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GA market in
China



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China's General Aviation market

China continues to amaze the World with the achievements in various fields of economy, but until recently the general aviation was on the side of progress in this country. Nine years ago in China there were only 335 aircraft, but today in the aviation press of the country are already appearing forecasts that by 2012 China would need from 10 to 12 thousands of aircraft for General Aviation. Whether these predictions will come true?

通用航空的发展水平，是一个国家科学技术水平、经济发展水平和人民生活水平高低的重要标志。据预测，到2012年，我国需要各类通用航空飞机1到1.2万架，通用航空及其带动的产业将形成1万亿人民币以上的市场容量。与此同时，通航产业的发展还将带动材料、冶金、机械制造、能源、高新电子产品等产业的发展，并创造出众多的就业岗位。国际经验也表明，一个通用航空项目发展10年后带来当地的效益：投入产出比可达1:80，技术转移比为1:16，就业带动比为1:12，为当地社会经济的可持续发展做出巨大贡献。

In November 2010 the official publication of the State Administration of Civil Aviation of China (CAAC) literally writes as follows [1]:

"The state of general aviation is an important indicator of national technological and economic development, quality of life of the people. It is predicted that by 2012 our country will need 10000-12000 various types of aircraft for general purposes. GA and related industries will shape the market capacity of more than 1000 billion yuan (about 151 billion dollars). At the same time, the development of GA promotes the growth of production of materials, metallurgy, mechanical engineering, energy, electronics and other industries and creates new workplaces. International experience testifies that one project in the field of general aviation in 10 years will bring economic benefits characterized by a parity of expenses at a level 1:80, and a parity of development of new technologies 1:16, increasing chances of employment 1:12, will bring a significant contribution into social and economic progress of the country "[1].

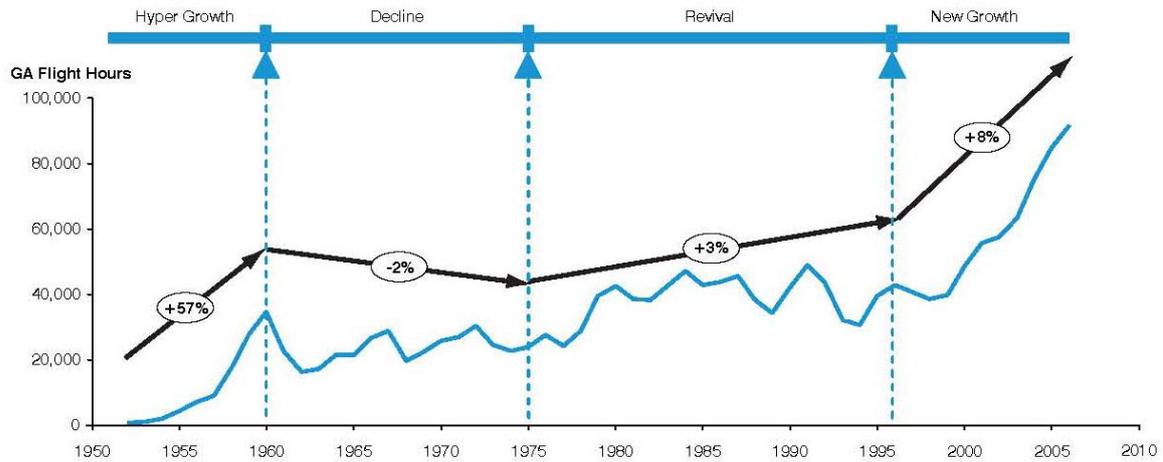
Forecast of China's demand for GA 12000 aircraft by 2012 was published in November last year not for the first time. Back in May 2006, news agency Xinhua referring to the aviation administration of the country voiced these figures [2]. Planning of twentyfold increase of GA within six years (and in comparison with the last year – more than in 13 times) seems to return to the days of the Great Jump and the Cultural Revolution. But convincing successes of modern China in almost all areas of the economy requires the close attention to the projected future of the branch, which to date has been waiting for its time in this country. It looks like the time of GA has come and to China.

