data provided by JETNET in e-mail to USITC staff, December 19, 2011.

Growth in some of the business jet markets of these countries, however, is limited by restrictions on airspace usage and poor aviation infrastructure. Moreover, high import tariffs in both Russia and India, along with India's stringent operating regulations for business jets, also present challenges to U.S. sales of business jets in these countries.[13] The net effect of these restrictions, infrastructure limitations, and tax challenges will be to slow the expansion of these countries' business jet fleets when compared to those of the United States and Europe. Increased sales opportunities for the U.S. industry may develop over the long term if these impediments are addressed.

In some cases, country-specific barriers to the business jet industry are already being addressed by governments, although the long-term outcome of these efforts is unclear. Until recently, China severely restricted use of its airspace, requiring multiple approvals

[9] Industry representatives, interviews by USITC staff, Wichita, KS, July 2011. Both Cessna and HBC increased the number of their global service stations during 2006–11.

[10] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011; industry representative, interview with USITC staff, Bordeaux, France, October 2011.

[11] USITC, hearing transcript, September 28, 2011, 46 (testimony of Robert Morin, Ex-Im Bank); USITC, hearing transcript, September 28, 2011, 84 (testimony of Bob Blouin, HBC); USITC, hearing transcript, September 28, 2011, 91–92 (testimony of Robert Wilson, Honeywell Aerospace).

[12] Some business jet producers see Brazil and China as the fastest-growing foreign markets during 2015–20. Industry representative, interview with USITC staff, Wichita, KS, July 2011; USITC, hearing transcript, September 28, 2011, 84 (testimony of Bob Blouin, HBC). These countries have primarily bought business jets outside of the scope of the investigation. USITC, hearing transcript, September 28, 2011, 109–10 (testimony of Ed Bolen, NBAA).

[13] Bombardier, *Bombardier Business Aircraft: Market Forecast 2011–2030*, June 2011, 33; Karzonov, "Russia Opens Up about Bizav Reform," May 17, 2011.

from various levels of government before allowing a business jet to fly within China.[14] These restrictions undercut one primary benefit of a business jet—providing on-demand transport promoting efficient use of workers' or executives' time.[15] China also lacks suitable infrastructure to support general aviation,[16] including general aviation airports, but has committed to building several new airports between 2011 and 2020.[17] While helpful, some industry observers question whether the new airports will satisfy the projected overall demand for general aviation and, more specifically, the demand from business jet owners seeking to travel efficiently between multiple Chinese cities.[18]

In Russia, high import tariffs on certain medium-weight business jets, an 18 percent value-added tax (VAT), and extensive regulations may limit growth in the business jet market. Currently, Russia categorizes civil aircraft purchased and brought into Russia by weight and passenger capacity, but does not distinguish between business and commercial aviation in its aviation code.[19] Imports of business jets seating less than 50 passengers fall under four line items of Russia's tariff schedule, based on their unladen weight. Aircraft weighing 44,000 lbs. or less enter free of duty; those over 44,000 lbs. are subject to a 20 percent import duty.[20] In November 2010, Russia changed some of its aircraft operating rules, potentially allowing business jet owners to use their aircraft more

[14] *Aero Network News*, "China Opens More Airspace for GA," August 17, 2011. Until 2003, private ownership of aircraft was prohibited in China. USITC, hearing transcript, September 28, 2011, 148–49 (testimony of Ed Bolen, NBAA); USITC, hearing transcript, September 28, 2011, 225 (testimony of Heidi Wood, Morgan Stanley). Flight approvals took days to conclude, negating the idea of fast, efficient air travel by companies wishing to expedite their business within China. These onerous levels of approvals have likely stifled the business jet market within China. Currently, approval times have been reduced, but still pose an obstacle in using a business jet within China for its intended purpose. For flights above 13,123 feet, where business jets would normally fly, extensive approvals are necessary. NBAA, "China Opens More Airspace for General Aviation," August 15, 2011.

[15] USITC, hearing transcript, September 28, 2011, 96–97 (testimony of Ed Bolen, NBAA).

[16] In 2010, the United States led the world with 15,079 airports. Brazil was next, with 4,072, and Russia fifth, with 1,213. China ranked 15th with 502 airports, while India ranked 23rd with 352 airports. CIA, The World Factbook: Country Comparison: Airports (accessed December 23, 2011). One private jet owner reported that he was limited to 2.5 hours of flight in China in 2010, and had a fuel truck follow him when he flew, as local airports were not always capable of providing fuel. Xinhuanet.com, "Take off: Relaxed Legislation Opens Skies," November 18, 2011.

[17] Honeywell Inc., "Honeywell Showcases Integrated Solutions," April 22, 2011.

[18] Bombardier, *Bombardier Business Aircraft: Market Forecast 2011–30*, June 2011, 24. China is expected to take 10 percent of all new deliveries of business jet aircraft over the next 10 years, or 960 business jets of all weight classes. *Aviation Week*, "Gulfstream Sees China's Bizjet Demand Changing," January 5, 2012.

[19] Voskoboynikov and Wicks, "Business Jet Aviation: The Industry Sector That Globalization Forgot," July 2010.

[20] Russian imports of business jets are classified under the following four tariff numbers in the Russian tariff schedule: (1) 8802.30.0002, covering aircraft weighing 4,400–33,000 pounds, which enter free of duty; (2) 8802.40.0011, covering aircraft weighing 33,001–44,000 pounds, which enter free of duty; (3) 8802.40.0031, covering aircraft weighing 44,001–198,000 pounds, dutiable at 20 percent; and (4) 8802.40.0041, covering aircraft weighing 198,001–264,000 pounds, dutiable at 20 percent. Government of Russia, "ЛЕТАТЕЛЬНЫЕ АППАРАТЫ, КОСМИЧЕСКИЕ АППАРАТЫ, И ИХ ЧАСТИ" [Aircraft, spacecraft, and parts], January 2012.

freely.[21] In spite of the hurdles to business jet operation in Russia, sales of business jets to Russian nationals continue to rise as their economic well-being grows.[22]

India's demand for business jets is hampered by the country's lack of adequate aviation infrastructure and high import taxes.[23] In the view of Bombardier, "India's business aviation sector has not lived up to its full potential due to lack of aviation infrastructure, stringent government regulations, high import taxes and duties, and long procedures for aircraft imports."[24] According to an industry consultant, India levies an almost 25 percent import duty on nonairline aircraft such as business jets, and has high duty rates for aircraft parts as well.[25] Another key limitation on business jet activity in India is the lack of airports. India had a total of 352 airports used for all purposes in 2010, compared to 15,079 airports in the United States.[26] As demand for air travel within India increases, the demand for an improved aerospace infrastructure will also likely grow. India is addressing some of these shortcomings in its eleventh (2007–12) five-year plan, which calls for the modernization of 39 airports and the building of 3 more on greenfield sites.[27] India is also working with the FAA to develop performance-based and satellite-based navigation to reduce flight congestion at airports and decrease weather-related delays and flight times,[28] and has established an Aviation Cooperation Program in India to aid in improving other aspects of India's air traffic system.[29] In 2010, India had a fleet of 110 business jet aircraft; by 2020, India's business jet fleet is expected to grow to 385 if the country's operating environment for aircraft improves.[30]

Workforce

Outsourcing and workforce education are two recurring themes in discussions of future industry competitiveness. The trend toward increased outsourcing of parts and systems is seen as diminishing the long-term prospects for increased employment at U.S. business jet manufacturers, but also the remaining workforce's capacity to innovate. Some industry representatives have stated that several of the best ideas for manufacturing innovation have come from the shop floor.[31] To the extent that the production functions are increasingly decentralized and delegated to suppliers, the OEMs' workforce may be less able to create the incremental innovations that come from hands-on experience

[21] For example, foreign charter operators, the major provider of business jet transportation in Russia, must request permission to transport people within Russia. As of November 17, 2011, this permission was to be decided within 72 hours, an improvement from former regulations. NBAA, *Global Business Aviation Update: Russia*, n.d. (accessed March 13, 2012).

[22] Bombardier, *Bombardier Business Aircraft: Market Forecast 2011–2030*, June 2011, 37. Russia's total business jet fleet, including those outside the scope of this study, grew from 100 aircraft in 2004 to 380 by 2010, driven in part by the surge in Russian billionaires (from 72 in 2009 to 116 in 2010). Bombardier predicts the business jet fleet will reach 845 by 2019.

[23] Matthews, "In Focus: Indian Business Aviation Snagged by Constraints," March 5, 2012; Chase, written submission to the USITC, September 9, 2011.

[24] Bombardier, *Bombardier Business Aircraft: Market Forecast 2011–2030*, June 2011, 33.

[25] Chase, written submission to the USITC, September 9, 2011.

[26] CIA World Factbook, "India: Transportation," November 9, 2011; CIA World Factbook, "United States: Transportation," December 23, 2011.This number includes both public use airports and private airports and landing strips.

[27] Government of India, Planning Commission, "Eleventh Five Year Plan, 2007–12," vol. I, 281.

[28] USDOT, FAA, "Existing Technologies to Power NextGen Goals" (accessed January 6, 2012). For more information on performance-based navigation, see USDOT, FAA, "Fact Sheet: NextGen Goal; Performance-Based Navigation," April 24, 2009.

[29] USDOT, FAA, "FAA International Strategies 2010 to 2014 Asia Pacific Region," January 6, 2012.

[30] Bombardier, *Bombardier Business Aircraft: Market Forecast 2011–2030*, June 2011, 33.

[31] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011.

throughout the entire process. Nevertheless, most business jet manufacturers have emphasized that without the ability to cut costs by sourcing to lower-cost suppliers or shifting some of their operations to low-cost countries, the U.S. industry would not be able to remain competitive.

Greater emphasis on science, technology, engineering, and math (STEM) education at the national level is necessary to ensure that future workforce capacity in the United States does not fall behind other countries where STEM education is a national priority.[32] Some companies are concerned that even among students who do pursue degrees in engineering in general or in aeronautical engineering in particular, many are foreign residents and lack the visas needed to remain in the United States upon graduation. According to the Aerospace Industries Association, "Of the 70,000 engineers that the United States graduates each year, only about 40,000 are eligible to work in U.S. aerospace because of security restrictions."[33]

The aerospace industry must compete with other industries for these engineers as well. In 2006, the most recent year for which data are available, 4,500 students were enrolled in U.S. graduate aerospace engineering programs—an increase of 40 percent from a decade earlier, but still accounting for only 4 percent of all graduate engineering enrollment.[34] One in three aerospace graduate students in 2006 was a foreign resident, a trend that is even more pronounced in the overall engineering community, where foreign students represent 45 percent of graduate engineering enrollment.[35] In 2007, aerospace engineering bachelor's degrees were awarded to 2,800 students, a small portion of the 68,300 engineering degrees awarded that year.[36] As a result, according to industry sources, it is difficult to develop a skilled labor supply for the aerospace industry, including OEMs and suppliers, in the U.S. economy.[37] Moreover, since the aforementioned number of graduates feeds the entire aerospace sector, only a fraction of aerospace engineers are likely to enter civil aviation and more specifically the business jet industry.

Innovation, Research, and Development

The lack of consistent U.S. aerospace agency funding for R&D and differing models of government-funded R&D are factors that could significantly affect the U.S. industry's ability to compete in the future. As previously noted, the business jet industry is characterized by substantial technological and business innovation and large financial investments in R&D. Continuous innovation and introduction of new technologies on aircraft are crucial factors of competitiveness. Although these activities are costly, the U.S. industry's R&D requirements are largely self-funded, with a substantial proportion of innovation and R&D performed by the OEMs or their tier-1 suppliers.[38] There is little involvement from the U.S. government. This situation is in direct contrast to other

[32] Industry representative, interview with USITC staff, Wichita, KS, July 2011.

[33] Aerospace Industries of America, "Workforce," 2011.

[34] The top five aerospace graduate programs in the United States in 2011 were Stanford University (CA), California Institute of Technology (CA), Massachusetts Institute of Technology (MA), Georgia Institute of Technology (GA), and University of Michigan at Ann Arbor. US News, "Education: Grad Schools, Aerospace/Aeronautical/Astronautical 2011," n.d. (accessed April 11, 2012).

[35] Percentages derived from National Science Board, *Science and Engineering Indicators 2010*, appendix table 2-17, 2010.

