SECTION 2: DEVELOPMENTS IN CHINA'S COMMERCIAL AND MILITARY AVIATION INDUSTRY

Introduction

Through a combination of hearings and research this year, the Commission investigated the increasing capabilities of China's aviation industrial base. Once virtually dependent upon imports, China now is able to produce its own advanced military aircraft and is on the cusp of fielding the first of two domestically developed commercial aircraft. These advances reflect strong efforts on the part of the Chinese government to have an aviation industry that can produce aircraft capable of rivaling foreign products. As described in testimony presented to the Commission this year:

> *With strong political backing, ample funds, and privileged access to fast-growing domestic civilian and military markets, the country's aviation industrial barons are pursuing an ambitious strategy to build an internationally competitive, innovative and comprehensive aviation design and manufacturing base within the next 1–2 decades.*[104]

The Commission also noted that China's strategies for developing its aviation industrial base bear watching, including China's adherence to its World Trade Organization (WTO) commitments. Beijing's strategies include the government's heavy political and fiscal support for China's aviation manufacturing industry and the requirement for foreign aviation firms to provide technology and know-how offsets in return for market access, strategies practiced by other countries as well. Also of note is the close integration between its commercial and military aviation sectors, and the potential for commercial advances to fuel military developments. This section of the Commission's Report discusses these issues and what they might mean for U.S. national security.

Recent and Ongoing Aircraft Development Projects

Until recently, China produced only low-end commercial and military aircraft, relying on imports for more advanced aircraft. In the past decade, however China has made significant progress developing and producing its own aircraft. This subsection provides a brief overview of some of the major commercial and military aviation projects currently under way in China, as well as ongoing engine development projects.

Commercial aviation

The ARJ–21 regional jet: The ARJ–21 is China's 70- to 100-passenger regional jet program, intended to compete with the only

other current manufacturers of regional jets, Canada's Bombardier and Brazil's Embraer. The ARJ–21 had its first test flight in November 2008 and is currently in production, with an expected delivery date sometime in 2011.[105] There are currently over 200 orders for the ARJ–21, of which at least 70 percent come from Chinese state-owned airline companies.[106] Some aviation experts opine that the ARJ–21 will not be successful commercially, due to its outdated design; lack of product support, sales, and financing capabilities; late entry into a competitive market; and lack of international safety certifications.[107] However, during President Obama's November 2009 trip to China, he pledged to try to expedite Federal Aviation Administration certification of the ARJ–21, potentially eliminating a key barrier to future international sales.[108]

"Buy Chinese"

In order to ensure that the ARJ–21 has a guaranteed market, Beijing in the past few years established two small, state-owned airline companies that are to fly only domestically produced commercial aircraft.[109] One company, "Joy Air,"* is a subsidiary of the Aviation Industry of China, while the other, "Chengdu Airlines," is owned by the Commercial Aircraft Corporation of China Ltd. As the table below shows, both Joy Air and Chengdu Airlines have placed orders for the ARJ–21.[110] In addition, according to Chengdu Airlines' website, the company also intends to purchase China's C919 large commercial aircraft when available.[111]

Airline Name	Parent State-owned Enterprise	Current Fleet Size	ARJ–21 Orders
Joy Air	Aviation Industry Corporation of China	Six MA–60 prop planes	50
Chengdu Airlines	Commercial Aircraft Corporation of China Ltd.	Seven Airbus A320	30

The C919 large commercial aircraft: Building upon the knowledge gained from previous joint ventures with foreign aviation manufacturers as well as the experience acquired during the development of the ARJ–21, the C919 is China's premier commercial aviation project. The developer of the C919, the Commercial Aircraft Corporation of China Ltd, intends the 150-passenger aircraft to compete with the Boeing 737 and the Airbus A320 in both the domestic and global markets.[112] Development of a prototype of the aircraft began in August 2010, with an initial delivery scheduled for 2016.[113] Aviation industry analysts are unsure of the C919's future success, given that China currently lacks the technology and know-how for completing such a difficult project.[114]

*Contrary to western reporting, only two such organizations exist, not three. The confusion stems from a mistranslation of Joy Air into English, which is sometimes also translated as "Happy Air."