1. History and the Present

In China, unlike the CIS, the definition of "general aviation" is closer to the American interpretation. Therefore, by analogy with FAR 91, in the GA fleet in China included airplanes and helicopters performing various aviation works, as well as non-regular transportation (analogy with FAR 135). Naturally, business aviation is also referred to GA, and the total annual flight hours are estimated based on the results of all these aircraft. That is, in China all parts of Civil Aviation, which is not related to regular commercial flights – general aviation.

Such an interpretation allows to consider that the GA was born in China in 1951, when the CAAC has started to use airplanes Curtiss-Wright C-46 for pest control in Guangzhou [3]. Until the mid-60's, that is, before the Cultural Revolution, there was an increase of various kinds of aviation works, replaced by recession that lasted until mid-next decade. Then the expansion of aircraft use in the interests of agriculture, forest protection, cartography, air patrols was observed. However, the development occurred irregularly. 1996 is considered as a turning point for GA progress in China when the CAAC has promulgated "The Decision by the CAAC on Issues Regarding The Development of General Aviation". The document recognized the importance of GA as a component of civil aviation and outlined several measures to promote its development. Since then the growth of annual flight hours for GA is observed, including a growing number of expensive corporate and business aircraft and helicopters.

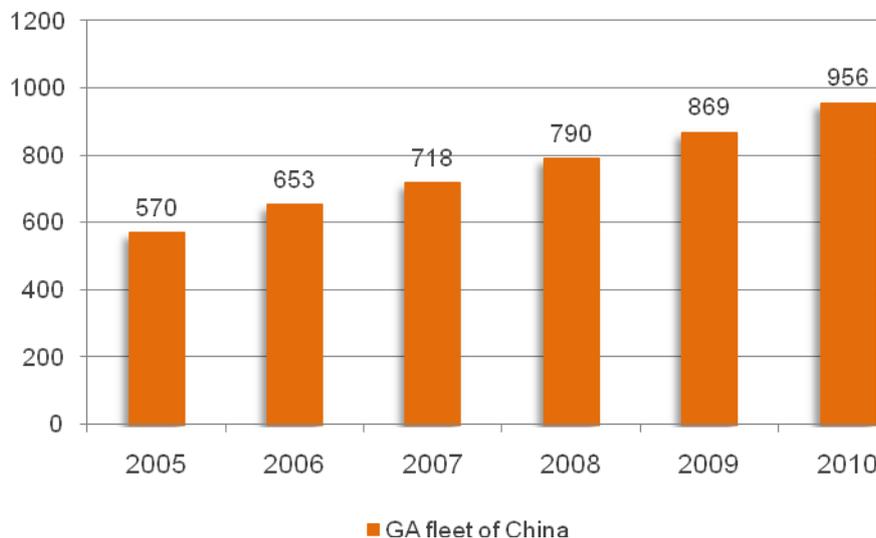
In 1996, China's GA industry entered a new era of growth with the promulgation of "The Decision by the CAAC on Issues Regarding the Development of General Aviation."



Source: CAAC, Bocz & Company analysis

Picture 1. Changing of the annual flight hours in China [3]

