Asia Passenger Plane Vision

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Asian Network of Major Cities 21

The Examination Committee for “Promotion of Development of a Small to Medium-Sized Jet Passenger Plane”

Contents

Prelude: About the Asian Network of Major Cities 21 and the "Promotion of Development of a Small to Medium-Sized Jet Passenger Plane" Project

1. Asian Network of Major Cities 21

Advocated by Tokyo Governor Shintaro Ishihara, representatives of Delhi, Kuala Lumpur, Seoul and Tokyo gathered in August 2000, and agreed to establish the Asian Network of Major Cities 21 as a new framework of cooperation for the further development of Asia. These representatives then called on other cities in Asia to participate, and convened the First Plenary Meeting of the ANMC 21 in Tokyo in October 2001 to formally launch the ANMC21.

Since then, the Network has held a plenary meeting once a year, and promoted various joint projects to enhance its network and range of activities. The Promotion of Development of a Small to Medium-Sized Jet Passenger Plane Project is one such joint project implemented by the ANMC 21.

There are a total of 11 ANMC 21 member cities: Bangkok, Delhi, Hanoi, Jakarta, Kuala Lumpur, Manila, Seoul, Singapore, Taipei, Tokyo and Yangon (in alphabetical order). The City of Beijing was formerly a member, but officially withdrew from the ANMC 21 in August 2005.

2. Promotion of Development of a Small to Medium-Sized Jet Passenger Plane Project

The Promotion of Development of a Small to Medium-Sized Jet Passenger Plane Project, one of the joint projects implemented by the ANMC 21, aims to compile, review and promote a vision for the development of a jet passenger plane (hereafter; "Asia Passenger Plane") that leverages the technologies and competencies of Asia in order to meet growing demand for air travel in the region.

A total of six ANMC 21 member cities are participating in the project including Delhi, Hanoi, Jakarta, Kuala Lumpur, Taipei and Tokyo (in alphabetical order).

Chapter 1: Significance of Developing a Jet Passenger Plane in Asia

1. Asia – the Third Pole Next to Europe and the United States

Emerging nations in Asia have maintained high economic growth rates (Figure 1), indicating there is sufficient potential for Asia to become the new growth engine of the global economy.

In addition, the number of commercial airplanes operating in Asia has increased rapidly on the back of economic growth boosting demand for business and leisure travel. Forecasts suggest that by 2029 Asia will become the largest air travel market in the world (see Figure 2 and 3).

2. Jet Passenger Plane Optimized for the Asia Market

The Asia region is unique in that it has high temperature, high humidity climates, high population density and large numbers of islands, meaning overland transportation networks have not been developed and most airports have short runways.

On the other hand, although the region has lower income levels when compared to Europe and North America, Asia has shown huge latent potential for air travel demand.

At present, most routes servicing cities in Asia are operated using Boeing 737 or Airbus A320 aircraft. In line with the future growth of the Asia market, however, aircraft replacement demand will grow for routes currently serviced by 50-seat or smaller turboprop passenger planes, while low cost carriers (hereafter; “LCC”) are expected to launch widespread operations in Asia. As a result, there is an anticipated need for a more regionally localized passenger plane that can link the cities of Asia.

According to a demand forecast for aircraft in Asia conducted by the Tokyo Metropolitan Government targeting the nations and regions of ANMC 21 member cities, together with China, Pakistan and the Middle East, demand for the 110 to 150 seat commercial aircraft segment will increase going forward (Figure 4).

3. Asia’s identity

Nearly all passenger aircraft operating in Asia are manufactured by commercial aircraft makers from Europe and the United States.

Given this situation, a passenger aircraft manufactured using Asia’s advanced

technologies and competencies will become a symbol of solidarity in the region. A passenger aircraft manufactured under the cooperation of multiple countries in Asia that services the cities of Asia will also form a new identity for the region.

In addition, through the success of the Asia Passenger Plane, Asia will be able to show Europe and North America its true potential, making it possible to enhance its presence in the eyes of the world.

The development, manufacture and operation of the Asia Passenger Plane should be encouraged as a means to respond to air travel demand in Asia, which is expected to grow substantially going forward, and to further solidify Asia's identity.

The development of a jet passenger plane currently underway in Japan represents the first of its kind in Asia, and as such carries with it great significance. Therefore, the Tokyo Metropolitan Government, through the activities of the ANMC 21, will continue to promote the participation of manufacturers in Asia in the development and production of the Asia Passenger Plane as well as its widespread use in the Asia region.

Through this initiative, the Tokyo Metropolitan Government will also seek to enhance technical competencies and collaboration in Asia, and to foster momentum to develop and manufacture the Asia Passenger Plane in Asia, which will widely link Asian cities.

Chapter 2: Requirements for and Background to Developing a Vision

1. Current Status of the Aerospace Industry in Asia

(1) Current Status of Japan's Aerospace Industry

Japan has experience developing civilian aircraft, as evidenced by the YS-11, FA-200, MU-2, MU-300 and others. Japan also has established a track record in system integration for civilian aircraft, including landing gear systems, flight control systems and interiors. In addition, Japan has a solid track record in materials and processing, including composite materials, the manufacture of parts and large components, through joint development together with Boeing, and manufacturing systems including primary devices.

On the other hand, there has been almost no independent maintenance repair and operation (MRO) programs.

In the defense sector, Japan has produced training, transport as well as support fighter aircraft, and has conducted several other licensed aerospace manufacturing work.

(a) Background

The seven year void following the Second World War marked a transition to a new period in air travel including the advent of jet technology and new passenger aircraft. This proved to be a major technical blow to Japan's aerospace industry.

Later, Japanese companies engaged in the licensed production of American made aircraft for the Defense Agency (today the Ministry of Defense), which served to rebuild their basic aerospace technologies (Figure 5). The rebuilding of this basic technical foundation enabled the development of the T-1 and YS-11 domestically in Japan, but production has since ceased for both aircraft.

Photo. 1: YS-11
Source: Wikipedia

Since then, both Mitsubishi Heavy Industries and Fuji Heavy Industries aimed to directly enter the business jet segment, but sales flopped despite the successful development of a high performance aircraft.

