FUTURE AIRCRAFT PROGRAMMES: COMPETITIVE OPPORTUNITIES FOR AEROSPACE SUPPLIERS

EDITION ONE: THE COMMERCIAL AIRCRAFT CORPORATION OF CHINA (COMAC)

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Contents

1.3 Joint venture partnerships

1.3.1. COMAC ARJ-21

Fuel, hydraulic and flight control systems - Parker Aerospace is working with ACAC to develop, integrate, build, test, certify and provide service for the three systems throughout the life of the program, as lead integrator for the fuel and hydraulic systems, and in partnership with Honeywell on the flight control system. The company has established new aerospace facilities in China to support the work (ACAC is a consortium of six companies and aerospace research institutes – including the Shanghai Aircraft Research Institute and the Xian Aircraft Design and Research Institute - involved in the development and manufacture of the aircraft).

Technical assistance - AVIC I and Bombardier Aerospace have signed an agreement for a long-term strategic cooperation in the 90- to 149-seat commercial aircraft market. Bombardier intends to participate in the development of AVIC I's five-abreast COMAC ARJ21-700-900 aircraft. Under the terms of the agreement Bombardier intends to invest $100 million US in the COMAC ARJ21-700-900 project, when launched, and provide technical assistance towards the development of the aircraft. Furthermore, in pursuit of its goal to become a major international Tier 1 structural supplier, AVIC I plans to invest $400 million US for research and development, construction of new facilities and equipment for the CSeries aircraft program, should it be launched.

Electrical wiring - Fokker Elmo, part of Fokker Technologies, has signed a contract with Commercial Aircraft Corporation of China Ltd (COMAC) subsidiary Shanghai Aircraft Design and Research Institute (SADRI) for cooperation on the ARJ21 Aircraft Electrical Wiring and Interconnection System (EWIS). The cooperation will start early 2013 and will predominately be performed at the SADRI facilities in Shanghai.

1.3.2 COMAC C919

Landing gear - AVIC Landing-gear Advanced Manufacturing Co., Ltd. (LAMC), Changsha, Province of Hunan in China and Liebherr-Aerospace Lindenberg GmbH, Lindenberg (Germany), have signed a joint venture contract for the COMAC C919 programme. The joint venture includes assembly and testing activities for landing gears for the Chinese market and will potentially extend its activities to other geographical markets. Liebherr-Aerospace Lindenberg GmbH and LAMC have been selected by COMAC to develop, supply and service the landing gear system of the C919. The landing gear system includes the main landing gear and nose landing gear, extension and retraction system, nose wheel steering system as well as the position and warning system. Liebherr-Aerospace is also participating in the C919 with the complete air management system, developed and supplied by Liebherr-Aerospace Toulouse SAS, Toulouse (France), sister company of Liebherr-Aerospace Lindenberg GmbH.

Fuel, inerting and hydraulic systems - Parker Aerospace, COMAC and AVIC have agreed a joint venture between Parker and AVIC Systems for the fuel, inerting and hydraulic systems. The Parker Aerospace Fluid Systems and Electronic Systems Divisions will be responsible for the complete fuel and inerting systems for the aircraft. The fuel system equipment will handle

Russian and Chinese teams have been working on the project for some years. The leaders of Russia's United Aircraft Corporation and the Commercial Aircraft Corporation of China signed an agreement to cooperate on the development of a new wide-body long-range passenger airliner in May 2014. Press reports of the time suggested China was interested in building at least 1,000 aircraft of this kind; the aircraft's target markets would be Russia, the CIS, and Southeast Asia, and that it may get up to 10% of the global market by 2032. Russia and China may also cooperate to develop the aircraft's engine. UAC would be responsible for the design of the new aircraft's wing, empennage and aerodynamic surfaces, which would comprise 50 percent of composite materials and 15 percent titanium.

While the structures, landing gear and engines would be mainly Chinese or Russian by origin there would be substantial opportunities for Western suppliers to set up joint ventures in the critical systems areas – engines, electrical supply, fuel system, air conditioning and pressurisation, lighting, cabin interiors, avionics – where both Russian and Chinese suppliers are in joint ventures with Western companies for their current aircraft programmes (see part three) but have yet to mature their own technologies to create entire subsystems competitive in performance - increased power, reduced weight, increased ruggedness – with those which will appear on competitive Airbus and Boeing models.