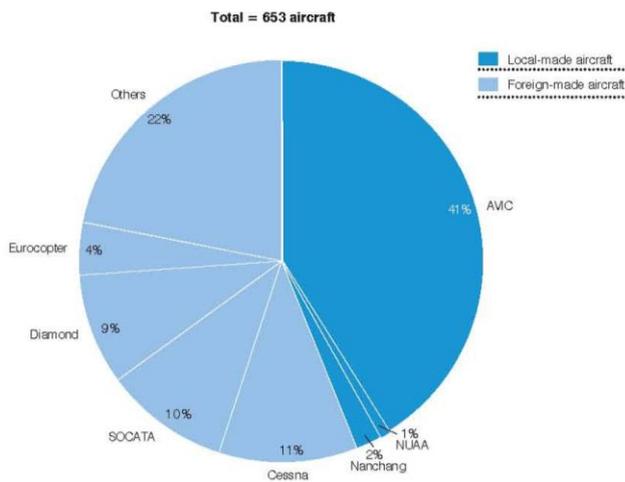
The fact that as the result of the first reforms in the second half of the 90-ies China's GA begins to acquire modern forms, could be seen already at the air show Air China 2002 in Zhuhai [4]. Even then, many Western aircraft companies have opened representative offices in China, and on exhibition stands, a wide range of equipment from self-made, paramotors, simulators, ultra light, light aircraft and helicopters up to business jets has been presented. By that time, the first agreements for the licensed production are concerned. Thus, China Commercial Aircraft R&D Department and Czech Evektor Aerotechnik agreed about the manufacture of LSA category Evrostar EV-97 aircraft. As we seen on Picture 1 annual flight hours during this period increased at an average of 8%, and the fleet has grown almost twice compared with 1978 when only 190 light aircraft and helicopters has been registered. However, even around 1000 aircraft in 2010, which in China referred to GA, – is not enough for the country with the population in 1.3 billion people (Picture 2). Besides, most GA aircraft are engaged in aviation works, the share of private jets and helicopters still insignificant.



Picture 2. Modeling of GA fleet changing in China [1, 2, 3, 5]

Despite the fact that China has its own powerful aircraft manufacturing complex, manufacture of GA aircraft in it so far is insignificant: the state enterprises are focused, primarily, on the needs of military and commercial aviation. In 2006 the share of foreign aircraft in GA's fleet of the country was 56% [3]. Nevertheless, the quantity of the workplaces involved in manufacturing and servicing of GA's engineering is growing. According to [3] in 2006 at the enterprises in the field of GA worked 7000 persons (in [6] stated that in 2009 on 100 enterprises 8000 people were employed).

In 2006, foreign-made aircraft constituted only 56% of China's GA aircraft.



Manufacture	Quantity	Share
AVIC	268	
NUAA	7	44%
Nanchang	13	
Cessna	72	
Socata	65	
Diamond	59	56%
Eurocopter	26	
Other	144	
Total:	653	

Picture 3. GA's fleet structure in China in 2006 [2]

Number of GA's pilots remains small yet. According to [3], in 2006 there were only 1,768 licensed pilots, and to 2010 was predicted growth on 75 % (up to 3091 person). Comparing these data with information on the annual flight hours, we can conclude that the aircraft of GA in China in 2006 flew for 130 hours per year (in 2010 annual flight hours was expected on the level of 146 hours), and the pilot was in the air on the average for 45-48 hours. That is, while in GA the intensity of operation is very low (in the U.S. and Europe, the average annual GA flight hours are 300-400 hours).

China's capabilities and the training of new pilots is also low for a while. The authors of the report [3] declare that in 2009 China had only 10 flight schools that could prepare up to 50 private pilots per year. It is necessary to notice that some data describing the state of Chinese GA, essentially differ. For example, in the presentation of Jane Zhang President of Silk Wings Aviation and the Director of AOPA China the number of licensed pilots (8800 person [5]) is almost three times higher compared with the estimates [3] (3091 people).

Forecasts also differ. For example, it is expected that by 2020 from 43000 [3] up to 55000 [2] people will be working in the field of GA in China and the income of GA enterprises will be from 0.4 billion USD [2] to 1.03 billion USD (7 billion yuan) [3]. By this time the GA fleet will be more than 10000 aircraft, including 1100 business jets, the number of pilots will reach 25000 while the annual flight hours will increase up to 700000 hours [2]. Thus, the estimates of the annual income of GA enterprises in 2020 is differ more than three times, and the number of companies – on 28%. Some forecasts surprise. For example, according to [2] in 10 years the annual flight hours of GA pilots in China will be up to standard of 28 hours (700000 hours and 25000 pilots), which is unlikely.