Since the 1970s, civilian commercial aircraft have primarily been co-developed

internationally. Firms from Japan's aerospace industry have participated as a core partner in large-scale development programs including the Boeing 767, 777 and 787 as well as the V2500 engine (Figure 5 and 6). Japanese companies are also suppliers for the Airbus A320, A330, A340 and A380.

One specific example is the Boeing 787 program where Japan's big three heavy industry firms, Mitsubishi Heavy Industries, Kawasaki Heavy Industries and Fuji Heavy Industries, are responsible for manufacturing 35% of the entire aircraft centered on the fuselage structure (Figure 6). In addition, 21 Japanese companies, including JAMCO Corporation and Toray Industries, are involved in the Airbus A380 program (Figure 7) .

(b) Domestically-Produced Jet Passenger Plane – the Mitsubishi Regional Jet (MRJ)

The MRJ program represents Japan's first passenger plane development project since the YS-11 half a century ago.

Launched as a development program for an environment-conscious high performance small passenger aircraft under an initiative by the Ministry of Economy, Trade and Industry in 2003, the project was officially launched by Mitsubishi Heavy Industries in March 2008.

Photo. 2: MRJ
Source: MRJ Website

The MRJ aims to achieve more than a 20% increase in fuel efficiency compared to existing competitors in its class (Figure 8). In addition, the MRJ fully clears the latest noise abatement and emission gas standards, as it is set to become the quietest and cleanest regional jet in the world (Figure 9). The MRJ's first flight is scheduled for the second quarter of 2012 with the first delivery to be made in the first quarter of 2014.

(c) Conversion of Ministry of Defense Aircraft to Civilian Airliners

In fiscal 2001, the Defense Agency designated Kawasaki Heavy Industries as the principle contractor for the development of the XP-1 maritime patrol aircraft and the XC-2 military transport aircraft.

Photo. 3: XP-1

Alongside this, the Ministry of Economy, Trade and

Industry starting in fiscal 2002 commissioned a study on the potential to covert these aircraft for civilian use.

Photo. 3: XC-2
Source: Kawasaki Heavy Industries corporate website

The XP-1's first flight took place in September 2007, with the first test frame delivered by Kawasaki Heavy Industries to the Ministry of Defense in August 2008.

The XC-2's first flight occurred in January 2010, with the first test frame delivered by Kawasaki Heavy Industries to the Ministry of Defense in March 2010.

In April 2010, the Ministry of Defense set up the Investigative Commission on the Conversion of Ministry of Defense Aircraft to Civilian Airliners, marking the start of an official government review into the potential for converting the US-2 rescue aircraft and XC-2 for civilian use.

Photo. 5: US-2
Source: Shin Maywa Industries corporate website

Three proposals were made for the conversion of the US-2 for civilian use: first, as a multipurpose aircraft to perform rescue operations during a disaster or provide medical air lifts for outlying islands, second, as a fire-fighting aircraft, and third, as a passenger plane connecting larger cities with outlying islands.

The XC-2 converted civilian cargo aircraft, the YCX, features sufficient cargo space and superior cruise performance to completely cover the entire Asia region, including Australia, with a 12-ton payload (Figure 10). The YCX is also expected to offer superior operating economics, as it will operate at high speed and cruise at high attitudes (Figure 11).

(d) Research and Technical Development by the Japan Aerospace Exploration Agency (JAXA)

JAXA has engaged in research and development of propulsion systems, composite materials and flight control systems aimed at the development of a domestically-produced aircraft that is fuel efficient, low-noise and environment-friendly.

Specifically, JAXA is participating as a joint research institution in the development program for an environment-conscious high performance small passenger aircraft

supported by the New Energy and Industrial Technology Development Organization (NEDO).

In addition, JAXA is also conducting research and development of the required clean engine technologies in order to develop an environment-friendly engine that easily clears aircraft environmental standards by a wide margin.

Furthermore, JAXA uses its wind tunnel facilities that can mimic low to high speed flight conditions to conduct research and development on advanced instrumentation technologies.

(2) Current Status of Asia's Aerospace Industries ex-Japan

The aerospace industries of nations, excluding Japan, of ANMC 21 member cities participating in the Promotion of Development of a Small to Medium-Sized Jet Passenger Plane Project as well as China have manufactured (domestically-produced or licensed production) completed civilian airliner fuselages, but today core businesses revolve around MRO or supplying parts for North American and European aircraft makers.

The following section compiles the current situation in each country as of the end of May 2010.

(a) India

In the civilian aircraft sector, India has the trusted experience of comprehensive production (licensed production, etc.) of turboprop aircraft, manufacturing metal-based parts (aluminum, etc.) and metallic materials, producing composite materials, avionics design and development and production. There are also some MRO providers in operation, manufacturing for overseas OEMS, design services for global aircraft companies.

In the military aircraft sector, India has domestically produced the Light Combat Aircraft (LCA) and helicopters.

i) National Aerospace Laboratories (NAL)

NAL is currently considering the development of RTA-70 which is a 70-seater, twin-engine regional airliner.

Photo. 6: RTA-70
Source: NAL Website

While both turbofan and turboprop engines are being considered for the RTA-70, aircraft equipped with turboprop engines are taking the lead. RTA-70 aims to decrease the initial cost by 25% and maintenance cost by 25% compared with existing aircraft of the same class. RTA-70 is to design a fuselage with superior STOL (Short Take-Off and Landing) performance. Early in 2010, in Hyderabad, NAL presented the RTA-70 cabin projection.

NAL also makes the 2-seater trainer: HANSA and also designed the 14-seater SARAS. Presently, NAL is designing a 5-seater aircraft in collaboration with Mahindra Aerospace.

A National Civil Aircraft Development (NCAD) Program has been established by the Government of India which is studying the feasibility of developing a right sized aircraft for India, that will also facilitate the further growth of the civil aviation industry in India. NCAD is being seeded at NAL and will be looking at a public private partnership structure and a joint venture with the private sector. NCAD is the logical extension of the studies on the RTA-70 being conducted at NAL.

ii) Hindustan Aeronautics Limited (HAL)

HAL is the largest domestic aircraft manufacturer. It is mainly involved in the licensed production of fighter planes and the development and production of domestically produced aircraft.