[36] National Science Board, *Science and Engineering Indicators 2010*, appendix table 2-17.

[37] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011.

[38] USITC, hearing transcript, September 28, 2011, 170 (testimony of Bob Blouin, HBC).

nations,[39] notably the EU, which supports European aeronautics R&D with the goal of ensuring the long-term competitiveness of Europe's civil aeronautics industry.[40]

To the extent that foreign governments place more emphasis on aerospace R&D funding and commit to consistent predictable budgets for agencies that support aeronautics, U.S. business jet OEMs may find themselves at a competitive disadvantage vis-à-vis their global competitors. For example, Europe's current Framework Program (FP, 2007–13) increased its aeronautical funding by 147 percent over the previous FP, reaching $2.9 billion by 2013. The FP allows those seeking aeronautics R&D funding to be assured that resources will be available for new aeronautical projects. In contrast, NASA's aeronautical funding for a similar time period declined significantly.[41] Some industry sources indicate that this disparity could increasingly undermine U.S. OEMs' ability to compete globally.[42]

Further, U.S. federal government funding of aerospace R&D is not conducted at the technological level where the benefits can be easily applied by U.S. industry. Unlike aeronautical R&D programs in other countries, NASA's aeronautical research is targeted at basic, foundational research—that is, at lower technology readiness levels (TRLs)—the results of which are not readily usable by U.S. industry. In contrast, Canada- and EU-funded aeronautical R&D appears to be increasingly focused on projects with higher TRLs that offer more opportunities to commercialize the research for the entire aircraft industry. According to industry sources, because European aeronautical research efforts are more easily adaptable by their aerospace industry, it eliminates the need for European OEMs and suppliers to perform them at their own expense.[43] Similarly, in Brazil, some R&D funding is directed toward specific aircraft programs at Embraer, according to the company's public documents.[44]

FAA research is also not directly applicable to the U.S. industry, as it focuses on safety, the environment, and air traffic management issues. Moreover, the FAA lacked multiyear funding[45] from 2007 through early 2012. As a result, although the FAA's R&D budget has remained relatively constant over the last decade, the availability of funding has been

[39] USITC, hearing transcript, September 28, 2011, 91 (testimony of Robert Wilson, Honeywell Aerospace).

[40] See chapter 5, "Technological and Business Innovation in Business Aviation," for a more complete discussion.

[41] NASA's aeronautics R&D budget has been cut significantly in recent years, falling from a peak of about $1.5 billion in FY1994 to $569.4 million in FY2012. See chapter 5, "Technological and Business Innovation in Business Aviation."

[42] Industry representatives, interview with USITC staff, Wichita, KS, July 2011.

[43] European Commission, *Aeronautics and Air Transport Research*, 2010, 11; industry representatives, interview with USITC staff, Wichita, KS, July 2011; industry representatives, interview with USITC staff, France, October 2011.

[44] Embraer, "Form 20-F," April 18, 2011, 86.

[45] While U.S. government funding is on a year-to-year basis, the FAA has received a four-year funding commitment worth $63.4 billion under the FAA Modernization and Reform Act of 2012. Smolenski, "FAA Reauthorization Bill Finally Signed Into Law," February 16, 2012.

unpredictable from one year to the next.[46] This has eroded its ability to introduce some of its research efforts in areas related to safety and air traffic control.[47] Since NASA and FAA research programs do not directly promote U.S. industry competitiveness, U.S. aircraft firms indicated that they would prefer more focused R&D efforts oriented toward applicable mature technologies for current or future aircraft.[48]

Government Policies and Agreements

Policies and programs at the international, national, state, and local government level may impact the future competitiveness of the U.S. business jet industry by facilitating or hindering aircraft and parts certification and, potentially, by imposing additional fees on owners and operators of business jets. On an international level, agreements between U.S. and other aircraft safety organizations are not uniform, nor is there mutual, multilateral agreement on the parameters of aircraft certification from all nations. National economic development plans play a role financially in countries outside of the United States, whereas state and local governments aid U.S. manufacturers. Lastly, U.S. legislation that is perceived to target the manufacturers and users of business jets has reportedly hindered new aircraft sales for all business jet manufacturers.

Bilateral Aviation Safety Agreements

Bilateral Aviation Safety Agreements (BASAs), which build a framework for authorities to validate other countries' certifications of aircraft and aircraft parts, were created to "address the growth of the aircraft design and manufacturing activities worldwide."[49] Several potential developments—an increase in the number of agreements, an expansion in the scope of existing agreements, and a move towards uniformity in what these agreements cover—may expedite certification of U.S.- and foreign-produced aircraft. It would also allow parts to be certified and sourced from a greater number of nondomestic suppliers without long waiting periods.[50] One result of this might be the expansion of trade in aircraft and aircraft parts among nations that are signatories to a BASA, potentially aiding U.S. competitiveness by increasing the flow of aeronautical goods.

Aircraft and Parts Certification by the U.S. Federal Aviation Administration

As discussed in Chapter 5, the complexity of the FAA's certification system, its resource constraints, and its funding issues are significant impediments that contribute to delays in aircraft and parts certification and create uncertainties for U.S. business jet manufacturers. Such issues, if not resolved, will continue to hamper the U.S. industry's ability to introduce new products and technologies, a key competitiveness issue. New technologies introduced by U.S. companies, such as upgraded avionics and composite

[46] USITC, hearing transcript, September 28, 2011, 123 (testimony of Robert Wilson, Honeywell Aerospace); Bunce, written testimony to the House Subcommittee on Space and Aeronautics, February 16, 2011. There have been 23 continuing resolutions to fund the FAA on a temporary basis since 2007. Karp, "US House Passes $63 Billion FAA Bill," February 6, 2012.

[47] Bunce (GAMA), written testimony to the House Subcommittee on Space and Aeronautics, February 16, 2011, 4; Bunce (GAMA), written submission to the USITC, September 9, 2011, 8.

[48] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011.

[49] USITC, hearing transcript, September 28, 2011, 21 (testimony of Dorenda Baker, FAA). For a brief discussion of BASAs, see chapter 5, "Technological and Business Innovation in Business Aviation."

[50] USITC, hearing transcript, September 28, 2011, 18 (testimony of Dorenda Baker, FAA).

structures, cannot reach the marketplace in a timely way because of the lengthy certification time frame, currently averaging 3.5 years.[51] As a result, with new generations of computer technology being born every six months, key parts in many aircraft systems will have generations-old computer technology on board when delivered.[52]

Further, the previously noted lack of multiyear funding in past years for the FAA has not allowed the agency to institute long-term plans, such as the NextGen air traffic control system, contributing to uncertainty among global business jet producers and suppliers.[53] In addition, the FAA is being asked to certify new technologies (e.g., composite airframes and parts and expanded use of digital avionics and flight controls) and respond to a greater number of requests from foreign certification agencies for test and production data on U.S.-certified aircraft than in the past, with no commensurate increase in staff or funding.[54] As a result of these issues, certain U.S. business jet firms have reportedly considered shifting production of complete aircraft outside of the United States to countries where certification agencies are more responsive to their commercial needs.[55] At the same time, U.S. industry officials have expressed the view that if the FAA's Organization Designation Authorization (ODA) process[56] is fully implemented, the program could greatly increase U.S. OEMs' ability to bring new products to the market.[57]

European Environmental Policies

Another challenge faced by the world's aviation community is Europe's Emissions Trading Scheme (ETS), which charges a user fee on aircraft weighing over 12,566 pounds based on their carbon emissions.[58] Despite widespread objections from all non-European aircraft manufacturers, users, and governments, this user fee was implemented on January 1, 2012.[59] The user fee affects aircraft, including certain business jets, which are taking off from, transiting through, or landing in the airspace controlled by the European Union (EU).[60] For example, a trip to from the United States to the EU would incur a cost based on the distance between the United States and the EU.[61] One effect of

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[51] USDOT, FAA, posthearing submission, October 12, 2011.

[52] Industry representative, interview with USITC staff, Olathe, MO, July 2011.

[53] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011; industry representatives, interviews with USITC staff, Canada, September 2011; industry representatives, interviews with USITC staff, France, October 2011.

[54] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011. While these requests should go to the FAA to act as a gatekeeper in the transaction, OEMs are increasingly responding directly to the requestor to expedite the transfer of information. Government representative, telephone interview by USITC staff, January 2012.

[55] Industry representatives, interviews with USITC staff, Wichita, KS, July 2011. Brazil, Canada, and France were mentioned by industry representatives.

[56] The ODA program addresses delays in certification by shifting responsibility for some of the approval tasks to the manufacturer, thereby reducing the burden on the FAA. See box 5.4 in chapter 5, "Technological and Business Innovation in Business Aviation," for more information on the ODA program, as well as USITC, hearing transcript, September 28, 2011, 20 (testimony of Dorenda Baker, FAA).

[57] USITC, hearing transcript, September 28, 2011, 121 (testimony of Bob Blouin, HBC); USITC, hearing transcript, September 28, 2011,123 (testimony of Robert Wilson, Honeywell Aerospace).

[58] Alcott, "Political Battlelines Drawn over ETS." Aircraft falling below this weight limit are very light business jets. All others are subject to the ETS.

[59] International Civil Aviation Organization, "Inclusion of International Civil Aviation," November 10, 2011; NBAA, "European Union Emissions Trading Scheme (EU-ETS)," January 2, 2012.

[60] See chapter 4, "The Market for Business Jet Aircraft," for background on this issue.

[61] As an example, a Gulfstream G450 making a trip from the United States to Europe would incur $2,300 in ETS fees for the flight, which are added to the aircraft's normal operating costs. Trautvetter, "EU-ETS Costs Really Add Up for Bizav Operators," March 3, 2012.

the ETS might be to lead business aircraft operators to stop in a nearby non-EU country before landing at their ultimate EU destination, thereby lessening the distance of the final flight into the EU and consequently the tax charged on the trip. However, this decrease in the tax burden would come at the expense of an increase in the time required to get to the ultimate destination, which business jet users seek to minimize.

Airlines in the United States and Canada challenged the ETS in the European Court of Justice (ECJ), but lost their case in December 2011.[62] In its legal opinion, the ECJ stated "the uniform application of the scheme to all flights which depart from or arrive at a European airport is consistent with the provisions of the Open Skies Agreement designed to prohibit discriminatory treatment between American and European operators."[63] Aircraft operators and countries not satisfied with this outcome are considering further action.[64]

Availability of Financing

U.S. industry views the increased participation of the U.S. Ex-Im Bank positively, and welcomes its help in financing export sales.[65] According to one official, the increased role of the U.S. Ex-Im Bank in providing or supporting financing for U.S. producers' export sales will likely enhance U.S. exports of business jets and industry competitiveness by providing support for foreign purchases of U.S.-made aircraft.[66] As noted earlier, U.S. Ex-Im Bank financing of U.S. business jet exports during the economic downturn helped to offset declining sales. Although the United States is the largest market for business jets, the proportion of deliveries going to foreign markets is increasing and will continue to grow into the future.[67] Continued assistance would be particularly helpful in high-growth economies such as Brazil, China, India, Russia, and other emerging markets, where credit may be less readily available than in North America and Europe.[68] The lack of financing options in such markets may lead to increasing requests for U.S. Ex-Im Bank assistance.

U.S. Policies Affecting Users/Purchasers of Business Jets

The U.S. administration and Congress have considered several policies that could increase the cost of owning and operating a business jet, creating an environment of uncertainty among potential business jet purchasers. These policies include limitations on existing tax benefits, new usage taxes, and relaxation of privacy protections for business jet users. The general political climate and prevailing perception of business jet travel also affect users' decisions to purchase business jets.[69] Several U.S. industry officials

[62] Court of Justice of the European Union, press release 139/11, December 21, 2011, case no. C-366/10. While airlines brought this case, the ETS applies to business jets as well. European Business Aircraft Association, "Environment: ETS-MRV," n.d. (accessed January 3, 2012).

[63] *Aviation Week & Space Technology*, "European Court of Justice Upholds Airline Inclusion in ETS," December 21, 2011.

[64] Air Transport World, "US DOT Secretary Slams EU ETS," March 13, 2012; Air Transport World, "European Aviation Industry Warns EU ETS Situation Is 'Intolerable'," March 13, 2012; Russian Aviation, "Joint Declaration of the Moscow Meeting on Inclusion of International Civil Aviation in the EU-ETS," February 22, 2012.