Major Players in China's Aviation Industry

Currently two large, state-owned organizations oversee almost all aviation research, development, and manufacturing in China: the Aviation Industry Corporation of China and the Commercial Aviation Corporation of China Ltd.

Established in 1993, the Aviation Industry Corporation of China is China's primary aviation design and manufacturing conglomerate. According to its website, the Aviation Industry Corporation of China is an "ultra-large state-owned enterprise and an investment institution" that is divided into 10 branches: defense; transport aircraft; aviation engines; helicopters; avionics; general aviation aircraft; aviation research and development; flight testing; trade and logistics; and asset management.[115] Under these ten branches, the company controls over 200 subsidiary firms and 31 research institutes, employing over 400,000 people.[116] Its products include not only military and commercial aircraft but also engines and airborne weapons.[117] In recent years, the Aviation Industry Corporation of China has turned a substantial profit, earning $1.4 billion in 2009 alone,[118] and CNN Money listed the company as a Global Fortune 500 company in both 2009 and 2010.[119]

In May 2008, China established a second aviation conglomerate, the Commercial Aircraft Corporation of China Ltd, specifically to "design, develop, manufacture, and maintain" China's large commercial aircraft project, the C919.[120] Headquartered in Shanghai, the conglomerate has a number of state-owned stakeholders, such as the State Council's State-Owned Asset Supervision and Administration Commission (31.5 percent), the Shanghai municipal government-owned Shanghai Guosheng (Group) Company Ltd. (25 percent), and the Aviation Industry Corporation of China (about 25 percent).[121] According to its website, the Commercial Aircraft Corporation of China Ltd. currently controls six subsidiary companies and organizations: the AVIC I Commercial Aircraft Corporation Ltd., the Shanghai Aircraft Design and Research Institute, the Shanghai Aviation Manufacturing Company Ltd., the Shanghai Aircraft Customer Service Company Ltd., the Industry Corporation Limited, and the Shanghai Aviation Industrial (Group) Co. Ltd.[122]

Military aviation

The J–10 fighter: After roughly 20 years of development, China's first 4th generation fighter,* the J–10, finally entered service around 2004.[123] Developed by the Aviation Industry Corporation of China, the J–10 is a multirole, all-weather combat fighter capable of both air-to-air and air-to-ground missions.[124] Although the J–10 fighter design heavily incorporates input from a variety of foreign sources, most foreign observers consider it a true "Chinese" fighter

*Generally speaking, a 4th generation fighter is classified as a fighter that is equipped with increasingly sophisticated avionics and weapon systems and emphasizes maneuverability rather than speed. For more details on fighter generations, see chapter 2, section 1, of this Report.

due to the "unique synthesis of these various [foreign] elements." [125] Some western analysts posit that China is also developing an improved version of the J–10, called the J–10B.[126]

The J–11B fighter: In the mid-1990s, China purchased the rights to assemble 200 of Russia's 4th generation fighters, the SU–27 (under the name the J–11). However, in 2006 Russia cancelled the agreement at 95 aircraft when it alleged that the Aviation Industry Corporation of China violated the terms of the license and copied the SU–27 to create its own variant, the J–11B.[127] China began incorporating the J–11B into the PLA Air Force in 2007. Ironically, further production of the J–11B may be dependent upon Russia, since China is having difficulties fielding an indigenous engine for the aircraft (see below for more on China's engine projects).[128]

The J–XX fighter: Little is known in unclassified sources about China's 5th generation fighter program, the J–XX. This fighter is still in the early stages of development and, according to the testimony of Wayne A. Ulman, China issue manager for the U.S. National Air and Space Intelligence Center, it will not be operational until at least 2018.[129] Experts disagree on the actual capabilities of the J–XX, with some maintaining that it will be about as capable as the U.S. F–22 (currently the only 5th generation fighter in service in the world), and others holding that it will fall short of such advanced capabilities due to likely problems developing an engine and other necessary advanced technologies, such as composite materials.* [130]

FC–1 fighter: Unique among China's fighter programs, the FC–1 is a 4th generation fighter coproduced with Pakistan.[131] Intended for export only, the FC–1 is less capable than China's J–10 or J–11B aircraft but costs significantly less. Pakistan is currently the only nation that fields the FC–1 fighter, although other nations, such as Egypt, have inquired about purchasing the aircraft.[132] While the FC–1 is powered by a Russian engine, recent tension between Russia and China over the possibility of the FC–1 competing with Russia's fighter exports may preclude future engine sales to China for this aircraft.[133]