Photo. 7: MTA (Multi-Role Transport Aircraft)
Source: NAL Website

HAL and Rolls-Royce reached an agreement in March 2010, regarding the establishment of a fifty-fifty joint venture in Bangalore to produce engine parts.

HAL has designed, developed and produced the Advanced Light Helicopter (ALH) which is used by the military and has a certified civilian version.

HAL has produced the Do 228 and HS 748 under license, and manufactures uplock boxes used in Boeing 777s, which is a structural part belonging to aircraft landing gear. It also makes structural components and assemblies like the rear fuselage for many global OEMs.

In addition, it is involved in the manufacturing of parts for the Boeing P-81 for the Indian Navy, and is drawing up the development plans for MTAs (Multi-Role Transport Aircraft) and attack helicopters.

iii) Taneja Aviation (TAAL)

TAAL has been producing Partanevia aircraft in India and presently carries out MRO work.

iv) Tata Group

TCS (Tata Consultancy Services), a subsidiary of the Tata Group, develops engineering-related software, and is already providing engineering services for the Airbus 380 in partnership with GE.

TCS sealed an engineering service contract with Rolls-Royce Group plc in April 2010. TCS has joined hands with Sweden's Saab for the selection of Indian next-generation fighter plane selections.

TASL (Tata Advanced Systems Limited), a subsidiary of the Tata Group, manufactures the cabin of the Sikorsky S-92 helicopter. The first cabin is scheduled to deliver in the second-half of 2010.

The Tata group has equity in Piaggio, the Italian small aircraft manufacturer

v) Mahindra Aerospace

This is part of the Mahindra Group which is an automobile company, but has made a foray into aviation. Mahindra Aerospace has presently acquired an Australian small aircraft company and has collaboration with NAL. It shows that Mahindra Aerospace is intent on entering the aerospace industry in a big way.

In recent years, there are a number of smaller companies that are supporting the global aerospace programs as sub contractors.

(b) Indonesia

i) PT Dirgantara Indonesia / IAe (Indonesian Aerospace)

PT Dirgantara Indonesia, or Indonesian Aerospace (IAe), is the only aircraft producer in Indonesia. IAe's main activities are aircraft manufacturing and assembly, aircraft structure components manufacturing as global supplier for various aircraft industry in the world, such as Airbus, Eurocopter, and MRO for the aircrafts operating in Indonesia. Most of IAe's aircraft products are used for transport both by civilian and military sector.

IAe developed the N-250, the twin-engine turboprop. The first plane, the fifty-seater N250-100, set out on its maiden flight in August 1995. The second plane soon rolled out.

IAe designed a 70-seater stretched-version of N-250. However, IAe halted the development of N-250 due to the 1997 Asian Financial Crisis. As of 1998, it had received orders for over 30 planes, but these orders were completely canceled.

Photo. 8: Outline of N219
Source: IAe Website

Currently, IAe has the plan to develop the N-219, the twin-engine turboprop. The N-219 is a 19-seater with a high STOL performance: it has a maximum takeoff weight of approximately 7 tons, a payload of 2.5 tons, and a landing run of 600 meters. The N-219 has three-abreast rows positioned in 2-1 sections, which is to rank as having the largest cabin class out of planes of the same size. N219 is designed to provide transportation for rural and isolated areas in Indonesia. If successful, it would be a great interest for Africa and other underdeveloped nations. N219 is designed to be a simple, reliable and robust construction, while to have a modern avionic suite to aid navigation in the remote regions.

Photo. 9: C212-400
Source: Brazilian Air force Website

In the past, IAe conducted the licensed production of CASA (Spanish subsidiary of EADS)'s C-212-200, and to date it has delivered 102 aircrafts. Recently Airbus Military (formerly EADS CASA) decided to completely move the production of the C-212-400 from Spain to Indonesia in the middle of 2009. C212-400 is a 24 passenger multipurpose aircraft, and it is the latest model in the C-212 series which have been operating in the world for the past 30 years.

IAe also produces CN 235 aircraft, a 42 passenger multi purpose twin turboprop. In 2009, IAe received orders from Korean Coast Guard for 4 of CN235, which will be started to be delivered in 2010. In addition, recently a large demand of specialized aircraft for maritime patrol has been received by IAe.

Beside fixed wing aircraft, IAe has also produced three different helicopters under license: the Eurocopter Super Puma, the Bell 412EP, and the Eurocopter BO 105. Recently, the Indonesian Army ordered the Bell 412EP helicopters through IAe. For the future, there is a development project of a replacement of BO 105 helicopter which is now required to fulfill light helicopter market in Indonesia.

(c) Malaysia

In the civilian aircraft sector, Malaysia has the advantage in designing aircrafts and manufacturing composite parts, and it has manufactured composite and metal aircraft parts mainly for Airbus and Boeing. Malaysia has focused on MRO, parts and component manufacturing, aerospace training, avionics and systems integration.

Regarding MRO operations, Malaysia has covered a wide spread of MRO activities such as aircraft modification, line, heavy, components and engine maintenance. Malaysia has also cooperated with overseas companies.

i) Malaysian Industry-Government Group for High Technology (MIGHT)

MIGHT is a non-profit organization under the purview of the Ministry of Science, Technology and Innovation.

MIGHT was established in 1993 as a company limited by guarantee to enable consensus building and coordination for Industry-Government partnership in high technology. It provides strategic technology inputs for Industry and Government, nurtures technology-based enterprises and entrepreneurship as well as prepares knowledge workers relevant to strategic and high technology industry needs.

MIGHT is playing the role of advancing Malaysia in the aerospace and defense industry through its role as the Secretariat to Malaysian Aerospace Council (MAC) which chaired by Prime Minister of Malaysia, member of MIDES (Malaysia Industry Council for Defense Enforcement and Security) and actively involved in promoting the Malaysian aerospace industry to the global market.

ii) Composites Technology Research Malaysia Sdn. Bhd. (CTRM)

CTRM is part of the global supply chain composites aero structures for major commercial and military aircraft manufacturers in the world. Apart from manufacturing of composites aero structures, CTRM is also providing engineering design services, composites assemblies, composites R&D, manufacturing of automotive composites structures and manufacturing of defense related equipments, including the Tactical Unmanned Aerial Vehicle.