Table one: New airliners – entry into service dates

	Entry into service	Seats	Notes
2016			
	COMAC ARJ-21[5]	70-95	274 orders in October 2015
	Bombardier CS Series6 100	108-133	Entry into service early 2016
	Bombardier CS Series 300	130-160	Entry into service six months after CS 100
2017			
	Airbus A330-800neo	257-406	Replacement for the A330-200, with Rolls-Royce Trent 7000 engines with 112-inch diameter fan for a 10:1 bypass ratio, along with new Sharklet wingtip devices. Planned for first deliveries in the fourth quarter of 2017
	Airbus A330-900neo	287-440	Replacement for the A330-300, with Rolls-Royce Trent 7000 engines with 112-inch diameter fan for a 10:1 bypass ratio, along with new Sharklet wingtip devices. Planned for first deliveries in the fourth quarter of 2017
	Boeing 737Max 8/200[7]	162-200	Entry into service Q3

[5] Source: http://www.reuters.com/article/2015/10/21/us-china-aircraft-arj21-exclusive-idUSKCN0SF2XN20151021#bdCvv6JV1GGmPY5o.97

[6] Source: http://www.theglobeandmail.com/report-on-business/bombardiers-c-series-delivery-pushed-back-to-2016/article23664450/

[7] Source: http://aviationweek.com/dubai-air-show-2015/boeing-could-sell-thousands-midsize-nma-jets?NL=AW-05&Issue=AW-05_20151110_AW-05_563&sfvc4enews=42&cl=article_8_2&utm_rid=CPEN1000001180520&utm_campaign=4238&utm_medium=email&elq2=289aee4ef7a44906bd427b8dffc15aae

air management systems - including air conditioning pneumatic and cabin pressure control systems - for the AVIC MA700 regional turboprop aircraft.

However, COMAC also has a strong relationship with Liebherr Aerospace, which is participating in the C919 with the complete air management system, developed and supplied by Liebherr-Aerospace Toulouse SAS, Toulouse (France), sister company of Liebherr-Aerospace Lindenberg GmbH (Germany). Liebherr-Aerospace Toulouse has also developed a major role on the SuperJet 100, comprising air conditioning, engine bleed air system, cabin pressure control system, anti-ice system, and high- and low-pressure distribution systems.

Table two: Air conditioning contract awards in recent wide-body aircraft programmes

Aircraft	Company	System details
Airbus A350 XWB-800/-900/-1000	Honeywell	Honeywell supplies the air management system: the bleed air, environmental control, cabin pressure control and supplemental cooling systems.
Airbus A380	UTC Aerospace	UTC Aerospace is providing 13 systems and major components for the A380. Among these are: **The Air Generation System (AGS):** The AGS provides heating and cooling for the entire airplane passenger cabin, flight deck, cargo bays and avionics equipment bay. The heart of the system is two pneumatically-driven air conditioning packs, or Air Generation Units (AGUs), that produce a total of 752 KBTU/hour of cooling. **Cabin Pressurization and Control System (CPCS):** The A380 CPCS controls the air pressure in the cabin. The system includes four outflow valves that regulate the cabin altitude to no more than 7,000 feet while flying up to 41,000 feet. **Ventilation Control System (VCS):** The A380 VCS regulates the flow of fresh and re-circulated air. It also regulates air temperature control throughout the three main decks of the pressurized fuselage: the mid-deck, upper-deck and cargo bays. This system includes the individual outlets located above each passenger seat row, which are adjustable in airflow and direction. **Avionics Ventilation System (AVS):** The A380 AVS comprises of two independent circuits, right and left hand, that control and regulate the flow of cooling air from the AGUs to the cockpit panels, avionics equipment racks, primary power centre and the upper-deck electrical equipment bay for cooling of electronic equipment. The system then finally discharges the air outside the airplane through a cabin outflow valve.
Boeing 777X	UTC Aerospace	UTC Aerospace Systems' 777X electric power generating system is a new main electrical generation system, providing 25 percent more power than the current 777 system, which is also supplied by UTC Aerospace Systems. The 777X system comprises two 150 kVA integrated drive generators, an auxiliary generator, three generator control units and a bus power control unit. UTC Aerospace Systems will also supply the cabin air conditioning and temperature control system, air foil and cowl ice protection system, and the complete ventilation system suite of fans.

2.7 Structures

Both Chinese and Russian companies have achieved considerable knowledge of building complex aerospace structures in recent years. China, in particular has invested heavily in composite companies outside China.[15]

Chinese composite manufacturers have considerable work underway with Bombardier, Airbus and Boeing. In 2009 Airbus signed a contract with Chinese partners to create a joint venture to make carbon composite parts in China for its A350 XWB and A320 aircraft. Airbus's Chinese business holds a 20% stake in the joint venture, based in Harbin, and China's Harbin Aircraft Industry Group holding a further 50% stake, while other local players HAI, AviChina and HELI will each own 10%. At the end of February 2011 the Harbin Hafei Airbus Composite Manufacturing Centre (the Manufacturing Centre), a joint venture between Airbus and its Chinese partners, was inaugurated. The 33,800-square-metres facilities are the first of what will be an 80,000-square-metres manufacturing compound, comprising production, technical support, office areas and other services. The Harbin Manufacturing Centre produces A350 components, including rudders, elevators, Section 19 maintenance doors and belly fairing parts – all in all a significant part of the five percent A350 XWB airframe work packages share to be carried out in China.