[65] See chapter 6, "Financing," for a more complete discussion.

[66] USITC, hearing transcript, September 28, 2011, 51–52 (testimony of Robert Morin, U.S. Ex-Im Bank).

[67] See chapter 4, "The Market for Business Jet Aircraft;" USITC, hearing transcript, September 28, 2011, 44 (testimony of Robert Morin, U.S. Ex-Im Bank).

[68] USITC, hearing transcript, September 28, 2011, 44–46 (testimony of Robert Morin, U.S. Ex-Im Bank).

[69] USITC, hearing transcript, September 28, 2011, 175 (testimony of Ed Bolen, NBAA).

expressed the view that these perceptions have been exacerbated by recent negative statements by certain U.S. government officials concerning users of business jets and contend that these users have been unfairly targeted for extra taxation.[70]

User Fees

The U.S. Congress continues to discuss the possibility of imposing a $100 fee on owners of general aviation aircraft (including business jets) each time an aircraft is flown. Most recently included as part of the Jobs Act of 2011, such fees would represent an additional funding source for the Airport and Airway Trust Fund.[71] This trust fund uses payments from a series of excise taxes on system users to finance aviation infrastructure and air traffic control.[72] Industry representatives oppose this fee because it imposes a financial burden on a select group of users and increases the administrative cost by developing a collection system that would require an invoice for every flat fee. The current fuel tax fee is less burdensome in terms of paperwork because it is assessed automatically at the fuel pump and does not entail a separate transaction.[73]

U.S. Depreciation Schedule

As indicated earlier, the depreciation rate in the tax code for new aircraft is one of the factors that affect customer decisions about whether and when to buy a new business jet.[74] For taxpayers with taxable income, a shorter depreciation period makes the purchase of a new aircraft more attractive because the individual or corporation can write off a large share of the cost of the aircraft against current taxable income (in some cases past income as well, netting a tax refund). In part for tax reasons, sales of new business jets have typically picked up in the fourth quarter of each year.[75]

Economic stimulus legislation enacted in 2010 made new qualifying aircraft eligible for "bonus" accelerated depreciation, allowing taxpayers to deduct more depreciation in the first year they placed the aircraft in service than would otherwise be permitted. The 2010 law allowed 100 percent depreciation of the cost of the new business jet aircraft if it was bought between September 8, 2010, and December 31, 2011.[76] For 2012, the rate decreased to 50 percent for the first year of ownership; this rate is due to expire December 31, 2012. According to industry representatives, it is likely that the expiration of the accelerated depreciation law will dampen demand for new business jets.[77]

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[70] USITC, hearing transcript, September 28, 2011, 127 (testimony of Bob Blouin, HBC); USITC, hearing transcript, September 28, 2011, 175, 185–86 (testimony of Ed Bolen, NBAA); USITC, hearing transcript, September 28, 2011, 222 (testimony of Heidi Wood, Morgan Stanley).

[71] Experimental Aircraft Association, "EAA Briefing on User Fees," 2011; Wynbrandt, "User Fees: Not Dead Yet," October 10, 2011.

[72] USDOT, FAA, "Airport and Airway Trust Fund (AATF)," n.d. (accessed January 9, 2012).

[73] USITC, hearing transcript, September 28, 2011, 136 (testimony of Ed Bolen, NBAA).

[74] See box 6.1 in chapter 6, "Financing," for more information.

[75] USITC hearing transcript, September 28, 2011, 247 (testimony of David Strauss, UBS Investment Research).

[76] Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010, Pub. L. 111–312, 124 Stat. 3296, 111–312 (2010), enacted in December 2010 (H.R. 4853). http://www.gpo.gov/fdsys/pkg/PLAW-111publ312/pdf/PLAW-111publ312.pdf.

[77] See chapter 6, "Financing," for more information.

Block Aircraft Registration Request (BARR)

Uncertainty about the release of information to the public regarding aircraft movements in the United States is another factor that may affect the U.S. industry's business jet sales. The Block Aircraft Registration Request (BARR) program was established to address security-related, commercial, and privacy concerns of business jet users by limiting the real-time public availability of flight information.[78] The industry argues that if such information was available to the public, it could compromise the security of company officials and the confidential nature of certain business operations of companies. The BARR program blocks or conceals aircraft movements from public dissemination upon request of the owner or operator. The ability to move confidentially in support of a company's business is seen by business jet users as a competitive advantage, and one that, if taken away, could impact their company's business strategy.[79]

The FAA's BARR policy changed three times in the course of 2011 in response to earlier developments. In late 2008, the FAA received a Freedom of Information Act (FOIA) request to release the list of BARR participants, claiming the owners of the aircraft were using the program to prevent public scrutiny of their use of the aircraft.[80] In June 2011, the FAA issued a notice detailing its plan to virtually eliminate the BARR program. On August 2, 2011, the FAA implemented a modified program whereby only requests fully justified by a "certified security concern"[81] would be honored. All other requests for blocking would be denied and real-time tracking information would be made available to the public. However, on December 2, 2011, the FAA reversed this position on the BARR, indicating that operators of general aviation and charter companies could again request that their aircraft registration numbers be withheld from real-time flight tracking programs without justifying their need.[82]

[78] BARR submissions were managed by the NBAA and provided to the FAA and Aircraft Situation Display to Industry (ASDI) vendors to block tracking at the appropriate levels.

[79] Miller, "DOT Dismantles Aircraft Operators' Basic Privacy Rights," May 31, 2011.

[80] Niles, "Court Opens Blocked N Numbers," February 27, 2010. The FOIA request followed the Big Three automakers' use of corporate aircraft to fly to Washington to testify before Congress regarding federal government financial support.

[81] 76 Fed. Reg. 32258 (June 3, 2011).

[82] USDOT, FAA, "The FAA Announces Changes," December 2, 2011.

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APPENDIX A
House Ways and Means Request Letter

COMMITTEE ON WAYS AND MEANS

U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, DC 20515

DOCKET NUMBER
2808
Office of the Secretary
Int'l Trade Commission

May 23, 2011

The Honorable Deanna Tanner Okun
Chairman
U.S. International Trade Commission
500 E Street, S.W.
Washington, D.C. 20436

Dear Chairman Okun:

The Committee on Ways and Means is interested in obtaining current information on the global competitiveness of the U.S. business jet aircraft industry.[1] The U.S. business jet aircraft industry remains the most globally-successful producer of such aircraft. However, despite the current global economic downturn, new foreign companies have entered the market for business jet aircraft.

In order to better assess the current market conditions confronting the U.S. industry, we request that the U.S. International Trade Commission conduct an investigation under section 332(g) of the Tariff Act of 1930 (19 U.S.C. §1332(g)), and provide a report setting forth the results of the investigation. The report should include, to the extent practicable, a discussion and analysis of the structure and factors affecting the competitiveness of the business jet aircraft industry in the United States, Brazil, Canada, Europe, and China. To the extent that information is publically available, the report should discuss:

- the structure of the global industry, including supply chain relationships and foreign direct investment;
- an overview of the global market for business jet aircraft and recent developments, such as the economic downturn, that may have affected demand;
- an examination of production, consumption, sales, financing mechanisms, research and development, and business innovation;
- government policies and programs that focus on or otherwise involve the industry, including policies and programs affecting financing, aircraft research and development, and certification; and

[1] Business jet aircraft for the purposes of this request are defined as very light jets to larger jets with a maximum takeoff weight of 50,000 pounds or less.

- factors that may affect the future competitiveness of the U.S. business jet aircraft industry, such as workforce characteristics, changes in regional demand, and new or growing entrants through 2028.

The report should focus primarily on the 2006-2011 time period. The Committee requests that the Commission transmit its report to Congress no later than 11 months following the receipt of this request. It is the Committee's intent to make the Commission's report available to the public in its entirety. Therefore, the report should not contain any confidential business information.

Thank you for your attention to this request.

Sincerely,

Dave Camp

Dave Camp

APPENDIX B
Federal Register Notice

INTERNATIONAL TRADE COMMISSION

[Investigation No. 332–526]

Business Jet Aircraft Industry: Structure and Factors Affecting Competitiveness; Institution of Investigation and Scheduling of Public Hearing

AGENCY: United States International Trade Commission.

ACTION: Notice.

SUMMARY: Following receipt of a request on May 23, 2011 from the United States House of Representatives Committee on Ways and Means (Committee) under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)), the United States International Trade Commission (Commission) instituted investigation No. 332–526, *Business Jet Aircraft Industry: Structure and Factors Affecting Competitiveness.*

DATES: *August 19, 2011:* Deadline for filing request to appear at the public hearing.

September 7, 2011: Deadline for filing pre-hearing briefs and statements.

September 28, 2011: Public hearing.

October 5, 2011: Deadline for filing post-hearing briefs and all other submissions.

April 23, 2012: Transmittal of Commission report to the House Committee on Ways and Means.

ADDRESSES: All Commission offices, including the Commission's hearing rooms, are located in the United States International Trade Commission Building, 500 E Street, SW., Washington, DC. All written submissions should be addressed to the Secretary, United States International Trade Commission, 500 E Street, SW., Washington, DC 20436. The public record for this investigation may be viewed on the Commission's electronic docket (EDIS) at *http://www.usitc.gov/secretary/edis.htm.*

FOR FURTHER INFORMATION CONTACT:

Peder Andersen (202–205–3388 or *peder.andersen@usitc.gov*) or Deborah McNay (202–205–3425 or *deborah.mcnay@usitc.gov*) for information specific to this investigation. For information on the legal aspects of this investigation, contact William Gearhart of the Commission's Office of the General Counsel (202–205–3091 or *william.gearhart@usitc.gov*). The media should contact Margaret O'Laughlin, Office of External Relations (202–205–1819 or *margaret.olaughlin@usitc.gov*). Hearing-impaired individuals may obtain information on this matter by contacting the Commission's TDD terminal at 202–205–1810. General information concerning the Commission may also be obtained by accessing its Internet server (*http://www.usitc.gov*). Persons with mobility impairments who will need special assistance in gaining access to the Commission should contact the Office of the Secretary at 202–205–2000.

Background: As requested by the Committee, the Commission will conduct an investigation and prepare a report on the structure and factors affecting the competitiveness of the business jet aircraft industry in the United States, Brazil, Canada, Europe, and China. To the extent that information is publicly available, the report will include—

1. An overview of the structure of the global industry, including supply chain relationships and foreign direct investment;
2. An overview of the global market for business jet aircraft and recent developments, such as the economic downturn, that may have affected demand;
3. An examination of production, consumption, sales, financing mechanisms, research and development, and business innovation;
4. Information on government policies and programs that focus on or otherwise involve the industry, including policies and programs affecting financing, aircraft research and development, and certification; and
5. A discussion of factors that may affect the future competitiveness of the U.S. business jet aircraft industry, such as workforce characteristics, changes in regional demand, and new or growing entrants through 2028.

The Committee asked that the report focus primarily on the 2006–11 time period, and that the Commission deliver its report no later than April 23, 2012.

Public hearing: A public hearing in connection with this investigation will be held at the U.S. International Trade Commission Building, 500 E Street, SW., Washington, DC, beginning at 9:30 a.m. on Wednesday, September 28, 2011. Requests to appear at the public hearing should be filed with the Secretary, not later than 5:15 p.m., August 19, 2011, in accordance with the requirements in the ''Submissions'' section below. All pre-hearing briefs and statements should be filed not later than 5:15 p.m., September 7, 2011; and all post-hearing briefs and all other statements should be filed not later than 5:15 p.m., October 5, 2011. In the event that, as of the close of business on August 19, 2011, no witnesses are scheduled to appear at the hearing, the hearing will be canceled. Any person interested in attending the hearing as an observer or nonparticipant may call the Secretary to the Commission (202–205–2000) after August 19, 2011, for information concerning whether the hearing will be held.

Written submissions: In lieu of or in addition to participating in the hearing, interested parties are invited to submit written statements concerning this investigation. All written submissions should be addressed to the Secretary, and should be received not later than 5:15 p.m., October 5, 2011. All written submissions must conform with the provisions of section 201.8 of the Commission's *Rules of Practice and Procedure* (19 CFR 201.8). Section 201.8 requires that a signed original (or a copy so designated) and fourteen (14) copies of each document be filed. In the event that confidential treatment of a document is requested, at least four (4) additional copies must be filed, in which the confidential information must be deleted (see the following paragraph for further information regarding confidential business information). The Commission's rules authorize filing submissions with the Secretary by facsimile or electronic means only to the extent permitted by section 201.8 of the rules (see Handbook for Electronic Filing Procedures, *http://www.usitc.gov/secretary/fed_reg_notices/rules/documents/handbook_on_electronic_filing.pdf*).