CTRM is a single source and the largest composites component supplier for the Airbus A320 Series Aircraft Wing, covering 20% of the wing surface. Almost 50% of the Airbus A320 aircrafts in service today, around the world, have its wing component made by CTRM.

In 2009, CTRM entered into a contract with Spirit AeroSystems, a subsidiary of American company Spirit AeroSystems (Europe) Ltd, and began manufacturing and supplying wing composites components of Airbus A350XWB

CTRM completed the construction of their third manufacturing facility in Melaka in June 2010, thus expanding their manufacturing capacities and capabilities for the ever increasing Airbus and Boeing work programs.

At the end of 2009, CTRM joined hands with QinetiQ Australia (research institute) concerning the foundation of AEO (Commercial Authorized Engineering Organization) in Malaysia.

Moreover, at the end of 2009, CTRM announced that it will collaborate with UTM (University Technology Malaysia) on development of UAV (unmanned aerial vehicle). The UST (Unmanned Systems Technology), a subsidiary of CTRM is currently involved in designing, manufacturing, and marketing of UAV.

iii) Asian Composites Manufacturing Sdn. Bhd. (ACM)

ACM is a joint venture company established in February 1998 and owned equally by Boeing and Hexcel.

The business of the JV is the manufacturer of flat and contoured primary (Aileron Skins, Spoilers & Spars) and secondary (Flat Panels, Leading Edges, Trailing Edges & MISC: Components) structure composite bond assemblies and sub-assemblies for aerospace industries.

iv) SME Aerospace Sdn Bhd

SMEA is a wholly owned subsidiary of the National Aerospace & Defence Industries (NADI) Bhd, and is a premier metal-based aerospace parts manufacturer in Malaysia, has a wide range capabilities and approvals, including Nadcap approvals.

The company commenced operations in 1993. Since then, it has contracts to manufacture and assemble parts and components for various aircraft models, including Airbus A320, A340 and A380, and Boeing B777 and B747.

v) AIROD

AIROD is a MRO provider which is currently 100% Malaysian-owned. It is under the NADI umbrella.

AIROD's multi-million dollar facility is an internationally recognized aerospace

maintenance and modification center. AIROD's well-established facility includes both narrow and wide body hangars, paint & strip hangar, support shops and engine test cells.

(d) Taiwan

In the civilian aircraft sector, Taiwan has the experience of manufacturing components and processing composite materials for Boeing and McDonnell Douglas. There are some prominent MRO providers, such as EGAT (Evergreen Aviation Tech Corp.)

In the military aircraft sector, Taiwan has experienced the manufacturing of fighter planes and training aircraft, and the licensed production of helicopters.

i) Aerospace Industrial Development Corporation (AIDC)

AIDC is the largest domestic aircraft manufacturer, and has Taiwan's only full aerospace facility – with development, manufacturing and service capabilities for components, engines and aircraft.

AIDC is also a leading provider of aircraft components and structures for global OEMs. Commercial programs include Bombardier Challenge 300 business jet empennage, Boeing 737/747 pressurized doors, Airbus 321 16A barrel, Bell 212/412 helicopter metal bonding composite parts, Bell 429 helicopter nose, cabin/crew doors, aft-fuselage and tailboom, as well as a joint venture with Sikorsky on S-92 helicopter cockpit.

AIDC has newly established its Taiwan Advanced Composite Center (TACC) facility to expand its capacity in composite parts design, development and manufacturing. This TACC will initially focus on parts for the MRJ program, for which AIDC will design and manufacture slats, flaps, belly fairings, rudders and elevators.

In the military sector, AIDC has self-developed and produced 130 Ching-kuo Indigenous Defensive Fighters (IDF), 63 AT-3 advanced jet trainers and other aircraft for the Taiwan Air Force. It has completed the modification of the F-16A/B fighter fleet and is now working on an upgrade program of the IDF-2. It is also planning a new attack trainer to meet the Air Force's requirements for replacement of the aging AT-3 trainers.

ii) Air Asia

Air Asia became a subsidiary of TAC (Taiwan Aerospace Co.) after TAC bought Air Asia in 1994.

Air Asia has expanded its MRO services for airlines since the 1980s. Moreover, it offers MRO service to Asian and Central and South American airlines.

iii) Taiwan Aerospace Corporation

Taiwan Aerospace Corporation is a manufacturer of components for the aircraft and space sectors established in 1991.

The company primarily manufactures aircraft structural components, parts, missile components and various processing machinery.

Today, the company employees a team of 17 and engages in the manufacture of parts for the Ching-kuo Indigenous Defense Fighter (IDF).

iv) Evergreen Aviation Technologies (EGAT)

In September 1998, EVA Air's MRO department became independent and established itself as the EGAT. GE joined as an equity partner.

EGAT is a MRO provider for the Asian region, and it has received FAA, EASA, JCAB, and CAA (China) certification.

EGAT is remodeling Boeing 747 LCFs (Dreamlifter) in cooperation with Boeing, which is used in the transport of the main wings of Boeing 787s.

EGAT is currently providing MRO service to over 20 major airlines. As of late, it has offered MRO-related services to numerous airlines, including interior renovation and engine overhaul of Saudi Arabian Airlines' Boeing 777 and overhaul of CF6 engines for Asiana Airlines; it has received MRO-related service requests from Vietnam Airlines, Thai Airway Company, China Eastern Airlines, Garuda Indonesia, Air Atlanta Icelandic (Iceland), Neos (Italy), and SAT Airlines (Russia).

(e) Vietnam

There had been small size of aviation industry in Vietnam. Foreign capital investments have inspired the production of aircraft components.

i)ARTUS Kollomorgen Vietnam

ARTUS Vietnam was created in 1997, originally for the sole purpose of manufacturing parts for ARTUS Avrille, but which today is gradually expanding to work for other companies within the Danaher Group.

Currently Artus Kollmorgen Vietnam Co., Ltd manufactures 400Hz motors and servo drives for aircraft seats.

ii) MHI Aerospace Vietnam (MHIVA)

MHIVA is a subsidiary of Japan's Mitsubishi Heavy Industries, Ltd.

MHIVA began the operations in June 2009 as Vietnam's first aircraft components manufacturer. It manufactures flaps for the Boeing 737NG (monthly output: ten sets). The first flaps were shipped out in August 2009.

iii) Nikkiso Vietnam

Nikkiso Vietnam is a subsidiary of Nikkiso, the manufacturer of Japan's aircraft components.