Engine projects

Despite progress in other areas of aviation, China's aviation engine sector remains an "Achilles' heel" in China's aviation manufacturing industry.[134] A major obstacle is China's inability to successfully develop and manufacture an advanced turbofan engine.† More efficient and more powerful than turbojet engines, turbofan engines are a necessary component of any modern commercial or military

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*Composite materials are man-made materials formed when two or more materials are combined into a third material. The third material has unique properties, which are the result of the component materials not blending together, but rather retaining their individual properties. Composite materials are increasingly used in aviation manufacturing since they are light, strong and corrosion-resistant.

†China is not alone in experiencing difficulties producing a turbofan engine. Currently, only a few nations have mastered the techniques necessary to manufacture a turbofan engine. Besides the United States, other countries that can independently manufacture turbofan engines include France, Russia, Ukraine, and the United Kingdom.

jet.* Without the ability to successfully produce a turbofan engine, China will remain dependent on imported engines. Presently, China is attempting to establish its independence from foreign engine suppliers by developing its own turbofan engines, such as the WS–10A and the SF–A turbofan engines, discussed below.

WS–10A military turbofan engine: The WS–10A is China's first modern fighter turbofan engine and was intended to power both of China's 4th generation fighters, the J–10 and the J–11. Although initiated in the 1980s, the WS–10A turbofan engine continues to experience significant problems, such as insufficient engine thrust, weak blades, and oil leakage.[135] Because of these problems, China has had to continue to import Russian-made engines for the J–10 and the J–11B fighters.[136]

SF–A commercial turbofan engine: The SF–A commercial turbofan engine is currently little more than a model and will not be operational until at least 2016. The Aviation Industry Corporation of China hopes to use this engine for China's indigenous large commercial aircraft, the C919.[137] However, the Commercial Aircraft Corporation of China Ltd. has already contracted for C919 engines with CFM International, a joint venture between GE [General Electric] and France's Snecma (Safran Group), so it is unclear if the SF–A engine, when and if developed, will replace the CFM International engine.[138]

Factors Assisting the Development of China's Aviation Industrial Base

In order to improve China's aviation industrial base and successfully conclude the above-mentioned aircraft and turbofan engine projects, Beijing has implemented an industrial strategy for its aviation industry. During this year's hearing cycle, the Commission heard about three factors in particular that help to promote China's aviation manufacturing industry. First, China's aviation industry enjoys strong government support. Second, the industry benefits from an offset policy that requires technology and know-how transfers from more-established foreign aviation manufacturing firms in return for market access in China. Third, the close integration between the commercial and military sectors of China's aviation industry allows Beijing to bolster its military aviation manufacturing capabilities by exploiting advances in the commercial aviation sector. Each factor will be discussed in turn.

Government-directed and -led development

The development of China's aviation industrial base would not be possible without the strong support it receives from the Chinese government. Beijing considers China's commercial aircraft industry a strategic industry and has made its development a national priority.[139] As China's Premier Wen Jiabao stated in regard to China's C919 large commercial aircraft project:

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*A turbofan engine is the most modern variation of the basic gas turbine engine. In the turbofan engine, the core engine is surrounded by a fan in the front and an additional turbine at the rear. This sort of construction allows a turbofan engine to provide significantly more thrust per fuel amount than a normal gas turbine engine. National Aeronautics and Space Administration, "Turbofan Engines" (Washington, DC: September 13, 2010). http://www.grc.nasa.gov/WWW/K–12/airplane/aturbf.html.

[The large commercial aircraft] is not only necessary for [China's] aviation industry, but also necessary for building an innovative country. The research and development of this aircraft will promote the development of science and technology in a number of important areas and will enable the entire passenger aircraft manufacturing industry to advance towards a higher level . . . The research and development of the large aircraft is a policy decision of great strategic significance made by the Party's Central Committee and the State Council in the new century.[140]

In recent years, several national-level programs have emphasized the development of China's aviation industrial base. The most important programs are China's Five Year Plans, through which the Chinese Communist Party maps strategies for national development in various areas over the next five years. In addition, China has also released other longer-term plans promoting its aviation industrial base.