Persons with questions regarding electronic filing should contact the Secretary (202–205–2000).

Any submissions that contain confidential business information must also conform with the requirements of section 201.6 of the *Commission's Rules of Practice and Procedure* (19 CFR 201.6). Section 201.6 of the rules requires that the cover of the document and the individual pages be clearly marked as to whether they are the ''confidential'' or ''non-confidential'' version, and that the confidential business information be clearly identified by means of brackets. All written submissions, except for confidential business information, will be made available for inspection by interested parties.

In its request letter, the Committee stated that it intends to make the Commission's report available to the public in its entirety, and asked that the Commission not include any confidential business information in the report that the Commission sends to the Committee. Any confidential business information received by the Commission in this investigation and used in preparing this report will not be published in a manner that would reveal the operations of the firm supplying the information.

Issued: June 15, 2011.

By order of the Commission.

James R. Holbein,

Secretary to the Commission.

[FR Doc. 2011–15248 Filed 6–17–11; 8:45 am]

BILLING CODE 7020–02–P

APPENDIX C
Calendar of Witnesses

CALENDAR OF PUBLIC HEARING

Those listed below appeared as witnesses at the United States International Trade Commission's hearing:

Subject: Business Jet Aircraft Industry: Structure and Factors Affecting Competitiveness

Inv. No.: 332-526

Date and Time: September 28, 2011 - 9:30 a.m.

Sessions were held in connection with this investigation in the Main Hearing Room (room 101), 500 E Street, S.W., Washington, D.C.

STATE GOVERNMENT WITNESS:

The Honorable Jennifer Carroll, Lt. Governor of Florida

U.S. FEDERAL GOVERNMENT WITNESSES:

Federal Aviation Administration
Washington, D.C.

Dorenda Baker, Director, FAA Aircraft Certification Service (AIR-1)

Export-Import Bank of the United States
Washington, D.C.

Robert Morin, Vice President, Transportation Division

PANEL 1:

ORGANIZATION AND WITNESS:

Wiley Rein LLP
Washington, D.C.
on behalf of

Hawker Beechcraft Corporation ("Hawker Beechcraft")

Bob Blouin, Vice President, Government and Industry Relations

Adam H. Gordon) – OF COUNSEL

PANEL 1 (continued):

ORGANIZATION AND WITNESS:

Honeywell
Washington, D.C.

Robert Wilson, President, Business & General Aviation, Honeywell Aerospace

National Business Aviation Association (NBAA)
Washington, D.C.

Ed Bolen, President & CEO

International Association of Machinists and Aerospace Workers (IAM)
Upper Marlboro, MD

R. Thomas Buffenbarger, International President

PANEL 2:

ORGANIZATION AND WITNESS:

Teal Group Corporation
Fairfax, VA

Richard Aboulafia, Vice President, Analysis

Chase & Associates
Lewisville, TX

Michael D. Chase, Principal

UBS AG
New York, NY

David Strauss, Managing Director. UBS Investment Research, U.S. Aerospace & Defense

Morgan Stanley
New York, NY

Heidi Wood, Managing Director

- END -

APPENDIX D
Summary of Positions of Interested Parties

Introduction

This appendix summarizes the positions of interested parties based on information provided at a public hearing held on September 28, 2011, and material submitted to the Commission in conjunction with this investigation (table D.1). Most of these summaries reflect only the principal points made by each party. The views expressed are those of the submitting parties and not those of the Commission, whose staff did not attempt to confirm or correct the information provided. The full text of the hearing transcript and written submissions associated with the current investigation can be found by searching the Commission's Electronic Docket Information System.[1]

TABLE D.1 Information provided by interested parties

Interested parties	Hearing testimony	Written submission
Government		
Congressman Bill Posey, Florida		X
Lieutenant Governor Jennifer Carroll, Florida	X	X
Federal Aviation Administration	X	X
U.S. Export-Import Bank	X	X
Industry		
BMW Group DesignworksUSA		X
Bombardier Inc.		X
Chase & Associates	X	X
Economic Development Commission of Florida's Space Coast		X
Embraer		X
Equipment Leasing and Finance Association		X
General Aviation Manufacturers Association		X
Hawker Beechcraft	X	X
Honda Aircraft Company		X
Honeywell	X	X
International Association of Machinists and Aerospace Workers	X	X
Learjet Inc.		X
Morgan Stanley	X	X
National Business Aviation Administration	X	X
Rolls-Royce North America		X
Teal Group Corporation	X	X
UBS AG	X	X

Source: USITC Electronic Docket Information System.

Congressman Bill Posey[2]

Representative Posey (Florida) submitted a written statement in which he pointed out the importance of Embraer's new business jet manufacturing facility, located at the Melbourne International Airport in Melbourne, Florida. He reported that the facility, which has the capacity to build about 100 jets annually, will be used to assemble, paint, flight-test, and furnish interiors of the Phenom 100 and Phenom 300 business jets. These jets are intended to be sold in the North American market and exported to Europe and the Middle East. The Melbourne site will also be the headquarters of Embraer's business jet operations in the United States.

[1] Available online at https://edis.usitc.gov/edis3-internal/app.
[2] Congressman Bill Posey, written testimony to the USITC, n.d.

Representative Posey added that the facility has created excellent job opportunities for engineers and technicians who recently lost their jobs due to the end of the space shuttle program, making it more likely that the United States will "continue to maintain and build a critical mass of businesses involved in inter-related aerospace activities."[3] He expressed his concern about the "lack of action in advancing U.S. aerospace capabilities"[4] and stressed the importance of maintaining U.S. leadership in aerospace technologies.

He stated that Embraer's decision to locate in Melbourne has boosted local efforts to attract other aerospace companies, and that other business aviation firms have chosen to locate in Melbourne in part because of Embraer's presence. According to Representative Posey, Embraer's contributions to the local and state economy are significant, and future benefits are likely to be even greater, including the addition of more well-paid, highly-skilled jobs.

Lieutenant Governor Jennifer Carroll, Florida[5]

Lieutenant Governor Jennifer Carroll (Florida) explained the important contributions Embraer has made to the state of Florida by opening a facility to build business jets in Melbourne, Florida. According to Lt. Gov. Carroll, this $50 million investment is attracting high-value aerospace industry jobs to Florida's Space Coast at a time when the space shuttle program has ended. She stated that the facility will be used for the assembly, painting, flight testing, and interior furnishing of Embraer's Phenom 100 and Phenom 300 business jets, which will be sold domestically and to export markets such as Europe. According to Lt. Gov. Carroll, other U.S. operations of Embraer include its North American corporate office in Fort Lauderdale, Florida; an aircraft maintenance services facility in Nashville, Tennessee; three executive jet service centers; and a global pilot and ground training center in Dallas, Texas.

Lt. Gov. Carroll noted that the opening of the Melbourne manufacturing center during the economic downturn demonstrated Embraer's commitment to create U.S. jobs. She indicated that the assembly plant will support about 200 jobs by the end of 2012, with salaries averaging $50,000 annually and benefits that include group medical insurance, disability insurance, matching 401K plan, and paid vacation and holidays. Lt. Gov. Carroll stated that Embraer will be able to leverage a highly skilled local workforce that includes former engineers and technicians with the National Aeronautics and Space Administration (NASA) who lost their positions with the end of the space shuttle program. Moreover, Lt. Gov. Carroll pointed out that additional high-wage, highly skilled jobs will be attracted to the region as a result.

According to Lt. Gov. Carroll, Embraer's decision to build in Florida allowed it to move closer to its suppliers and optimize its supply chain, as more than 70 percent of components for the Legacy 600, Phenom, 100, and Phenom 300 are supplied by U.S. firms. Lt. Gov. Carroll noted that this location is close to Embraer's North American headquarters, and is a convenient geographic center between Embraer in Brazil, its North American suppliers, and the significant export market of Europe.

[3] Congressman Bill Posey, written testimony to the USITC, n.d., 2.
[4] Congressman Bill Posey, written testimony to the USITC, n.d., 1.
[5] Lieutenant Governor Jennifer Carroll (Florida), written testimony to the USITC, September 28, 2011.

Federal Aviation Administration[6]

Ms. Dorenda D. Baker, Director of Aircraft Certification Service of the Federal Aviation Administration (FAA), addressed three areas: aircraft certification, resource leveraging, and work prioritization. Ms. Baker noted that the Aircraft Certification Service is responsible for issuing design and production approvals, developing and implementing standards, and ensuring the continued operational safety of the entire aircraft fleet, including business jets, which is the agency's first priority. According to Ms. Baker, once an aircraft design is approved and a type certificate issued, the manufacturer must obtain production approval to produce the aircraft for distribution. To gain production approval, Ms. Baker stated that the manufacturer must demonstrate that it will reliably produce duplicate aircraft that meet the approved type design within the structure of a quality control program. She noted that surveillance audits are conducted by the FAA to ensure that the quality system does not degrade over time. She added that the standards required of an aircraft reflect the regulations in effect at the time of the application, the size of the aircraft, and any unique features.

With respect to leveraging resources both domestically and internationally, Ms. Baker focused on Bilateral Aviation Safety Agreements (BASAs) and the Organization Designation Authorization (ODA) program. She stated that BASAs "establish a formal acceptance of the competencies of a foreign Civil Aviation Authority,"[7] thereby allowing aviation authorities to validate their counterparts' type certification. According to Ms. Baker, these agreements allow manufacturers to gain certification more efficiently by eliminating duplication of effort; they also facilitate consistent international regulation. With ODAs, Ms. Baker stated that the FAA may delegate certain responsibilities (e.g., examining aircraft designs, production, quality, and airworthiness) to approved private individuals and organizations to act as representatives of the FAA. She indicated that ODA programs take advantage of the experience and knowledge of the designees and allow the FAA to focus its limited resources on safety-critical areas as aviation needs continue to expand.

However, Ms. Baker pointed out that while BASAs and ODAs leverage the FAA's resources, the FAA still faces the challenge of prioritizing its resources to meet its responsibilities. According to Ms. Baker, to ensure that its resources were not drawn away from its safety mission, in 2005 the FAA implemented a certification project sequencing process. She reported that the goal of this process is to ensure that enough resources are dedicated to operational safety before they are allocated to certification activities. Any new certification and validation projects requiring more than 40 hours of FAA work are now sequenced at the national, rather than local, level to provide fair and equitable treatment of the applicants.

[6] Dorenda D. Baker, director of Aircraft Certification Service, FAA, written testimony to the USITC, September 28, 2011, and written submission to the USITC, n.d.

[7] Dorenda D. Baker, director of Aircraft Certification Service, FAA, written testimony to the USITC, September 28, 2011, 4.

United States Export-Import Bank[8]

Mr. Robert Morin, Vice President of the Transportation Division at the United States Export-Import Bank (Ex-Im Bank), stated that the current industry structure and outlook for business jets warrants a larger role for Ex-Im Bank to ensure a level playing field for U.S. manufacturers. Mr. Morin said that the Ex-Im bank provides financing for U.S.-produced aircraft sold to purchasers around the world, and described the business jet market is being in a state of transition, with the highest growth markets shifting to developing economies as manufacturers recover from the economic downturn. He indicated that with too little credit available, export credit agencies are an important tool to fill the financing gap. However, Mr. Morin stated that there are indications that certain purchasers are benefiting from more favorable financing terms from these agencies than those provided for in the Organization for Economic Cooperation and Development (OECD) Aircraft Sector Understanding (ASU). This includes the U.S. market, where Mr. Morin notes that foreign manufacturers and their export credit agencies are offering terms that are not available on a commercial basis.

Mr. Morin indicated that as the business jet industry recovers, Ex-Im Bank expects that a larger share of such deliveries will occur to markets other than North America and Europe. He explained that China, India, Russia, Turkey, and Brazil are expected to experience particularly high growth in purchases of business jets as wealth creation and improved infrastructure spur new sales opportunities. However, Mr. Morin noted that a difficult credit environment in leading growth markets could harm business jet industry prospects. Only two significant financiers of business jet aircraft remained active during the credit crisis, and they preferred to finance larger business jets purchased by "best credits" customers, according to Mr. Morin.