Its production plant for the manufacture of carbon fiber reinforced plastic (CFRP) was constructed in January 2010, and began the operation in May 2010. The number of the initial employees is thirty. Nikkiso manufactures blocker door parts for Boeing 777s and cascades for civilian aircrafts.

(f) Peoples' Republic of China

At present, the main civilian passenger aircraft programs in China's aerospace industry are the independently developed ARJ21 regional jet and the 150 to 200 seat C919. In addition to this, in the civilian aircraft sector, to date China has also manufactured components and parts for Boeing, McDonnell Douglas, Airbus and Bombardier.

In the military aircraft sector, China manufactured a number of military aircraft for the former Soviet Union under licensing agreements and today manufactures domestically-produced copies.

i) Aviation Industry Corporation of China

The Aviation Industry Corporation of China (AVIC) forms the heart of China's aerospace industry.

AVIC consists of several domestic aircraft makers, including Shanghai Aviation Industrial (Group) Corporation (SAIC), Xian Aircraft Industry (Group) Company Limited (XAC), Shenyang Aircraft Corporation (SAC), Chengdu Aircraft Industrial Corporation (CAC), Guizhou Aircraft Industrial Corporation (GAIC) and Harbin Aircraft Manufacturing Corporation (HAMC).

The 70-seat version of the ARJ21, the ARJ21-700, had its successful maiden flight in November 2008, and test flights involving several test frames continue today. AVIC is also moving forward with the development of a 90-seat version. Bombardier of Canada is providing assistance in composite materials for the development of the 90-seat ARJ21.

Several European and North American aircraft makers, primarily United States makers, are participating in the development of the ARJ21 series. Most of the main systems are being developed by these same European and North American makers. The ARJ21 uses General Electric CF34-10A engines.

The ARJ21 series has reportedly won orders for more than 200 frames at present.

ii) Commercial Aircraft Corporation of China, Ltd. (COMAC)

The Commercial Aircraft Corporation of China is a new company established in May 2008 for the development of the COMAC C919. The C919 is a 150 to 200 seat commercial passenger plane whose development was officially announced by the Chinese government in January 2008. The program is known in China as the large passenger airplane project. In 2009, development of a 169 to 190 seat version was announced that will use all-new engines currently being developed by CFM International.

Like the ARJ21, most of the C919's systems will be developed by aerospace systems makers from the United States and other foreign countries. Currently, more than 10 suppliers have been officially announced.

The C919 is scheduled to have its first flight in 2014 and enter revenue service sometime in 2016.

iii) Other

Xian Aircraft Industry (Group) Company has developed and sells the Y-7, a twin engine turboprop passenger plane. The company also sells the MA60 twin engine turboprop passenger plane, which uses the fuselage of the Y-7 with engines and systems manufactured by European and North American makers, to countries and airlines in Asia and Africa.

Harbin Aircraft Manufacturing Corporation has developed the Y-11 and Y-12 Panda, a small twin engine passenger plane, which it sells to airlines in China as well as third countries.

China also performs final assembly of Airbus A320 series aircraft at a factory in Tianjin and manufactures the Embraer ERJ145 regional jet under a licensing agreement in Harbin.

In addition, Shenyang Aircraft Corporation is in charge of producing the rear fuselage for the new 130 to 150 seat C series currently under development by Bombardier.

(g) Korea

Currently, Korea Aerospace Industries (KAI) and the aerospace division of Korean Air form the nucleus of Korea's aircraft industry.

i) Korea Aerospace Industries (KAI)

Korea Aerospace Industries was established in October 1999, with the consolidation of Daewoo Heavy Industries, Samsung Aerospace Industries, and Hyundai Space and Aircraft Company. It had 2,775 employees as of the end of 2007, and its 2009 proceeds totaled around 930 million dollars.

Its civil aviation division manufactures components and parts for the airframes of Airbus, Boeing, Bombardier, and others. Beginning with outer-wing lower panels for the Airbus A380, it manufactures various parts for the Airbus, including main wings and fuselage parts for the Airbus A320 series, the A330/A340 series, and the A350.

Additionally, they also manufacture parts for Boeing, including parts for the main wings of the Boeing 747, 757, 767, and 777.

ii) Korean Air

The aerospace division of Korean Air was established in 1976.

It has a history of manufacturing components and parts for Airbus, Boeing, and McDonnell Douglas passenger planes in the civil aviation sector.

For the Airbus, it manufactures machine parts for Airbus A380 fairings, and for the Boeing B787, it produces flap track fairings and wing tips.

It is also involved in MRO operations.

(h) Singapore

Singapore is focusing its attention on aircraft maintenance operations (MRO operations) as a national strategy. According to the Singapore Economic Development Board, the gross proceeds of Singapore's aviation operations in 2009 totaled approximately 5 billion dollars and have birthed some 18,000 jobs, a rapid growth over the figures for five years ago (2004), which tallied around 1.1 billion dollars.

Singapore Technologies Engineering stands at the center of Singapore's aviation

industry and the revenue of its aerospace division totaled approximately 1.29 billion dollars in 2009.
Additionally, Singapore Aerospace Manufacturing produces engine mounts, engine parts, and undercarriage system parts. Furthermore, the Japan-owned Singapore JAMCO is in the business of airplane cabin repair and maintenance.

(3) Rapid Expansion of Air Travel Demand in Asia

According to a global air travel demand forecast released by the Japan Aircraft Development Corporation, the share of the Asia Pacific region (26%), while currently below that of North America (30%) and Europe (28%) as of 2009, will grow to 32% in 2029, surpassing North America and Europe to become the largest market in the world (Figure 2). In addition, Boeing forecasts also indicate that the size of the Asia market will expand more than other markets going forward (Figure 3).

Air travel demand is to a certain extent linked to annual per capita GDP growth (Figure 1). The air travel demand grow rate, however, is thought to fluctuate due to competition with other modes of transportation such as passenger rail, cars and sea transport.

In Asia, excluding Japan, super high speed passenger railways capable of speeds in excess of 250 kilometers per hour have been developed in China, Taiwan and South Korea and are currently being planned in Vietnam as well. This mode of transportation will likely become a direct competitor to air travel in the region going forward.