- *10th Five Year Plan* (2001–2005)—one of the most important policies for China's aviation manufacturing industry, this Five Year Plan first emphasized the development of China's aerospace and aviation industries and specifically listed commercial aircraft manufacturing as a new emerging industry that requires Beijing's support.[141]
- *11th Five Year Plan* (2006–2010)—building upon the baseline provided in the 10th Five Year Plan, this plan specifically called for developing large commercial aircraft, helicopter, and general aviation aircraft programs. This plan also stressed developing China's aviation manufacturing knowledge and skill base.[142]
- *12th Five Year Plan* (2011–2015)—still being drafted, this new plan likely will provide further information on developing China's aviation industrial base. According to the testimony of Tai Ming Cheung, associate research scientist at the University of California, San Diego, China's 12th Five Year Plan possibly will prioritize China's 5th generation fighter program, the J–XX.[143]
- *National Medium- and Long-term National Science and Technology Development Program* (2006–2020)—this State Council plan specified the development of large commercial aircraft as one of 16 key industry areas on which China will focus over the next 15 years.[144]
- *Catalogue Guiding Indigenous Innovations in Major Technology Equipment*—this December 2009 document encouraged the domestic development of 18 types of major technological equipment, to include commercial aircraft.[145]

China's "Large-Scale Aircraft Leading Small Group"

Demonstrating Beijing's strong commitment to develop a large commercial aircraft, in 2006 China's State Council established a "Large-Scale Aircraft Leading Small Group" to oversee the development of China's large commercial aircraft project.[146] In the Chinese government, leading small groups are national-level ad hoc policy and coordination working groups, the membership of which consists of Chinese political elites.[147] The creation of such groups of high-level officials allows the Chinese government to focus efforts and resources from various disconnected ministries and departments on issues or projects that the central government feels are important. At the time of its creation, Zeng Peiyan, then vice premier and Politburo member, was the head of the Large-Scale Aircraft Leading Small Group, while Zhang Ping, then deputy secretary general of the State Council, served as deputy head. Other members included Ma Kai, then director of the National Development and Reform Commission; and Lieutenant General Li Andong, then deputy director of the General Armaments Department and alternate member of the 16th Chinese Communist Party Central Committee.[148] Further research failed to determine whether this leading small group is still in existence.

In order to achieve these macrolevel goals, China has implemented a number of policies:

- *Reorganization of the aviation industry*—In 2008 Beijing implemented two major organizational changes to its aviation industrial base. First, in May 2008, China established a new aviation conglomerate, the Commercial Aircraft Corporation of China Ltd., with the specific goal of developing China's large commercial aircraft project, the C919.[149] In November 2008, Beijing also combined two existing state-owned aviation conglomerates, the Aviation Industry Corporation of China I and the Aviation Industry Corporation of China II, into one entity.* According to Commission-sponsored research, this new organization, the similarly named Aviation Industry Corporation of China, was created to consolidate resources to better compete with western aerospace firms, such as Boeing and Airbus, among others.[150]
- *Preferential trade policies*—Beijing provides several incentives to domestic firms seeking to import or export aviation-related goods, such as an import duty exemption and value-added tax rebates.[151]

*In 1999, Beijing split the state-owned Aviation Industry Corporation of China into two smaller state-owned groups, the Aviation Industry Corporation of China I and the Aviation Industry Corporation of China II. The split was justified at the time as an attempt to foster competition in China's aviation industry. However, according to most outside accounts, the breakup was only on paper, and little competition was actually achieved in the industry.. U.S.-China Economic and Security Review Commission, *Hearing on China's Emergent Military Aerospace and Commercial Aviation Capabilities,* written testimony of Tai Ming Cheung, May 20, 2010; and Evan S. Medeiros et al., *A New Direction for China's Defense Industry* (Alexandria, VA: The RAND Corporation, 2005), pp. 174–75.