Mr. Morin also commented on the changing competitive environment in the business jet industry. He noted that the industry had traditionally been concentrated in the United States (Wichita, Kansas), but foreign manufacturers (i.e., Bombardier, Embraer, and Dassault) have captured larger shares of business jet deliveries. According to Mr. Morin, all three foreign firms have close ties with their country's export credit agencies, and have been able to use this financing to increase sales to export markets, including the United States. In this regard, he explained that U.S. business jet manufacturers are at a disadvantage since they must rely on commercial financing for their domestic sales (although Cessna does have a captive finance company), as Ex-Im Bank does not finance domestically sold products. By contrast, Mr. Morin noted that BNDES (the Brazil Development Bank) has a special program to provide financing for Phenom jets delivered to domestic customers. He indicated that the terms for this domestic financing are more favorable than those under the OECD guidelines for financing exported aircraft, but that limited information exists on the exact details and terms of this program. Mr. Morin pointed out that any financing arrangement that falls outside the OECD guidelines has the potential "to create market distortions that can lead to an undue competitive disadvantage for U.S. manufacturers."

Mr. Morin stated that without the assistance of the Ex-Im Bank, the market for small and medium-sized business jets will likely be disproportionately filled by foreign manufacturers. He pointed out that greater Ex-Im Bank support is also necessary to

[8] Robert Morin, vice president, Transportation Division, Ex-Im Bank, written testimony before the USITC, September 28, 2011.

ensure that business jets, an important source of U.S. economic activity, continue to be manufactured in the United States. In this context, he noted that the Ex-Im Bank increased its financing activity in this market to more than $600 million to fill a gap that developed during the credit crisis, and for fiscal years 2010 and 2011, that support has totaled approximately $250 million.

BMW Group DesignworksUSA[9]

In a written submission, BMW Group DesignworksUSA (DesignWorks USA) stated that it is a strategic design consultancy and subsidiary of BMW Group, and was Embraer's design partner for the Phenom 100 and 300 business jets. DesignworksUSA stated that it believes that the success of Embraer's Phenom business jets was largely attributable to design excellence. DesignworksUSA indicated that because Embraer was open to innovative design, it was able to develop a theme of "modern luxury" for the Phenom, focusing on space, connectivity, simplicity, and authenticity.

According to DesignworksUSA, the final design creates "a feeling of serenity," using intelligent design solutions and a high attention to detail; the design also integrates the flight deck with the rear cabin. Although the buyer has a variety of color and material options, according to Designworks USA, the production process is still streamlined. Designworks USA stated that the launch of the "paradigm shifting" Phenom 100 and 300 in November 2005 at the National Business Aviation Association (NBAA) convention was well received, increasing Embraer's "brand awareness and design leadership."

Bombardier Inc.[10]

Bombardier Inc. (Canada) commented on certain statements in a pre-hearing brief filed by Hawker Beechcraft regarding two Canadian measures that were challenged in the World Trade Organization (WTO): (1) in 1999, the WTO found that certain Technology Partnerships Canada (TPC) assistance to the regional commercial aircraft industry were WTO-inconsistent, and (2) a similar finding was reached on certain aspects of Canada's export financing support for regional commercial aircraft. Bombardier stated that these inconsistencies were corrected long ago. In addition, Bombardier noted that business jets never participated in the TPC program, and that they very rarely participated in the export financing program. Moreover, Bombardier indicated that, as a matter of corporate policy, since that time it does not participate in government programs that are inconsistent with WTO obligations.

Chase & Associates[11]

In hearing testimony, Mr. Mike Chase stated that he is the principal at Chase & Associates, an aviation consulting firm that specializes in industry and market research in the commercial and business aviation sectors. Mr. Chase stated that 21 companies have produced business jets since 1955 (including those outside the scope of this investigation), with only 8 manufacturers in business today as a result of consolidation

[9] Laurenz Schaffer, president, BMW Group Designworks USA, written submission to the USITC, n.d.

[10] John K. Veroneau, Covington & Burling, on behalf of Bombardier Inc., written submission to the USITC, October 5, 2011.

[11] Mike Chase, principal, Chase & Associates, testimony before the USITC, September 28, 2011.

and stopped production. He indicated that new business jet deliveries rose steadily starting in 2003, with a record 1,313 deliveries posted in 2008. In 2009, deliveries fell by 33.7 percent to 870 units, and declined again in 2010 to 763 units. Mr. Chase noted that the North American share of global business jets in operation fell from 77 percent in January 2006 to 68 percent in January 2011.

Mr. Chase pointed out that new business jet sales are driven by strong economic activity, corporate profitability, wealth creation, and business investment. He also noted that purchasers are either new aircraft buyers or pre-owned aircraft buyers. He explained that the delivery cycles for these two types of business jets are different, with the pre-owned business currently in an upswing while new deliveries continue to decline.

Economic Development Commission of Florida's Space Coast[12]

In a written submission, the Economic Development Commission of Florida's Space Coast (EDC) indicated that its focus is to expand the aerospace industry in Brevard County (Florida), known as "The Space Coast" since the inception of NASA at the Kennedy Space Center. According to the EDC, the economic effects of the end of the Apollo program in the 1970s led legislators and community leaders to agree to never let the economy be so tied to any one federal program. The EDC stated that through commitments to economic development and diversity, the Space Coast is now "one of the most high tech economies in the country."[13]

The EDC explained that as the region was no longer dependent on NASA and its space programs, it sought other opportunities suited to its competitive advantages, such as its high-tech workforce. The EDC stated that local business leaders were looking for a company that would be a "game changer" for the local economy. With its strong aviation base through the presence of NASA, the Melbourne International Airport, and the Titusville-Cocoa Airport Authority, Brevard County was primed for expansion in that field, according to the EDC, and as Embraer looked for a manufacturing site for its Phenom 100 and 300 aircraft, the county saw an opportunity. The EDC explained that the business community and government worked with Embraer to create a competitive package to secure Brevard County's selection by Embraer. Embraer's decision to locate its manufacturing facility on the Space Coast has since encouraged other companies to consider the region's advantages, such as its workforce, advanced infrastructure, and low-cost business climate, leading several firms to relocate their services to the county, according to the EDC.

Embraer[14]

Embraer reported that it is the world's third-largest aircraft manufacturer, with operations supplying the commercial, defense, and executive aviation markets. According to Embraer, the company entered the business jet market to diversify its production and to benefit from projected growing demand for business jets. Embraer attributed its success

[12] Lynda Weatherman, president and CEO, EDC, written submission to the USITC, October 3, 2011.
[13] Lynda Weatherman, president and CEO, EDC, written submission to the USITC, October 3, 2011, 1.
[14] King and Spalding, counsel, on behalf of Embraer S.A. and Embraer USA, posthearing submission to the USITC, October 5, 2011, and transcript of news briefing submitted to the USITC, October 6, 2011.

in the market to its core strengths related to its long experience in developing aircraft, with state-of-the-art production facilities operating on lean manufacturing principles supported by a highly trained workforce and numerous engineers. Embraer noted that the company was established by the government in 1969 but was privatized in 1994 and is currently a joint stock company incorporated under Brazilian law. Embraer explained that the Brazilian federal government holds one share of a special class of Embraer common stock known as the "golden share,"[15] which conveys a veto power over a limited number of company actions, but does not impact corporate strategic planning or normal business operations.

Embraer stated that its business strategy was to pursue a gradual evolution into the business jet market, starting with a derivative design aircraft (the Legacy 600) based on a regional jet platform, followed by clean sheet designs for entry-level business jet aircraft, the Phenom 100 and 300. The company reported that it entered into risk-sharing partnerships with suppliers of key components, an approach used in its regional jet development that allows Embraer to focus on its core business, reduce its development expenses and risk, shorten the product development cycle, improve operating efficiency, and provide flexibility in the production process. Embraer also noted that it employed intensive customer surveys and panel discussions to identify unique product positioning, and introduced an innovative cabin design in the Phenom series. According to Embraer, its Phenom aircraft offer "superior range, speed, comfort, and luggage capabilities, as well as lower operating costs, higher fuel efficiency, and fewer maintenance cycles/inspection requirements."

According to Embraer, the business jet industry and its suppliers are global in nature, exemplified by the high U.S. content in Embraer's Brazilian-assembled business jets. Embraer reported that it annually imports into Brazil more than $2 billion of U.S.-made aircraft components. Embraer noted that it has also invested $52 million in a Melbourne, Florida facility to build the Phenom series aircraft, employing many highly skilled workers that lost their jobs with the retirement of the space shuttle program; that facility's first Phenom 100 delivery is scheduled for the fourth quarter of 2011. Embraer explained that the facility is currently designed to produce about 100 business jets annually, with capacity expansion possible. In addition to deliveries to the North American market, Embraer indicated that the Florida site is well situated to export product to Europe. Embraer stated that its decision to locate production in Melbourne has given a boost to further development at Melbourne's international airport and to attracting other aerospace companies to the region. Embraer also noted that it has also invested in several maintenance services facilities, business jet service centers, and pilot and crew training facilities in the United States.

Embraer cited several reasons for investing in the Melbourne facility: (1) since most of its components originate in the United States, Embraer would optimize its supply chain; (2) Melbourne has a qualified and available workforce; (3) Melbourne is a short distance from Embraer's USA headquarters in Ft. Lauderdale, Florida; (4) the United States is the world's largest market for business jets; (5) Melbourne is closer than Brazil to Europe, the world's second-largest market; (6) access to nearby deepwater ports reduces transportation costs; and (7) Melbourne is an attractive location to receive potential customers.

[15] King and Spalding, counsel, on behalf of Embraer S.A. and Embraer USA, posthearing submission to the USITC, October 5, 2011, 6.

Embraer also pointed out that its success in the market is not due to any financing advantages over other business jet producers nor to any official support for customer financing. Embraer cited its support for the government of Brazil's advocacy for strong WTO subsidy disciplines and participation in the WTO dispute on *Large Civil Aircraft*. As a result of an earlier aircraft dispute brought by Canada against Brazil, Embraer said that Brazil revamped and replaced its PROEX program[16] to bring it into compliance with its WTO obligations. Brazil also joined the Aircraft Sector Understanding (ASU) "to establish a level playing field for official financing support for aircraft exports."[17] Financing of domestic aircraft sales, however, are not prevented under the ASU, according to Embraer. With respect to customer financing, Embraer responded to assumptions that special BNDES domestic financing explains Embraer's strong performance in the smaller end of the market. The company noted that it would be "surprised" if its customers in Brazil did not pay higher financing rates than a Brazilian customer of a U.S. exporter

Equipment Leasing and Finance Association[18]

In its written submission, the Equipment Leasing and Finance Association (ELFA) stated that it represents more than 500 financial services companies and manufacturers in the U.S. equipment finance sector, including most of the major financing providers to the business jet industry. ELFA explained that these firms facilitate the growth and expansion of the business jet industry by providing financing for sales of these aircraft and other aviation equipment. ELFA noted that its equipment finance volume in 2010 reached $559 billion and is expected to total $628 billion in 2011.

ELFA stated that business jets are often financed by banks, equipment finance companies, or investors based in the United States or with significant operations in the United States. ELFA noted that financing may be extended by secured loans or leases, and that financing providers have a sophisticated understanding of the market. According to ELFA, during the recession, the number of firms that received financing for business jet purchasers declined, as did the appetite for risk of those financial companies remaining in the market. ELFA pointed out that those firms still providing financing are taking a more deliberative approach, increasing due diligence and focusing on the financing approval process. Moreover, ELFA noted that certain financing providers are less willing to rely on the aircraft as the sole means of collateral, and are requiring non-aircraft collateral such as deposits.

Key competitiveness issues related to financing include tax policy, title and lien risks, noncitizen trusts, and liability, according to ELFA. With respect to tax policy, ELFA noted its support of capital formation tax incentives that focus on investment in plants and equipment, including business jets, as a key component of economic growth, competitiveness, and productivity. ELFA pointed out that these tax incentives include policies for bonus depreciation and 100 percent expensing, and noted that extending the depreciation period from five to seven years for general aviation aircraft may adversely

[16] PROEX was Brazil's export financing support program that provided export credits to Brazilian exporters either through direct financing or interest rate equalization payments. World Trade Organization, *Brazil – Export Financing Programme For Aircraft, Report Of The Panel*, April 14, 1999, 2. http://www.wto.org/english/tratop_e/dispu_e/46r.pdf (accessed April 7, 2012).