However, the countries of Asia consist largely of islands, meaning that air travel represents a critical mode of transport that can expect to see higher growth rates going forward.

Based on the above, conditions 10 years into the future are expected to be as follows:

- Air travel demand in Asia will grow to be on par with that of North America and Europe
- Air travel will become a key mode of transport for the people of Asia in connecting ASEAN nations and the cities of the Indian subcontinent
- The fleet of and routes serviced by Asian airlines will grow largely
- Regional jets will become more widely used to respond to regional air travel demand in Asia
- LCC connecting Asian cities will expand their market share
- The number of local Asian LCC and foreign LCC operating in Asia will increase markedly

(4) Growing Awareness of the Environment

According to the Intergovernmental Panel on Climate Change (IPCC), as of 1992 aircraft carbon dioxide emissions accounted for 2% of all worldwide human-made emissions (700 million tons per annum). According to an IPCC scenario, in 2050 the rate of aircraft CO2 emissions will increase from 1.6 to 10 times 1992 levels.

The International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA) both are actively engaging in the reduction of aircraft CO2 emissions. The ICAO has announced a commitment to improve aircraft fuel efficiency by 2% per year, and is also considering strengthening noise abatement standards.

Based on the above, conditions 10 years into the future are expected to be as follows:

- Restrictions on aircraft CO2 emissions and noise pollution will grow stronger going forward
- Some countries will implement emissions trading systems or fee-based systems governing emissions output
- Specifically, the European Union plans to implement an emissions trading system for EU airlines starting in 2011 and will expand this system to non-EU airlines starting in 2012
- Concerns are also evident that environmental restrictions will have a greater impact on the airline business
- More airlines will choose environment-friendly aircraft
- The environment will become a key element in determining fleet plans for all airlines

2. The Need of Vision for Developing the Asia Passenger Plane

With passenger plane development programs currently underway, Japan's aerospace industry has entered a new stage. This particular project is an important passenger plane development project not only for Japan but for Asia as a whole. As such, there is a need to develop a system where all of Asia can contribute to the success of the project, and to have a long-term perspective that will link up with the realization of the Asia Passenger Plane.

In this sense, strengthening collaboration in the region and developing a long-term vision for Asia through this project, which aims to promote the development,

manufacture and operation of an Asia Passenger Plane that leverages the technologies and competencies of the region, will be vital to the future of the development of jet passenger planes.

The tangible significance of developing this vision is as follows.

(1) For the Future of the Aerospace Industry in Asia

In Asia, where economic and population growth is forecast, air travel demand is expected to expand going forward, which will also increase the importance of air travel as a mode of transport.

In particular, air travel will play an increasingly important role in regions with large numbers of islands and regions where sufficient development of road and rail infrastructure has yet to take place. Aviation is also critical for responding to natural disasters, such as large earthquakes, or other emergencies.

The aerospace industry represents an effective means to advancing industrial technologies that will help spur the further development of nations in Asia. Moreover, aerospace industry development is also important as it will provide youth of the region with dream to aspire for as well as an opportunity to be a part of an advanced technology industry with a global impact.

(2) For the Future of Japan's Aerospace Industry

According to the Ministry of Economy, Trade and Industry, aircraft consist of an overwhelmingly larger number of components than automobiles and as such require a wide range of supporting industries. In Japan, nearly 1,200 companies act as direct contractors to major heavy industry firms, accounting for more than 20,000 jobs.

From a technology standpoint, as aircraft demand super high reliability, such as a 1/100 failure rate compared to automobiles even in extreme low and high temperature environments, the advancement of aerospace-related technologies will directly contribute to the advancement of Japan's overall industrial infrastructure, centered on advanced reliability industries.

In addition, from a geographical standpoint, aircraft are an absolute necessity for Japan.

Moreover, the retention and advancement of aerospace technologies is also critical from a national security perspective as well.

However, because the initial investment in aircraft development requires large sums of capital, carries with it the risk that it will take many years to collect on this investment, and requires long-term investment, unlike automakers, aircraft manufacturers face great difficulty in bearing the entire burden of costs alone.

Therefore, passenger plane development requires an international framework of cooperation and collaboration.

(3) The Need for Collaboration among the Nations of Asia

The expansion of air travel demand in Asia represents an excellent opportunity to develop the aerospace industry in the region based on cross-border cooperation and collaboration. This also has the potential to become a specific target for forming collaborative frameworks among the nations of Asia.

The nations of Asia possess individual experiences in the development of entire airframes, licensed production, development of composite components and MRO businesses. By effectively combining these experiences, competencies and strengths, Asia can aim to become the third leading global influence in the aerospace industry behind the United States and Europe. It will carry with it a significant meaning for a wide range of fields in the region, including technology, industry and the economy.

Chapter 3: Asia Passenger Plane Vision – Target Vision for 2020

Based on current conditions surrounding the aerospace industry in Asia and future forecasts, the following can be assumed about the status of the industry 10 years from now in 2020.

The target countries of this assumption are the six nations of the ANMC21 member cities participating in the Promotion of Development of a Small to Medium-Sized Jet Passenger Plane Project: India, Indonesia, Malaysia, Taiwan, Vietnam and Japan.

1. Growth and Rapid Progress of the Aerospace Industry in Asia

(1) Enhance Asia's Aerospace Technologies via Participation in an International Co-development Project

Aircraft makers in Asia, including Japan, are increasing their participation in the international co-development projects of Boeing and Airbus both qualitatively and quantitatively. The result is that technical competencies of aircraft makers in Asia are improving more and more.

(2) Commercialization of Civilian Aircraft Development Programs in Japan

(a) MRJ

The Aerospace Industrial Development Corporation (AIDC) of Taiwan is participating in the development of the MRJ as a core partner, while other aircraft makers in Asia are also participating as part designers, suppliers or manufacturers.

Asian airlines have also placed orders for the MRJ.

As a result, the MRJ, which is of great significance for the Asia region, will be widely deployed on regional routes around the world including in Asia. This coupled with a growing awareness of the environment has brought the superior performance of the MRJ into the worldwide spotlight.