- *Creation of aviation industrial parks*—The Chinese government has established industrial parks in an effort to nurture domestic industries by "promoting geographic proximity to advanced foreign multinational company production facilities in specially constructed industrial and science parks."[152] * In recent years, Beijing has established at least eight aviation industrial parks throughout China.† In addition, China has set up an industrial hub in Beijing to coordinate the manufacturing and foreign sales of military aircraft.[153]

Technology and know-how transfer through offsets ‡

While China has no publicly stated policy requiring offsets in international aviation deals, China's commercial aviation industrial base continues to benefit from them. As the Commission previously pointed out in 2005, often in aviation deals involving China, "Chinese firms have used their leverage to extract offsets—agreements to transfer some of the aircraft production along with related expertise and technology—as part of the deals."[154] Mary H. Saunders, deputy assistant secretary for manufacturing at the U.S. International Trade Administration, reaffirmed that this problem still exists, stating that "while China does not have an official offset policy . . . a company's 'commitment' to building a relationship with China is a factor in purchasing decisions."[155] As an example, in 2008, the deputy general manager of the Commercial Aircraft Corporation of China Ltd. openly alluded to the importance of offsets while discussing the bidding process for components on China's C919. "We will choose international suppliers through bidding. But priority will go to foreign suppliers that design and manufacture products with domestic companies in China," he said.[156]

One way Chinese aviation firms acquire technology and know-how from foreign firms is through the establishment of joint ventures in China. According to Deputy Assistant Secretary Saunders:

> *China has increasingly required that joint ventures be established as a condition for awarding manufacturing contracts. These joint ventures typically involve some element of technology transfer by the U.S. partner. The intention seems to be for China to develop domestic capabilities in subsystems in addition to airframes.*[157]

Mr. Andersen described to the Commission one example where the European aerospace company, Airbus, established a joint venture in Tianjin, China, to assemble its A320 large commercial aircraft:

> *In April 2005, China approached Airbus seeking an Airbus final assembly line to be located somewhere in China. In*

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* Both Beijing and local governments support the growth of these parks by providing incentives to foreign firms, such as cheap land, plentiful labor, and tax breaks. The more advanced industrial parks in China also include local suppliers and Chinese start-up companies that provide components to or buy products from the foreign firms. Many of these parks also have links to local universities and research institutes for research and development support. Susan M. Walcott, "Chinese Industrial and Science Parks: Bridging the Gap," *The Professional Geographer* 54: 3 (2002): 349–350.

† These hubs are currently located in the Chinese cities of Anshun, Chengdu, Harbin, Shanghai, Shenyang, Tianjin, Xian, and Zhuhai.

‡ For the purpose of this Report, offsets refer to a demand for a transfer of a technology, know-how, or production capability in return for some type of market access.

December of that year, China placed an order for 150 Airbus A320s worth almost $10 billion. Though an agreement was not signed, construction on a final assembly line began in May 2007. Some analysts for the aircraft sector interpreted the announcement as a quid pro quo. An Airbus spokesman confirmed this and "acknowledged that Airbus' main reason for the plant is to gain greater access to the Chinese market." [158]

Civil-military integration in China's aviation industry

For at least a decade, China's military aviation industry has benefitted from advances made in China's commercial aviation sector. According to Deputy Assistant Secretary Saunders, "China intends to develop new capabilities through its commercial [aviation] programs, some of which could then be used to support its military programs." [159] This idea is captured in the term "civil-military integration," where a nation combines its defense industrial base with its commercial industrial base, thus using "common technologies, process, labor, equipment, material, and/or facilities" to satisfy the needs of both commercial and defense consumers.[160] In China, civil-military integration is not new. From the late 1970s into the 1990s, China promoted policies that required China's defense industry to support the development of China's civilian economy. However, in the late 1990s, Beijing reversed the direction of civil-military integration to capitalize on China's growing civilian economy as a means to develop its moribund defense economy.[161] As the Commission heard during a meeting in Beijing with the Ministry of Science and Technology, collaboration on research between the commercial and defense sectors occurs when "goals are consistent," minimizing the use of resources on similar projects.