In 2010 Boeing has announced plans to double the number of employees in China; Boeing Tianjin Composites Co Ltd is increasing its workforce to 1,200 in the next few years, working mainly on Boeing 737 structures - flight deck, close out panels, dorsal fin, wing-to-body fairing, cover panels, wing fixed trailing edge, wing fixed leading edge, interior panels. In November 2014 a new agreement was reached between Boeing, AVIC Shenyang Commercial Aircraft Corporation (SACC) and AVIC International. It builds on the contract Boeing signed with AVIC in 2014 to produce vertical fin and horizontal stabilizer forward torque box panels. Under the contract, workers at SACC build tips for the 777 vertical fin and horizontal stabilizer at its facility near the airport in Shenyang, China. Boeing qualified SACC for composite work in July 2014 following a comprehensive audit of equipment, workforce and processes. The two companies are also working together in establishing a Manufacturing Innovation Center (MIC) within the SACC facility to enhance the manufacturing and technological capabilities of SACC employees. Boeing and AVIC pioneered the MIC concept in 2012.

Meanwhile United Aircraft has decided on Ulyanovsk as the site for a composite manufacturing plant capable of manufacturing 100 sets of composite wings a year along with airframe structures for the Sukhoi Superjet and Irkut MC-21 airliners. The Novosibirsk Aircraft Production Association (NAPO) is a member of the Sukhoi holding company. NAPO makes the forward and after sections of the Superjet 100 along with the empennage and the 75-seat version is assembled in Novosibirsk, with many components and substructures made by KnAAPO.

However, a wide-body aircraft with a 50% carbon fibre structure would require a huge leap in technical and integrator expertise; the C919 has a relatively low carbon fibre content in the fuselage and structure[16] and this is one area where Airbus and Boeing are likely to retain a competitive advantage despite the time available to the aircraft's developers for further research in this area. At least Chinese manufacturers now have the option to use increasingly lighter but stronger aluminium alloys which are entering the market, making the choice between carbon and aluminium slightly less critical than it might have been a few years ago.[17]

[15] Source: http://www.reuters.com/article/2009/10/04/us-facc-xac-idUSTRE5931LT20091004
[16] Source: http://aviationweek.com/awin/china-increasing-output-strong-carbon-fiber
[17] Source: https://www.promexico.gob.mx/documentos/mapas-de-ruta/Roadmap-Aerospace-2014.pdf

3.2 COMAC C919

Contractor	Supplier	Plant/company location	Work package	Comment
COMAC	See comment	See comment	See comment	China's Large Commercial Aircraft Corp has named its 190-seat single-aisle, twin engined-aircraft the C919. First flight planned for 2016. The C919 will be assembled in Shanghai and major partners already announced are: AVIC companies Chengdu Aircraft Corp, Xian Aircraft Corp, Shenyang Aircraft Corp, and Shenxi Aircraft Corp. In June 2009.
COMAC	Jiangxi Hongdu Aviation (also known as Nanchang Aircraft)	Hongdu, China	Aft fuselage	
COMAC	Harbin Aircraft	Harbin, China	Composite fairings and moving surfaces and	
COMAC	Shenyang Aircraft	Shenyang, China	Empennage	
COMAC	Aerospace Haying	Zhenjiang, China	Tail cone	
COMAC	Hongdu Aviation	Nanchang, Chna	Forward and aft doors	
COMAC	Chengdu Aircraft	Chengdu, China	Nose	
COMAC	Xian Aircraft	Xian, China	Cockpit, wings and main fuselage	
COMAC	Alcoa	New York, New York, USA	Advanced aluminum structural concepts	Through a technology cooperation agreement, the two companies are examining advanced aluminum structural concepts, designs and alloys to create the 190-seat aircraft.
COMAC	Crane	Redmond, Washington DC, USA	DC power subsystem	Crane Aerospace & Electronics, Power Solutions is supplying a DC power subsystem consisting of Transformer Rectifier Units (TRUs), Battery Controllers and Batteries
COMAC	Crane Aerospace and Electronics	Lynnwood, Washington, USA	Door signal system	The Crane doors signals system will monitor and communicate the position of the C919 fuselage doors, cargo doors and flight locks. The Doors signal system will communicate with other aircraft