[17] King and Spalding, counsel, on behalf of Embraer S.A. and Embraer USA, posthearing submission to the USITC, October 5, 2011, 22.

[18] William G. Sutton, president and CEO, ELFA, written submission to the USITC, October 18, 2011.

affect the availability of lease financing, further depress the used aircraft market, and decrease demand for new aircraft.

With respect to title and lien risks, ELFA pointed out that the FAA Civil Aviation Registry maintains and exercises oversight over all records pertaining to U.S. registration of aircraft, including recordable interests. ELFA noted that financing providers allocate to the customers all responsibility for operation, maintenance, and registration of the aircraft. ELFA further explained that the imposition of any new or modified legal requirements often creates a "risk of breach" by customers, which could lead to a loss of aircraft registration, resulting in additional costs and risk for "an already pressured"[19] financial industry. Any such noncompliance of legal requirements by customers will result in defaults on loans and leases, and ELFA indicated that override provisions or other protective measures are necessary to preserve a financing company's title or lien status in that aircraft.

ELFA noted that noncitizen trusts (NCTs) are discretionary trusts established by one or more beneficiaries who are not U.S. citizens in order to register an aircraft with the FAA registry. According to ELFA, U.S. financing providers often require noncitizens to register their aircraft, necessitating the use of NCTs, which provide collateral value benefits; a diminished risk of unrecorded liens; and more remedies for repossession, deregistration, and disposition. The FAA, however, has raised doubts about the validity of existing and future NCT-registered aircraft, which would create a significant barrier to new business jet financings that require the NCT structure, according to ELFA.

Lastly, in terms of liability, ELFA commented on Section 44112 of the Federal Aviation Act, as recodified in 1994, which covers the liability of an owner, lessor, or secured party for personal injury, death, and property loss and damage. ELFA said that the intent of this law was to protect "owners of aircraft for security purposes only, or who are lessors of aircraft," from civil liability to "remove one of the obstacles to the financing of purchases of aircraft." ELFA noted that this provision has been challenged, including recently by the Florida Supreme Court,[20] with suggestions by ELFA that both the scope of Section 44112 and the extent to which it covers secured parties and lessors need to be clarified.

General Aviation Manufacturers Association[21]

The General Aviation Manufacturers Association (GAMA) stated that it represents 71 companies that are the world's leading manufacturers of general aviation aircraft, engines, avionics, and components, including the business jets subject to this investigation. GAMA identified the general aviation (GA) sector as an important contributor to world economies. According to GAMA, in the United States, the GA industry supports over 1.2 million jobs, provides $150 billion in economic activity, and generated nearly $5 billion in exports in 2010. GAMA noted that the general aviation industry has become increasingly export-oriented, and is one of the few U.S. manufacturing sectors with a trade surplus. GAMA indicated that this export activity includes not only complete aircraft, but components as well, with U.S.-made components incorporated into GA aircraft produced in Canada, Europe, and Brazil. Moreover, GAMA

[19] William G. Sutton, president and CEO, ELFA, written submission to the USITC, October 18, 2011, 4.

[20] According to ELFA, the Supreme Court of Florida determined that Section 44112 did not preempt the filing of a wrongful death action against an aircraft lessor filed by the administrator of the decedent's estate. William G. Sutton, president and CEO, ELFA, written submission to the USITC, October 18, 2011, 6.

[21] Peter J. Bunce, president and CEO, GAMA, written testimony to the USITC, n.d.

pointed out that foreign business jet producers have located manufacturing activities in the United States. Dassault, for example, sends its business jets to a "completion center" in Little Rock, Arkansas where interiors are fitted, and Embraer recently opened a facility in Florida where its Phenom business jets are assembled. According to GAMA, all of these activities reflect the global nature of the GA industry, its supply chain, and markets.

During 2006–10, 4,968 business jets valued at $93.4 billion were assembled globally, according to GAMA. Of this total, GAMA indicated that 82 percent (4,074 units) valued at $52 billion (55.7 percent of the total) were of the type subject to this investigation (i.e., under 50,000 lbs. maximum takeoff weight). In 2008, GAMA noted that global business jet deliveries totaled 1,313 units; by 2009, with the economic downturn, deliveries fell by 33.7 percent to 870 aircraft. According to GAMA, producers of these light and medium business jets felt the impact of the economic downturn most severely, as deliveries declined by 50 percent to 561 units during 2008–10. In contrast, deliveries of larger business jets rose by 5.2 percent during the downturn to 202 units in 2010. GAMA pointed out that the scope of the investigation omits these larger business jets, "a significant, valuable and growing segment of the business jet product catalog." GAMA stated that although all business jets are designed for specific missions, with a wide variety of sizes, seating, configurations, and capabilities available, these aircraft are more alike than they are different. GAMA indicated that they can help businesses maintain their competitiveness and ability to respond quickly to market opportunities.

According to GAMA, another leading characteristic of the business jet market during 2006–11 has been the growth in markets outside of North America, such as those in the Asia Pacific region, South Asia, Latin America, and the Middle East, due in part to higher gross domestic product (GDP) growth rates and the greater linkages across global markets. Europe has also experienced significant market expansion. Despite this growth, GAMA pointed out that the North American market remains the largest market for business jets and GA aircraft.

GAMA also noted that deliveries of all GA aircraft have declined significantly during the economic downturn, with layoffs of over 20,000 employees in the last several years. GAMA reported that billings for all GA aircraft declined in 2008–09 to $19.5 billion, but rose by 1.2 percent in 2010 to $19.7 billion on the strength of sales of large-cabin, long-range business jets rather than light and medium jets.

GAMA identified several challenges confronting the general aviation and business jet industry. The current economic downturn is the most important "drag" on the industry, according to GAMA. Despite strong demand from new emerging markets, GAMA noted that demand in North America and Europe, the largest markets for these aircraft, has yet to rebound. With respect to new product certification, GAMA indicated that the aerospace industry's contribution to the U.S. economy will be significantly diminished if the FAA cannot support new technology and product certification. According to GAMA, the lack of FAA engineering and technical resources and delays in product certification impact company investment decisions and product speed to market. In addition, GAMA stated that discussions to change current tax policy that extends the R&D tax credit and allows 100 percent expensing of capital investments will also impact the U.S. industry's recovery. In addition, GAMA noted that "political attacks" on corporate aircraft use would negatively impact the GA industry. Environmental regulations, particularly those that "restrict the growth of aviation to deal with carbon emissions," are another issue that "threaten[s] the viability" of the industry, according to GAMA. Finally, GAMA cited delays in FAA reauthorization and funding that have made long-term financial planning

and progress on important programs difficult for the agency, contributing to uncertainty about the direction of the aviation system within the aviation community.

Hawker Beechcraft Corporation[22]

Hawker Beechcraft Corporation (HBC) is a U.S. manufacturer of business jets located in Wichita, Kansas. The company indicated that the global business jet industry is experiencing significant changes and challenges, and that U.S. manufacturers are producing, and will continue to produce, the most technologically advanced aircraft in each market segment to compete successfully. HBC noted that the industry is characterized by increased globalization and "aggressive expansion" of foreign producers that are frequently supported, or even partially owned, by their governments. In particular, HBC cited Embraer as a new market entrant partly owned by the Brazilian government that, in an "extraordinary accomplishment," brought five clean sheet business jets to market over a four-year period. HBC also highlighted the inflow of foreign direct investment into the U.S. industry, both through the establishment of new facilities and through the acquisition of existing operations. In addition, HBC stated that supply chain relationships have evolved, with original equipment manufacturers (OEMs) increasingly partnering with suppliers to maximize their ability to develop advanced technologies best suited to individual aircraft. Supply chains are also more global in nature, according to HBC, as U.S. manufacturers have outsourced or relocated production of certain components.

With respect to the global market, HBC pointed out that new markets such as Brazil, Russia, India, and China have emerged as fresh sources of demand, driven in part by their higher growth rates relative to more mature markets. However, the global economic downturn has affected sales opportunities in these growing markets. HBC indicated that the market is also influenced by the ability of foreign producers to rely on the assistance of their governments to provide favorable financing or other support that affects their national producers' ability to compete. To the extent these programs influence the ability of these manufacturers to participate in the global market, HBC stated that "they have a negative effect on U.S. manufacturers."[23] Moreover, the growth in fractional ownership of business jets has changed the market, according to HBC. HBC noted that fractional-share companies purchase a large number of business jets, often from a single manufacturer, with significant ramifications for industry players. According to HBC, foreign governments help their manufacturers attract purchases from fractional share firms.

HBC stated that production, research and development (R&D), and business innovation are integrally linked in the business jet industry. HBC indicated that these activities are a priority at the company, but that significant investment over long periods of time is required to develop new aircraft and enter the market. HBC's ability to invest in these activities is a function of its ability to finance from its internal sources of capital. According to HBC, other companies' investment in R&D and other related activities may be affected by their ability to gain funding and assistance from outside sources, including foreign governments. With respect to consumption, sales, and financing mechanisms,

[22] Wiley Rein, counsel, on behalf of Hawker Beechcraft, written submissions to the USITC, September 7, 2011, and October 5, 2011.

[23] Wiley Rein, counsel, on behalf of Hawker Beechcraft, written submissions to the USITC, September 7, 2011, 5.

HBC said that the ability of an OEM to offer favorable financing directly impacts the real cost of ownership and can stimulate sales and consumption of business aircraft.

Government policies and programs have a very important role in the global business jet industry, according to HBC. HBC pointed out that government restrictions on airspace, such as those in China and Russia, affect market growth; the opening of this airspace to general aviation operations should result in significant market growth for these aircraft, including business jets. Tariff barriers, such as those in Russia, also impair the competitiveness of U.S. and foreign manufacturers, according to HBC. HBC also noted the significance of government certification and regulation in the business jet market. HBC indicated that government aviation authorities have traditionally exercised near-complete control over the time- and resource-intensive certification process, but recent steps to allow manufacturers to self-certify certain phases of the manufacturing and development process may reduce some of the regulatory burden. HBC noted that it understands that similar programs are in place in counterpart agencies abroad, although the manner in which they are administered could significantly affect the ability of manufacturers to compete.

With respect to factors affecting future competitiveness, HBC highlighted the U.S. industry's need to maintain its long tradition of innovation and production of the most advanced, customer-oriented business jets, which will require continued investment in R&D, commitment to and from its workforce, and a close working relationship with industry regulators. According to HBC, U.S. industry competitiveness "will be affected by its ability to compete on an equal footing"[24] with foreign manufacturers. HBC suggested that foreign government assistance to and promotion of their business jet industries must be carefully considered, and that steps should be taken to ensure such activities remain consistent with all international obligations, such as the WTO's SCM Agreement.

Honda Aircraft Company[25]

In a written submission, Honda Aircraft Company (Honda Aircraft), located in Greensboro, North Carolina, stated that it will develop and manufacture the market's most advanced light business jet at its Greensboro facility, which encompasses all R&D, assembly, service, support, and sales functions for the HondaJet. Honda Aircraft stated that it has more than 20 years of research in jet aircraft and power plant development, which has resulted in a "dramatic step forward"[26] in fuel efficiency for business aviation. According to Honda Aircraft, the FAA's Atlanta office is overseeing HondaJet certification, with flight testing, ground testing, and system integration testing currently underway. Honda Aircraft outlined areas of interest, including job creation and investment, advanced clean technologies, foreign direct investment and supply chain relationships, the global market, and government policies and programs.

Honda Aircraft noted that its Greensboro facility represents an investment of over $170 million in infrastructure and tooling, with employment growing to over 500 workers in

[24] Wiley Rein, counsel, on behalf of Hawker Beechcraft, written submissions to the USITC, September 7, 2011, 8.

[25] Michimasa Fujino, president and CEO, Honda Aircraft Company, written submission to the USITC, n.d.