China's Guiding Concept of Civil-Military Integration

In 2003, Beijing promulgated an official slogan to promote the use of China's commercial industrial base to rejuvenate its failing defense economy after decades of government neglect. This slogan has four phrases and can be summarized as follows:

Combine civil and military needs—focus on increasing the amount and pace of both military-to-civilian and civilian-to-military technology transfers;

Locate military potential in civilian capabilities—establish civilian enterprises that are able to satisfy the requirements of the military and defense economy;

Promote coordination and cooperation—promote close cooperation among various commercial and military entities involved in research and development; and

Conduct independent innovation—ensure that China is self-reliant when it comes to developing its military equipment.[162]

Advances made in China's commercial aviation industry directly benefit its military aviation manufacturing capabilities. "Instead of

relying on its own resources, the [military] aviation and defense industries seek to make use of commercially available technologies and manufacturing processes as a suitable substitute," stated Dr. Cheung.[163] Despite a division on paper between China's civilian and military aviation firms, "military and civilian assembly lines remain co-located, to ease the sharing of skills and technology," testified Richard D. Fisher, Jr., senior fellow at the International Assessment and Strategy Center.[164] Particular areas where commercially available technology and know-how have been included into military aircraft include avionics, microelectronics, composite materials, information technologies, and computer-aided manufacturing processes.[165]

One important technological advance transferred from the commercial to the military sector is composite materials. In military aviation, composite materials are a crucial component for constructing lighter and stealthier military aircraft. Much of China's knowledge of composite materials originated from western firms working with Chinese commercial aviation manufacturers. For example, Mr. Ulman noted that China's commercial aviation industry acquired composite material technology, equipment, and know-how from joint ventures with western aviation industries, which in turn allowed the military manufacturing sector "to increase the quantity and quality of composite materials in Chinese military aircraft." [166] A possible example of this pathway is the decade-long joint venture among two U.S. firms, Boeing and the Hexcel Corporation, and the Aviation Industry Corporation of China to produce composite materials in China.* Demonstrating another path, David Wang, president of Boeing China, noted that Boeing also is working with the Chinese Academy of Sciences to research composite materials.[167]

Implications for the United States

Changes in China's aviation market and the development of its aviation industrial base have three main implications for the United States. First, because of the projected growth in the demand for air travel in China, and China's current lack of domestic production capability, U.S. aviation-related exports to China could rise in the near to medium term. In the longer term, however, a stronger China aviation industrial base could increasingly compete with U.S. aviation manufacturers, resulting in the loss of U.S. aviation exports to China and third-country markets, as well as possibly even a decrease in their share of the U.S. domestic market. Finally, continued close interaction between China's commercial and military aviation sectors will strengthen China's military air capabilities.

Rising demand in China for commercial aircraft in the coming years could provide an opportunity for the United States to increase its already substantial aviation-related exports to China (see

*This joint venture was originally formed in 1999 among Boeing, Hextel, and the Aviation Industry of China and began production in 2002. In 2008, Boeing bought out Hextel, increasing Boeing's share in the venture to 88 percent. In August 2010, Boeing announced that it would be doubling size of the factory over the next few years. *China Daily,* "Boeing to Piece Together Composite Factory," August 26, 2010. http://www.china.org.cn/business/2010–08/26/content_20795312.htm; and *Business Wire,* "Hexcel-Boeing Joint Ventures to Produce Aerospace Structures in China and Malaysia Formally Open," September 16, 2002. http://www.allbusiness.com/defense-aerospace/aerospace-industry-commercial-general/5931651–1.html.

the table below for recent import-export data). Since 2001, China's domestic air travel has grown by 197 percent, surpassing 449 million travelers in 2009, a 22 percent increase over 2008.[168] Projected to continue to grow, the increasing demand for air travel will cause China to emerge as one of the world's largest aviation markets over the next two decades.[169] According to industry estimates, China will require roughly 3,800 aircraft by 2030, with a market value of $400 billion.[170] Boeing anticipates that upwards of 70 percent of this demand will be for single-aisle, large commercial aircraft, similar to Boeing's 737 and Airbus' A320.[171] "U.S. companies throughout the aerospace supply chain are well positioned to capitalize on [China's aviation] growth, expanding U.S. exports, and jobs," stated Deputy Assistant Secretary Saunders.[172]