2. Reasons of the lack of development

In principle, it is not as important as quantitatively different all long-term forecasts of GA development in China. Much more important to know the tendencies that can be identified by examining the reasons that can be revealed on the basis of studying the reasons, braking this progress or assisting it. It is necessary to recognize, that greater consensus of experts is observed here.

The report [3] identified four groups of factors braking the process of China's GA development (Picture 4):

- Regulatory restrictions;
- Restrictive air space;
- Poor infrastructure;
- Weak support and insufficient supplies of equipment

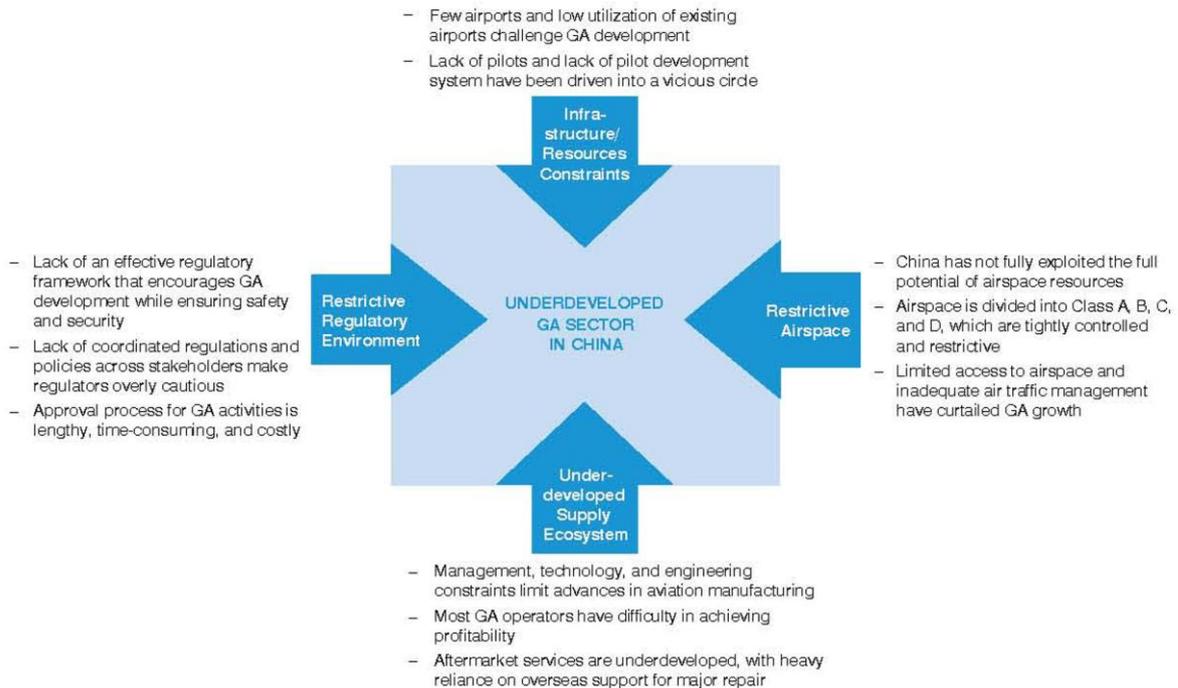
Obviously, these groups of factors are typical for the initial stage of GA progress in the country, passing from total control from the state to free development. These factors long time braked and even still slow down the development of GA in the countries of former Soviet Union.

2.1. Regulatory restrictions

In this group researchers of company Booz&Company Inc. identify the following deterrents:

- Lack of coordinated regulations and policies across all shareholders makes regulators overly cautious;
- Lack of an effective regulatory framework that encourages the GA development, while insuring necessary safety and security;
- Approval process for GA activities is lengthy, time consuming and costly.

Stakeholders are actively addressing infrastructure, airspace, supply, and regulatory constraints.