(b) Conversion of Ministry of Defense Aircraft for Civilian Use

The mass production and delivery of XP-1 and XC-2 aircraft for the Ministry of Defense is progressing smoothly.

The US-2, the first example of a civilian converted military aircraft, has been commercialized for rescue and fire fighting operations. Specifically, in converting the US-2 for civilian use, rules have been stipulated for the provision and use of technical information between the manufacturer and the Ministry of Defense, and the civilian conversion of Ministry of Defense aircraft is being promoted further.

Following the US-2, the YCX has also been commercialized. The YCX is servicing growing worldwide air cargo demand as a highly convenient high-speed transport plane.

Through (a) and (b), Japan's heavy industry firms are building experience as integrators capable of developing an entire jet passenger plane.

Furthermore, Japan's heavy industry firms have also strengthened their collaboration.

2. Trigger for the Development of the Asia Passenger Plane

Increasing air travel demand in Asia and the growth of the region's technology and industrial infrastructure is fostering momentum for the development of a passenger plane in Asia.

Japan, based on the success of the MRJ and Ministry of Defense converted aircraft, is beginning the development of the Asia Passenger Plane as the successor to the MRJ focused on the three keys of safety, environmental compliance and low price / low operating costs through collaboration with the nations of Asia.

3. Outline of the Asia Passenger Plane

In addition to the environment and operating costs, after-sale services and support will be important considerations in the design of a next-generation passenger plane that is developed utilizing the technology and competencies of Asia. In particular, emerging airlines, which are expected to increase going forward, tend to focus more on cost structures and after-sale services rather than performance.

Therefore, the following makes reference to the business vision for the Asia Passenger Plane, including from an after-sale service standpoint.

Photo.10: Conceptual image of the Asia Passenger Plane

(1) Number of Seats

Considering first and foremost that the Asia

Passenger Plane will service cities in Asia, it will be a short-range narrow body (single aisle) aircraft, rather than a long-range wide body (double aisle) aircraft.

The Asia Passenger Plane shall be designed with between 100 and 150 seats (Figure 12 and 13). In light of future air travel demand in the region, this segment of aircraft offers the greatest promise.

(2) Features

Airlines in Asia, if the basic attributes (speed, range and seats) have already been narrowed, will tend to next focus on items related to costs, such as fuel efficiency, purchase price / lease cost and maintenance costs (Figure 14).

Therefore, the candidate engine for the Asia Passenger Plane is next-generation engines that use less fuel and make less noise.

In addition, the Asia Passenger Plane project will build a low-cost framework by establishing a cross-border division of labor, and it will emphasize environmental compatibility.

As Asia can also become a major producing region for biofuels (that do not directly compete with food production), from this environmental compatibility standpoint, the potential to use biofuels as a source for jet fuel as well as further system electrification by using a renewable fuel cell system as an auxiliary power unit will be reviewed.

Furthermore, the Asia Passenger Plane will be designed to suite to Asia's geography and environment (cooling systems optimized for the high temperature high humidity climates of Asia, lightning strike countermeasures for carbon fiber reinforced plastic [CFRP], etc.).

(3) Target Airline Customers

The target airline operators for the Asia Passenger Plane shall be the airlines of Asia.

While Asia represents a huge potential market, low operating costs will be critical, as LCCs will continue to expand their presence in the region going forward. Therefore, the Asia Passenger Plane will be designed to be operated under lower cost structures in order to provide lower airfares to passengers.

The Asia Passenger Plane project will also seek to enhance support service capabilities

for aircraft operations (operational consulting, monitoring, MRO, product support, crew training, business model, etc.)

(4) Development Structure for the Asia Passenger Plane

The participation in the development of a next-generation passenger plane by aircraft makers in Asia will be envisioned based on the country track record in civilian aircraft development (entire airframe), system integration, device and systems manufacture, components manufacture, parts manufacture, materials, processing and MRO businesses.

(a) Integrator (Fuselage Manufacturer)

An integrator should possess strong leadership capabilities and the experience of civilian aircraft development (entire airframe).

(b) Engine Maker

The integrator will select from among Japanese, North American and European firms an engine maker that has a solid track record in engine development and the technical capability to fulfill the aforementioned requirements of the Asia Passenger Plane.

(c) Tier 1 Suppliers (direct supplier to the manufacturer)

The integrator will select the equipment manufacturers as well as tier 1 suppliers from among Asian, North American and European aircraft makers that have a solid track record and the technical capability to fulfill the aforementioned requirements of the Asia Passenger Plane.

(d) Tier 2 and Below Suppliers (supply directly to Tier 1 supplier)

The integrator will select tier 2 suppliers from among Asian, North American and European aircraft makers, MRO providers and IT firms that have a solid track record and the technical capability to to fulfill the aforementioned requirements of the Asia Passenger Plane.

(5) Government Support

National governments in the region are implementing comprehensive and collaborative assistance for research and development, project commercialization and sales of the

Asia Passenger Plane. The following represents an assumption of specific support measures.

- Subsidies to defray research and development costs for national / public research institutions, etc.
- Airport and air traffic control infrastructure development
- Industrial promotion (aerospace and other industries)
- Human resource development training
- Support for certification / accreditation
- Tax breaks, export credit guarantees, compensation for foreign currency losses, etc.

(6) Conclusion

The Asia Passenger Plane project will seek to make value added services a competitive advantage together with aircraft performance.

With regards to seat number, the Asia Passenger Plane will be developed in a family of aircraft that can accommodate between 100 and 150 passengers.

Furthermore, the Asia Passenger Plane will be developed to provide a broad range of options (low cost to high quality) to meet customer demand.

Assistance from each national government will also be an ongoing consideration for development.

Chapter 4: Challenges facing the Asia Passenger Plane Project

1. Difficult Conditions facing the Asia Passenger Plane

(1) Challenges

The target 100 to 150 seat segment of the Asia Passenger Plane is a market that is in the spotlight for its future potential. The following summarizes the future plans and current status of aircraft makers from around the world relating to the same segment as the Asia Passenger Plane.

(a) Boeing

The Boeing aircraft that will likely be in direct competition with the Asia Passenger Plane is the 737 next generation series.

At present, Boeing is producing 31.5 737s per month, but plans to increase production to 38 planes per month in 2012.