Even if China successfully develops its own commercial aircraft, it will be unable to satisfy such a large demand for aircraft solely by relying upon domestic suppliers, testified Dan Elwell, vice president of the Aerospace Industries Association of America. U.S. manufacturers also could benefit from potential aftermarket sales, as well as by supplying components and parts to China's domestic aviation projects.[173] For example, according to industry analysts, 13 of the at least 20 foreign firms supplying components to the ARJ–21 are American. In addition, China also has contracted with foreign firms to provide key components for the C919 large commercial aircraft. Currently, six U.S. companies (out of 13 total foreign companies) have contracted to provide parts and systems for the C919 project.*

Table 9: U.S.-China Aviation-related Trade (2001–09)

	2001	2002	2003	2004	2005	2006	2007	2008	2009
U.S. imports from China									
% of total U.S. aerospace imports	0.3%	0.3%	0.4%	0.6%	0.6%	0.8%	1.0%	1.1%	1.3%
$ (millions)	$90	$86	$105	$159	$171	$254	$368	$406	$421
U.S. exports to China									
% of total U.S. aerospace exports	4.4%	6.2%	5.1%	3.4%	6.0%	6.4%	6.2%	4.7%	6.5%
$ (millions)	$2,591	$3,526	$2,684	$1,814	$3,748	$4,791	$5,183	$3,874	$5,314

Sources: U.S. Bureau of the Census, "Top Twenty Aerospace Suppliers to the U.S." (Washington, DC: U.S. Department of Commerce, September 3, 2010). http://trade.gov/wcm/groups/internet/@trade/@mas/@man/@aai/documents/web__content/aero__stat__top20imp.pdf; and U.S. Bureau of the Census, "Top Twenty U.S. Aerospace Export Markets" (Washington, DC: U.S. Department of Commerce, September 3, 2010). http://trade.gov/wcm/groups/internet/@trade/@mas/@man/@aai/documents/web__content/aero__stat__top20exp.pdf.pdf.

*The U.S. suppliers to the ARJ–21 program include Eaton Aerospace, Rockwell Collins, Sagem, Aircraft Braking Systems, B/E Aerospace, Goodrich, Goodrich Aerospace (Hella), Hamilton Sundstrand, Honeywell, Kaiser Electroprecision, Kidde Aerospace and Defense, MPC Products, and Parker Hannifan. The U.S. companies providing components to the C919 project include General Electric, Eaton Aerospace, Rockwell Collins, Honeywell, Goodrich, and Parker Hannifin. U.S.-China Economic and Security Review Commission, *Hearing on China's Emergent Military Aerospace and Commercial Aviation Capabilities,* written testimony of Peder A. Andersen, May 20, 2010; Richard Aboulafia, "ACAC ARJ–21," *World Military & Civil Aircraft Briefing,* November 2009, pp. 1–2; Lu Haoting, "New Aircraft Targets Airbus-Boeing Duopoly," *China Daily,* November 5, 2008. OSC ID: CPP20081105968061. http://www.opensource.gov; Philip Butterworth-Hayes, "China's Short March to Aerospace Autonomy," *Aerospace America* (February 2010), p. 30; and Reinhardt Krause, "China's Jet Ambition a Boon to Suppliers—Or Their Bane?" *Investor's Business Daily,* August 18, 2010. http://www.investors.com/NewsAndAnalysis/Article/544256/201008181859/Chinas-Jet-Ambition-A–Boon-To-Suppliers-and151–Or-Their-Bane-.aspx.

At the same time, however, there is the potential that as China's commercial aviation industrial base improves, it will have a negative impact on U.S. economic security. First, although China likely will continue to rely on foreign imports in the near future, there is no guarantee that China will continue to purchase U.S. aircraft. Given Beijing's goal of having the ARJ–21 and C919 aircraft compete with foreign aircraft manufacturers, it is probable that Beijing will compel more of its state-owned domestic airlines to purchase Chinese aircraft rather than foreign aircraft.[174] In addition, the continued presence of technology and know-how offsets, the increase in joint ventures between foreign and Chinese aviation manufacturing firms, and the growth in sourcing of aviation components from Chinese manufacturers will likely improve China's aviation industrial base, making it increasingly capable of competing with U.S aircraft and aviation-related component manufacturers both in China and abroad.[175] For example, according to the vice president for Business Development at Boeing China, "Boeing partnerships in China are strategically chosen for long-term benefits to all. The company works on projects that help Chinese partners gain technical and manufacturing experience, which enables the delivery of aviation products with superior quality and value."[176] A Boeing spokesman was recently quoted as stating that Boeing is now the "Chinese aviation industry's largest foreign customer" and that "Chinese suppliers now have a role in all Boeing airplanes."[177] Moreover, more than a third of Boeing's total aircraft parts come from China.[178] Finally, the rise of China's commercial aviation industrial base could displace U.S. aviation manufacturing jobs, affecting a workforce that includes more than 492,000 highly skilled people.[179] Summing up the potential threat of China's growing aviation industrial base to the United States, Owen E. Herrnstadt, director of trade and globalization at the International Association of Machinists and Aerospace Workers, testified that:

> *[t]ransfers of production and technology from U.S. aerospace and related companies [to China] cost U.S. aerospace jobs and lead to a further decline in our aerospace industrial base in at least four different but related ways: First, jobs that may be associated with the transfer of technology and production are lost; second, the skills that accompany the transfers are lost, leading to a further decline in our industrial base; third, future jobs are lost as China (and other countries) utilizes the transfer from the U.S. to create and strengthen their own aerospace companies that compete directly with U.S. companies; and fourth, the technology and production that would have led to more U.S. jobs through the development of innovative products is lost.*[180]

Table 10: Chinese Suppliers to Boeing Aircraft

Chinese Supplier	Work package	Aircraft type (to include variants)
BHA Aero Composites	Composite panels and parts	Boeing 737
	Composite panels, door liners, fixed trailing edge	Boeing 747
	Wing fixed trailing edges and dry bay barriers, empennage panels	Boeing 767
	Wing fixed trailing edges and dry bay barriers, empennage panels, flight deck interior panels	Boeing 777
Chengdu Aircraft Corporation	Forward entry doors, over wing exit doors	Boeing 737
	Aileron and spoilers	Boeing 747
	Horizontal stabilizers and subassemblies	Boeing 747
	Composite rudder	Boeing 787
Hafei Company	Wing-to-body fairing panels	Boeing 787
Shanghai Aviation Industries Group	Horizontal stabilizers	Boeing 737
	Parts for vertical fin, horizontal stabilizer	Boeing 737
Shenyang Commercial Aircraft	Aft fuselage subassemblies	Boeing 737
Xian Aircraft	Fuselage section, vertical fin	Boeing 737
	Fixed trailing edge wing ribs	Boeing 747

Source: Adapted from Philip Butterworth-Hayes, "China's Short March to Aerospace Autonomy," *Aerospace America* (February 2010), p. 28

Finally, improvements in China's military aviation industry as a result of its close working relationship with China's commercial sector could impact the U.S. military. Technology and processes perfected in China's commercial aviation industry will strengthen China's military aviation industry. This in turn will increase China's air combat capability and contribute to China's capacity to hinder the U.S. military's ability to operate freely in East Asia. (For more on China's increasing air power, see chap. 2, sec. 1, of this Report.)

Conclusions

- Given the close integration of China's commercial and military aviation sectors, advances in China's commercial aviation industry gained through interactions with western aviation manufacturers directly benefit China's defense aviation industry. As China's commercial aircraft manufacturing capabilities improve, newly acquired technology and know-how, such as composite materials production, are directly transferred to the defense aviation sector.
- Over the past decade, China's aviation industrial base, with the strong support of the Chinese government, has improved substantially. China currently is capable of developing and producing both advanced commercial and military aircraft and seeks to compete with foreign aviation manufacturing companies in the near future. Despite these advances, however, the industry continues to experience some problems, most notably in producing advanced engines.

- China's aviation industrial base benefits from several practices that bear watching. In particular, the industry enjoys strong government support that favors domestic firms over foreign firms and also benefits from technology and know-how offsets from western aviation firms in exchange for market access.
- Developments in China's aviation industry pose both benefits and challenges to the United States. In the near term, U.S. aviation manufacturing firms stand to benefit from increased aviation exports to China. However, as China's aviation manufacturing firms improve, U.S. aircraft and aviation component manufacturing companies will likely face increased competition from these aviation firms in China's domestic, third country, and U.S. markets.