[26] Michimasa Fujino, president and CEO, Honda Aircraft Company, written submission to the USITC, n.d., 1.

engineering, production, administration, sales, and service. According to Honda Aircraft, the HondaJet is being manufactured in partnership with hundreds of U.S.-based suppliers, while the aircraft's turbofan engine is being developed in a joint venture with General Electric at Honda Aero, Inc., in Burlington, North Carolina. Honda Aircraft noted that these aircraft will be sold domestically and exported globally, with over 100 orders currently in place. According to Honda Aircraft, the HondaJet incorporates many new technological advances in aviation design, such as the over-the-wing engine-mount configuration that contributes to improved aircraft performance and fuel efficiency that is as much as 20 percent greater than that of a similarly sized business jet.

Honda Aircraft stated that Honda Motor chose to establish the company in the United States because of its corporate strategy to produce where it sells its products, and because of the large pool of aviation professionals available. Honda Aircraft noted that Greensboro was selected because of its airport infrastructure, supportive business climate, shared vision with state and local officials, and highly skilled workforce and educational/training partners.

Citing GAMA data, Honda Aircraft noted that global deliveries of new business jets totaled 763 aircraft valued at $18 billion in 2010, down from a peak of 1,313 aircraft delivered in 2008, and have continued to decline in 2011. According to Honda Aircraft, the market closely tracks general economic conditions, with key drivers being overall economic strength, wealth creation, and the strength the of pre-owned jet market and aircraft utilization rates. Honda Aircraft cited Bombardier's forecast of 10,000 new business jet deliveries during 2011–20, with new deliveries expected to start rebounding in 2012.

Honda Aircraft stated that two key government policies or programs affect the business jet industry: (1) the bonus depreciation provisions in the U.S. tax relief legislation, which grant 100 percent bonus depreciation for aircraft delivered on or before yearend 2012 and 50 percent depreciation for those delivered by yearend 2013, and (2) the Sector Understanding on Export Credits for Civil Aircraft, which has both positive and negative elements that impact industry growth. Honda Aircraft indicated that continuation of the former policy would have a significant positive effect on the industry by supporting demand for light jet aircraft. With respect to R&D issues, Honda Aircraft highlighted three items: (1) a supportive tax policy that provides incentives for continued foreign investment in U.S. R&D, (2) continued U.S. government action to support a world-class education system, and (3) continued support of the FAA, with adequate reauthorization.

Honeywell Aerospace[27]

In a written submission, Honeywell Aerospace (Honeywell) indicated that it provides a wide variety of products and services to the business jet industry, including integrated avionics systems, airframe systems, safety avionics, engine accessories, and propulsion engines, as well as extensive global support to operators of its equipment. Honeywell noted that it supplies content on nearly every business jet in production on a global basis, with content ranging from $100,000 to over $5 million per model. Moreover, Honeywell explained that its support services range from repair and overhaul to hardware and software updates, training, and logistics. Honeywell stated that such support services can

[27] Robert Wilson, president, Business & General Aviation, Honeywell Aerospace, written testimony to the USITC, September 28, 2011, and written submission to the USITC, n.d.

be a "true discriminator" [28] for a customer when selecting an aircraft or for an OEM choosing a supplier.

Honeywell noted that most suppliers, including Honeywell, typically self-fund investment for new product development, and that very little government support exists for such investment activities. Honeywell stated that investment programs may range up to hundreds of millions of dollars, and may include the costs of certification and development assistance paid by suppliers to OEMs on new aircraft projects. According to Honeywell, development programs may take up to five years to complete, with payback on the initial investment received many years after certification. Honeywell indicated that for this reason suppliers must be sensitive about allocating scarce resources in the pursuit of winning technologies and aircraft applications.

With respect to the industry outlook, Honeywell pointed out that light and medium business jets were particularly hard hit during the economic recession because they are more popular in the United States and Europe. According to Honeywell, sales of larger, longer-range business aircraft also declined, but emerging markets and global business needs supported higher demand for these jets. Honeywell has observed a customer shift to long-range aircraft in the mid-term until financing improves, used jet values stabilize, and traditional markets for the light and medium jets recover. Honeywell indicated that emerging markets will expand their business jet needs to include small and midsize aircraft to serve growing domestic business requirements.

Honeywell stated that it expects deliveries to rise in 2012, based in part on the introduction of new models and healthy demand for larger aircraft in emerging markets. According to Honeywell, these emerging markets are also expected to outpace North America in terms of growth, but North America will remain the single largest regional market for the foreseeable future.

Financing mechanisms are key to the health and recovery rate of the industry, according to Honeywell, as business jets are not typically self-financed and do not benefit from asset-based financing. Honeywell explained that those business aircraft that are financed tend to be secured by corporate or personal assets, with 35 to 40 percent of new and used aircraft purchases being financed. Honeywell noted that the financial crisis of 2008–09 led to a loss of many financing options and made terms and conditions more costly and stringent. As a result, the share of purchases made with cash rose to an "unprecedented"[29] level, contributing to a sharp decline in overall volume and a shift in demand from smaller companies and private individuals to larger firms with financing resources, according to the company. Honeywell stated that the scarcity of financing and more costly terms exacerbated conditions in the used aircraft market, delaying the return of flight activity volume.

[28] Robert Wilson, president, Business & General Aviation, Honeywell Aerospace, written testimony to the USITC, September 28, 2011, 4.

[29] Ibid.

International Association of Machinists and Aerospace Workers[30]

In a written statement and hearing testimony, the International Association of Machinists and Aerospace Workers (IAM) stated that it represents over 700,000 active and retired workers in North America in a variety of industries, including aerospace and general aviation. The IAM noted that it is the world's largest union representing aerospace workers, with over 100,000 members from this sector. The IAM pointed out that the general aviation industry is critical to the U.S. economy and communities. Citing data from GAMA, the IAM stated that the industry contributed more than $150 billion to the U.S. economy and employed more than 1,254,000 people.

The IAM cited the significance of the U.S. business jet industry, not only in restoring the economy but also in developing leading-edge technologies. The IAM stated that the industry creates high-technology, high-skilled, and high-wage jobs that will help rebuild the nation's economy. Despite its importance, the IAM indicated that the industry is struggling and related aviation jobs are disappearing, attributable in part to the global economic downturn as well as the mischaracterization of the industry as "a caterer to the extravagant luxuries of the rich."[31] The IAM pointed out that, in fact, business jets are an essential business tool in the fast-paced global economy.

The IAM encouraged the government to implement comprehensive policies to create and expand the domestic aerospace industry as other countries have done. According to the IAM, for example, Mexico is aggressively developing its aerospace industry, with Bombardier, Hawker Beechcraft, Cessna, and others performing sophisticated production work at their Mexican facilities. The IAM stated that this type of investment is attracting other companies to move production to Mexico, costing more U.S. jobs and opportunities. Mexico is now the seventh largest source of U.S. imports of aerospace products. The IAM also pointed out that China is building its aerospace industry, claiming that its industry has benefited from production and technology transferred from Western companies to obtain market access and/or "cheap"[32] labor costs.

The IAM indicated its support for incentives to keep production in the United States, including financial support that conditions recipients to manufacture, assemble, and service business jets in the United States. The IAM also stated its support for enforcement of all trade agreements and for challenging unfair subsidies. In addition, the IAM noted its demand for the adoption and effective enforcement of international labor standards under the International Labor Organization Conventions.

[30] R. Thomas Buffenbarger, international president, IAM, written testimony to the USITC, September 28, 2011.

[31] R. Thomas Buffenbarger, international president, IAM, written testimony to the USITC, September 28, 2011, 2.

[32] R. Thomas Buffenbarger, international president, IAM, written testimony to the USITC, September 28, 2011, 4.

Learjet[33]

Learjet Inc. stated that the company is a wholly owned subsidiary of Bombardier Inc. (Canada), a global provider of innovative transportation solutions focused on the aerospace and rail industries that employs 65,400 workers worldwide. Learjet noted that Bombardier and Learjet have a long history of investment and success in the United States, citing Bombardier's employment of over 7,000 workers at 37 U.S. rail and aerospace facilities. According to Learjet, Bombardier Aerospace's U.S. activity is focused on the business jet industry, with its anchor facility in Wichita, Kansas, where Learjet is located. Bombardier Learjet aircraft are designed, manufactured, and assembled by 2,400 employees at this site. Bombardier also has a Flight Test Center at the Wichita site, where developmental flight testing is performed for all of Bombardier's business and commercial aircraft, and an aircraft service center for maintenance, repair, and modification services.

Learjet noted that in October 2007, Bombardier launched the Learjet 85 aircraft that incorporates advanced composite technology and invested $600 million in its Wichita facility. Learjet stated that this program is leveraging Bombardier's aerospace design capability, manufacturing resources, and supply chains, but is also creating significant, high-value jobs and will increase U.S. exports. In response to hearing testimony regarding its Mexico operations, Learjet commented that Wichita, Kansas, is the lead site for the Learjet 85 program, where design, final assembly, flight testing, completion, and delivery will occur. The program draws on many U.S. suppliers, as well as Bombardier's Querétaro, Mexico unit, which will supply the principal composite aerostructures. According to Learjet, the government of Mexico has offered incentives to aerospace companies that have started operations in that country, including Bombardier, but Learjet indicated that there is no indication that these incentives are unique to any one company or country. As a matter of corporate policy, Learjet pointed out that Bombardier "does not participate in any government programs inconsistent"[34] with a host country's WTO obligations.

Morgan Stanley[35]

Ms. Heidi Wood, Managing Director of Morgan Stanley, identified two key points in her hearing testimony: (1) business jets fuel economic growth and can be a competitive discriminator, and (2) U.S. policies toward business jets should be pro-business to remain competitive in the global landscape. Ms. Wood noted that policies need to adapt to the shift from the industrial age to the information age of the 21st century, which is characterized by simultaneous receipt of information worldwide that requires business to move rapidly; a greater number of markets; and a larger pool of competitors. To be successful, Ms. Wood explained that a company must have a greater understanding of its business, customers, and facilities, and its own strength and weaknesses. In this environment, aerospace transportation is going to become more crucial, according to Ms. Wood.

[33] Ralph Acs, vice president and general manager, Learjet Inc., written submission to the USITC, October 5, 2011.

[34] Ralph Acs, vice president and general manager, Learjet Inc., written submission to the USITC, October 5, 2011, 4.

[35] USITC, hearing transcript, September 28, 2011, 218–227 (testimony of Heidi Wood, Morgan Stanley).

According to Ms. Woods, government policies need to be more thoughtful about ways to enhance, rather than restrict or tax, this economic engine. As a business tool, business jets are "key instruments of business efficiency"[36] that will play a role in U.S. economic prosperity. As commercial air travel becomes less efficient and less "schedule" reliable,[37] Ms. Woods suggested that the United States needs to recognize that an alternative solution is necessary for businesses that need agility.

U.S. competitiveness is also being challenged, according to Ms. Wood. She pointed out that businesses need to be enticed to the region, and that the United States should have policies and regulations that attract new businesses. Ms. Woods further explained that economic wealth is now spreading to emerging markets, such as India and China, where there is a growing appreciation for business jets and their efficiencies. Ms. Wood commented on China's long-term aerospace strategies and government agility to respond to outdated policies. In the case of business jets, for example, China limited airspace access until about five years ago, when China reversed regulations and began opening the airspace. Ms. Woods identified three reasons for this change. By opening airspace, China can (1) stimulate economic growth; (2) expand into western China; and (3) reach its populace in case of humanitarian need.

National Business Aviation Association[38]

Mr. Ed Bolen, President and CEO of the National Business Aviation Association (NBAA), stated that the NBAA represents companies that use general aviation (GA) aircraft as a tool for meeting certain business challenges. The NBAA pointed out that GA contributes more than $150 billion annually to U.S. economic output and employs over one million people. The NBAA noted that it is committed to working with the government to modernize the aviation system and to policies that support continued growth of all aviation segments.

Business aviation is an important economic engine, creating jobs and investment, according to the NBAA. The NBAA indicated that the business aviation fleet is dominated by piston engine aircraft, helicopters, turboprops, and light jets, which account for over 80 percent of the registered fleet of over 30,000 aircraft. According to the NBAA, these aircraft reach areas without scheduled airline service where many small and medium businesses are located. Rather than senior executives, these aircraft typically carry managers and other mid-level employees. The NBAA stated that the business aviation segment not only provides an economic lifeline to these communities, but also provides support in times of crisis.