As there has been difficulty in replacing the existing engines of the 737 with new more fuel efficient versions, Boeing is currently reviewing the potential to develop an all-new airplane that serves the same segment as the 737. Attention must be paid to the result of this review which is expected to be released at the beginning of 2011.

(b) Airbus

The Airbus aircraft that will likely be in direct competition with the Asia Passenger Plane is the A320.

At present, Airbus is producing 34 A320s per month, but plans to increase production to 40 planes per month in 2012.

Airbus is also reviewing the potential to replace the engines of the A320 with new more fuel efficient versions. As such, attention must be paid to future developments concerning this review.

(c) Bombardier (Canada)

The Bombardier aircraft that will likely be in direct competition with the Asia Passenger Plane is the 130 to 150 seat C series.

The C series, which uses an all-new fuel efficient engine, has won orders from US regional airline Republic (February 2010), in addition to launch customer Lufthansa of Germany, as the C series has established a presence that cannot be ignored by both Boeing and Airbus.

(d) Embraer (Brazil)

Embraer is reviewing plans to develop the E-195X, which is a 130-seat stretched version of the current E-190 series.

Embraer expects to make an official decision on whether to launch development of the E-195X by the middle part of 2011. As such, attention must be paid to future developments concerning this review.

Although the same super fuel efficient engines that will be used for the MRJ and C series are candidates for the E-195X, Embraer is also considering the development of an all-new airplane not derived from the E-190 series. Embraer is expected to decide on the platform for a new aircraft program during the second half of 2010.

(e) Irkut (Russia)

The MS-21 is an all-new 150 to 180 seat passenger plane currently being developed by the Irkut Group of Russia. The manufacture of the test frame for the program will begin in 2012, with the first flight scheduled for 2014. The plane is to enter commercial service in 2016.

The MS-21 will use an all-composite wing. While Russian-made engines remain an alternative candidate, Irkut has selected the same new fuel efficient engines that will be used on the C series. As a result, Irkut has stated that the MS-21 will be 12 to 15% more fuel efficient and cost 5 to 10% less than conventional 150-seat passenger aircraft.

To date, Malaysia investment firm Crecom Burj Resources as well as Ilyushin Finance and VEB Leasing of Russia have placed orders for the plane, while Aeroflot of Russia is considering adding the MS-21 to its fleet.

Given this competitive environment, it will be critical to incorporate new features, appeal to the market and look to differentiate the Asia Passenger Plane from its competitors going forward.

In addition, aircraft manufacturers in Asia have a comparatively weaker track record in developing entire airframes compared to their counterparts in European countries and the United States, and so they are not able to provide adequate aerospace systems on par with European and US manufacturers. As a result, it will be a challenge to make the development of the Asia Passenger Plane a success.

(2) Measures

In aiming to launch development activities of Asia Passenger Plane, the project must build a flexible development concept that pursues design and performance in line with the needs of customers, based on demand for public transportation systems in Asia as well as the competitive environment surrounding the newest class of 100 to 150 seat passenger aircraft.

In addition, in order to support the Asia Passenger Plane development project, which requires vast sums of capital, long-term development and a long-term investment recovery horizon, the Tokyo Metropolitan Government will seek assistance on a national level from the Government of Japan, which has positioned aircraft development programs as one of the cores of its national economic growth strategy.

Furthermore, the Tokyo Metropolitan Government will host regular international conferences to further strengthen collaboration throughout Asia. The Tokyo Metropolitan Government will also lobby the Government of Japan to provide support for international cooperation as a means to building an international framework for cross-border collaboration in passenger aircraft development.

In addition, the Tokyo Metropolitan Government will continue to work to realize a low cost production structure in Asia.

Therefore, the Tokyo Metropolitan Government will seek to share information between aerospace industries throughout the region and realize the vision for the Asia Passenger Plane by advocating broad participation in the manufacture of the plane and for the plane's widespread use in the region.

2. Lack of Experience and Track Record Compared to European Countries and the U.S.

(1) Challenges

Aircraft manufacturers in Asia are limited to supplier status for aircraft manufacturers in

Europe and the U.S. and have few experiences in manufacturing complete airframes.

As a result, aircraft manufacturers in Asia, compared to Boeing, Airbus, Bombardier and Embraer, lack the experience and track record as well as the aerospace-related technologies to develop the Asia Passenger Plane.

In addition, the aerospace industry in Asia also lacks the framework to develop the large number of human resources with specialized knowledge and skills required for the development a commercial passenger plane.

(2) Measures

The MRJ program offers a golden opportunity to dramatically improve aerospace-related technologies for not only Japan but also aerospace industries throughout the Asia region.

The Tokyo Metropolitan Government will continue to provide a platform for information sharing in order to help aerospace industries in Asia actively involve in the MRJ program and raise its technical competencies.

In addition, the development of human resources is critical to the long-term improvement of aerospace-related industries in Asia.

The Tokyo Metropolitan Government will utilize its Asian Human Resources Fund to actively host trainees from Asia as a means to developing the human resources capable of driving the future expansion of aerospace-related technologies in Asia.

3. Large Technology Hurdles

(1) Challenges

Demand for environment-friendly airplanes with reduced noise and lower carbon dioxide emission footprints will likely grow stronger going forward.

Moving forward, environmental standards, such as noise and carbon dioxide emissions, defined by the ICAO and other aviation organizations will grow tighter, and if the regulations of each national government are also strengthened, additional costs will be incurred to comply with these standards and regulations.

In addition, the severe geographic and climate conditions of Asia (high temperature,

high humidity, large number of squalls, etc.) will need to be addressed.

Furthermore, the demands of LCCs for high frequency services and reduced aircraft operating weight will also need to be considered.

(2) Measures

It will be important to promote steady development aimed at achieving the planned performance and functions at present, including environmental compatibility, fuel efficiency and operating economics.

The Tokyo Metropolitan Government will use the Examination Committee for the Promotion of Development of a Small to Medium-Sized Jet Passenger Plane to continue to foster momentum in Japan to support the development of the successor jet passenger plane to the MRJ.

For that, the Tokyo Metropolitan Government will establish a platform at international conferences to collect information on the needs of airlines in Asia including LCCs, and will work to build an aircraft development structure in close collaboration with airlines.