The NBAA then profiled two companies, LaBov and Beyond and Apogee Medical Group, which rely on business aviation. For LaBov and Beyond, a small marketing and communications firm located in Fort Wayne, Indiana, business aviation allows the firm to compete for clients with large firms, according to the NBAA. Business jets provide the flexibility to meet with clients on short notice, making the firm competitive with its larger competitors. For Apogee Medical Group, a small business that provides teams of hospitalists to remote facilities in 15 states, business aviation has been key to meeting

[36] Heidi Wood, hearing transcript, September 28, 2011, 221.
[37] Heidi Wood, hearing transcript, September 28, 2011, 222.
[38] Ed Bolen, president and CEO, NBAA, written testimony to the USITC, September 28, 2011, and Mike Nichols, vice president, Operations, Education & Economics, NBAA, written submission to the USITC, October 5, 2011.

client needs, according to the NBAA. The NBAA noted that the firm's business jet "makes money" by allowing the firm to "do more in a single day than their competitors can do in a week."[39]

The NBAA pointed out that the industry producing civilian aircraft, engines, equipment, and parts is one of the strongest positive contributors to the U.S. balance of trade. According to the NBAA, in 2010, world shipments of piston engine, turbojet, and turboprop aircraft totaled 2,015 aircraft. Of this total, 1,334 were manufactured in the United States, of which 52 percent (689 units) were exported. The NBAA cited information from the International Trade Administration that aircraft deliveries are becoming more evenly distributed throughout the world. North America remains the world's leading market for aircraft sales, with the Asia-Pacific region ranking second.

The NBAA highlighted two challenges to the business aviation industry. The NBAA first cited the global economic downturn that led to decreased aviation flying, a record-high used-airplane inventory, and declining aircraft prices and industry employment. Activity is still below 2008 levels, with a slow, gradual recovery expected. Second, the NBAA noted that business aviation is in "jeopardy"[40] in the absence of a clear national aviation policy. With a global marketplace, aviation makes face-to-face communication possible. According to the NBAA, business aviation is also about the value of time and the ability to travel quickly. The NBAA concluded that a national aviation policy is needed to help the industry grow and thrive in the United States.

Rolls-Royce North America[41]

In its written statement, Rolls-Royce North America (Rolls-Royce) indicated that it is a leading supplier of engines to the business jet aircraft industry, holding a 36 percent share (by value) of global engine deliveries in this sector, as its engines power the largest, fastest, and longest-range business jets. Rolls-Royce noted that it considers aftermarket service to be a crucial determinant of success in the business jet engine market, since engine work, other than routine maintenance, is beyond the capability of most business jet operators. To meet customer needs, Rolls-Royce stated that it offers the option of traditional engine overhaul or its "Power by the hour type" programs known as CorporateCare.[42]

Rolls-Royce estimated that the business jet market will account for about 18 percent of total civil aircraft demand of $3.85 trillion over the next 20 years. With respect to business jet industry structure, Rolls-Royce noted that the industry was rather stable over the last five years, with six incumbent producers. Rolls-Royce highlighted new entrants in the industry, such as Honda, which has a product in development, and China's AVIC, which has expressed interest in entering the market. Rolls-Royce also stated that it considered the business jet engine market to be highly globalized and competitive.

[39] Ed Bolen, president and CEO, NBAA, written testimony to the USITC, September 28, 2011, 6.
[40] Ed Bolen, president and CEO, NBAA, written testimony to the USITC, September 28, 2011, 8.
[41] Dean C. Roberts, director of Market Analysis, Civil Small and Medium Engines, Rolls-Royce North America, written submission to the USITC, October 3, 2011.
[42] The CorporateCare program offers "stable and predictable engine maintenance expenses, manages all engine maintenance, repair and overhaul activity, and provides engine data collection and analysis." Dean C. Roberts, director of Market Analysis, Civil Small and Medium Engines, Rolls-Royce North America, written submission to the USITC, October 3, 2011.

According to Rolls-Royce, business jet characteristics and engine requirements are not homogeneous across subsectors, with price a more important purchase consideration for very light jets than for very long haul business aircraft (with a maximum takeoff weight of about 95,000 pounds), where range, speed, and cabin comfort become more important. Rolls-Royce explained that business jet customers include large or medium corporations, private companies, private individuals, management companies, and fractional companies that purchase a business jet largely to move people quickly and efficiently, and that a typical customer buys a new aircraft every 7–12 years.

Rolls-Royce stated that since 1995, the business aviation industry has become a substantive transportation sector driven in part by general economic growth, globalization, the introduction of new aircraft models, countries that have reached economic thresholds that trigger demand, and the fractional share companies. Rolls-Royce further noted that the recent recession had a serious impact on most of the business jet market, with total annual deliveries down 45 percent to 760 aircraft from the 2008 peak of 1,350 aircraft. According to Rolls-Royce, the market for very long range aircraft was largely immune to the downturn, as this segment's customers tend to be non-U.S.-based purchasers, large global companies, and very rich individuals that had less exposure to the downturn. Rolls-Royce also indicated that the current market is sluggish and exacerbated by a large inventory of large pre-owned aircraft that has led to declining resale prices, and that economic uncertainty appears to be a major impediment to purchase, particularly in the United States.

In terms of financing, Rolls-Royce noted that business jet aircraft are purchased either directly with cash or financed with a bank loan, with cash currently accounting for more purchases. Rolls-Royce also indicated that government export credit agencies have increased their participation in the industry. With respect to business innovation, Rolls-Royce stated that successful business jet manufacturers are able to manage their portfolios of offering old and new aircraft models to the market. In addition, Rolls-Royce pointed out that most governments are involved in supporting their domestic aircraft industries, although the business jet sector has had the least involvement.

Rolls-Royce highlighted five factors that may impact the future competitiveness of the U.S. business jet aircraft industry: (1) the emergence of government subsidies; (2) the emergence of more aggressive export credit support by governments; (3) the reduction of innovation by U.S. manufacturers; (4) the introduction of trade barriers; and (5) political critiques on the industry that damage U.S. manufacturers.

Teal Group Corporation[43]

Mr. Richard Aboulafia, Vice President of Analysis for Teal Group Corporation, an aerospace and defense industry analysis company, provided a brief overview of the business jet industry structure and issues in his hearing testimony. He noted that the business jet industry has been characterized by two periods of very high growth since its creation in the early 1960s—one in the second half of the 1990s and the other during 2003–08. Mr. Aboulafia indicated that the market value of business jets grew from $5 billion annually before the first growth period to over $25 billion in 2008, and accounted for over 30 percent of the value of the global commercial jet transport business.

[43] Richard Aboulafia, vice president of Analysis, Teal Group Corporation, presentation to the USITC, September 28, 2011.

Mr. Aboulafia stated that the industry is typically seen as being structured in two segments, one composed of business jets priced above $25 million and the other composed of those priced below that amount; previously, each segment accounted for about one-half of the market. He then pointed out that market trends have bifurcated since the economic downturn, with deliveries of the higher-priced business jets continuing to grow while the lower-priced aircraft experienced "the worst market cataclysm"[44] as the value of deliveries fell by 57 percent. Mr. Aboulafia cited several reasons for the vulnerability of lower-priced aircraft, such as greater sensitivity to market cycles by smaller businesses that are more active in this segment, greater exposure to North America, and greater exposure to fractional ownership. In addition, he noted that this market segment had a far greater reliance on third-party financing. In terms of financing, Mr. Aboulafia indicated that 80 to 85 percent of the purchases of aircraft in the higher-priced segment of the market were self-funded by either the company or the wealthy individual. The majority of financing for the lower-priced segment, however, came from commercial credit, which was largely absent during the economic downturn and played a key role in the market bifurcation, according to Mr. Aboulafia.

Mr. Aboulafia identified another trend in the industry as well—the fact that corporate profits, which are a primary driver of business jet sales, are making a recovery, but corporations are not making big capital investments. He attributed this lack of spending in part to economic uncertainty. He noted that the Teal Group's assumption is for a three-year downturn, with a pick-up sometime in 2012. He indicated that there were no obvious reasons that a recovery should not occur in 2012, but that the spending problem seems to be psychological. He stated that the big question is how sales of the lower-priced aircraft will recover and whether this market segment will return to its traditional 50 percent share of the market or continue at its lower share.

Mr. Aboulafia pointed out that a real change is occurring in this business. He noted that two companies (Hawker Beechcraft and Cessna) are totally exposed to the lower-priced market segment at a time of bifurcation and of the entry of a new competitor (Embraer) in this same market segment. Mr. Aboulafia noted Embraer's success at entering the civil aircraft industry, and commented that the company has leveraged its penetration of the civil aircraft market to get into the business jet industry, which is perceived to have greater profit and growth potential.

On the topic of China's business jet industry, Mr. Aboulafia stated that the Chinese government is creating a government-owned industry and providing the upfront working capital. According to Mr. Aboulafia, "they're doing a stellar job both in terms of acquiring foreign assets as well as cultivating the development of an indigenous supply chain and homegrown models."[45] Mr. Aboulafia likened the development of China's industry with that of the Soviet Union, "with its cultivation of vertical integration. Everything needs to be supplied locally. It's how you wind up with a truly worst-in-class industry."[46]

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[44] USITC, hearing transcript, September 28, 2011, 201 (testimony of Richard Aboulafia, Teal Group Corporation).

[45] USITC, hearing transcript, September 28, 2011, 249 (testimony of Richard Aboulafia, Teal Group Corporation).

[46] USITC, hearing transcript, September 28, 2011, 250 (testimony of Richard Aboulafia, Teal Group Corporation).

UBS AG[47]

Mr. David Strauss, the U.S. aerospace and defense analyst for UBS, commented on the global competition for the U.S. business jet aircraft industry in his hearing testimony. He stated that the United States is the leading player in the global business jet industry, supplying more than 50 percent of the world's business jets. Three major business jet manufacturers and most of the industry's supply chain are headquartered in the United States. However, Mr. Strauss noted that the U.S. industry is no longer as dominant as it once was, having lost 10–15 percentage points of market share during the last 10 years.

Mr. Strauss identified three non-U.S. producers of business jets, noting that Bombardier and Dassault are well-established manufacturers that supply across a broad range of the market. Embraer, he pointed out, is a relatively new industry player, introducing a clean sheet business jet in 2002. According to Mr. Strauss, Embraer has been able to leverage its investment in the regional jet market into success in the business jet market. He also claimed that Embraer had taken advantage of lower labor costs and favorable financing to compete against more established U.S. aircraft producers by offering a newer, cost-competitive product.

While the business jet sales have fallen 30–40 percent, Mr. Strauss indicated that the long-term growth outlook for the industry is extremely positive, although in the near term the industry will have to deal with high levels of used aircraft and tighter lending standards. The U.S. industry will experience greater international competition because of the attractive growth outlook and strong financial returns accrued by the industry, according to Mr. Strauss.

Mr. Strauss pointed out that industry growth is expected to be driven by expanding markets in Latin America, Eastern Europe, China, India, and the Middle East, as the United States and Europe are mature markets with lower growth rates. Emerging markets are expected to account for more than 50 percent of demand in the next 5–10 years, according to Mr. Strauss.

Mr. Strauss focused on China's business jet industry and market, noting that only 150–200 business jets are currently registered in China. He indicated that China has targeted the aerospace industry as part of its most recent five-year plan, with the goal of developing its own business jet manufacturing capability. Mr. Strauss explained that China is expected to follow a similar path in business jets as with its commercial aircraft manufacturing, such as entering into joint ventures or technology-sharing arrangements with Western firms. However, China and other emerging markets will remain dependent on current business jet suppliers for now, limiting their ability to develop cost or technological advantages. China is expected to develop its own supply base for engines and avionics, although not before the next decade, according to Mr. Strauss.

Mr. Strauss commented on exchange rates as a factor in industry developments. According to Mr. Strauss, dollar depreciation has benefited demand because business jets are typically priced in U.S. dollars, making them less expensive for international buyers. Mr. Strauss pointed out that U.S. manufacturers benefit the most from this situation, while returns of foreign producers are generally under pressure. Mr. Strauss commented that the appreciation of the Brazilian real compared with high real-wage inflation was at

[47] David Strauss, UBS AG, testimony before the USITC, September 28, 2011.

least partially responsible for Embraer's decision to locate production in Florida rather than expand capacity in Brazil; likewise, Dassault and Bombardier's U.S. production facilities partially offset the negative impact of the weaker dollar for these firms.