Picture 4. Reasons, breaking the development of GA in China [3]

Understanding of the factors restraining the development – half of the success in struggle against them. The specific character of China is equally important. A combination of one-party management with the development of market-based methods of regulation gives unusual results. It is obvious that "over caution of regulators" in China will be significantly weakened, because the GA is included as one of key area of development in the Five-Year Plan of China. Now promoting GA progress – duty of party members, who constitute the majority of employees in state institutions. This duty extends to the institutions themselves, so today, CAAC, drawing on the experience of countries with developed GA, use political levers to control a new wave of growth of general aviation in China.

Should be separately noted that natural disasters, which in years past have fallen on some areas of China, create additional motivations for GA progress promotion, because in such situations, its aircraft, pilots and infrastructure are the reserve to overcome the effects of earthquakes, floods, fires.

As part of GA development the regulatory framework is improved in China as well and, in particular, has been published aviation rules CAAC-91 and CAAC-135 (analogous to FAR 91 and FAR 135), which facilitate the organization of flights and certification of commercial GA operators.

According to the five-year plan, the state agency responsible for the development of GA in China, is the CAAC. Its work is contributed by various organizations to promote the progress of civil aviation, such as China Air Transport Association (CATA), China Civil Aviation Science Popularization Foundation.

Also some public organizations directly assisting to the development of business aviation and general aviation: China General Aviation Association, General Secretary Wang Xia), Friends of China GA (FCGA, Director Jane Zhang), Association of Pilots-owners (AOPA China, director Jane Zhang) [2, 7]. There is magazine "China Civil Aviation Report" – issues – once in two months (publisher Francis Chao) [7]. The listed agencies and organizations carry out regular forums [8], conferences and exhibitions devoted to the development of GA [9], which involve foreign experts and companies-manufacturers. Thus, China has created conditions for improving the regulatory framework, development and popularization of the GA.

2.2. Restricted airspace

The following group of GA progress braking in China consists of three subgroups (Picture 4, [3]):

- The full potential of air space resources is not to fully exploited;
- The air space divided into classes A, B, C and D which are tightly controlled and restrict operating of aircraft in the interest of GA;
- The limited access to air space and the insufficient air traffic management have curtailed GA growth.

Indeed, China's airspace is still under tight military control. Besides, access for GA's aircraft is limited in many airports in China. However, these factors have gradually to pass [10-14].

In November 2010, the State Council and Central Military Commission of China issued "Considerations on the deepening of reform in control mode of airspace at low altitudes" [10]. Thus, officially announced that China plans to open its airspace below 4000 m for GA aircraft. Low-altitude airspace will be divided into three spaces:

- Controlled;
- Area under supervision;
- Free area, after preliminary application of Flight Plan [11].

It should be noted that the liberalization of air space will be held in two phases. At first, in 2011, a pilot program in northeast of China (Beijing, Lanzhou and another three zones), will be implemented, by result of which experience of flights in uncontrolled space will be extended to the whole territory. Probably this will happen no earlier than 2012. And for now, China reduced the time for flight permission obtaining. Naturally, to implement the plans of air space liberalization extensive the great work on the classification of airspace, the release of navigational charts and NOTAM should be carried out. But there is no doubt that it will be done soon.

2.3. Poor Infrastructure

The third group of the factors that brakes the progress of GA in China, is divided into two subgroups:

- Some airports are available for GA in China and a level of their use are very low;
- Lack of pilots and absence of effective system of their training

It is considered, that today from 150 up to 192 airports with an artificial covering (in 1996) operate in civil sector while in military sector there are about 400 airports [17, 19]. All civil airports, except Beijing and the two airports in Tibet, are self-administrated, many of them unprofitable, non-aviation incomes of these airports are minimal [17]. Currently, from one and a half hundreds airports, from 57 (in 2006) to 70 (in 2010) are available [2] for GA aircraft. State plans to put into operation further 100 airports in 2020, actions in a direction of expansion of access to existing airports for GA aircraft [15] are undertaken. It is likely that with the introduction of new rules for the use of airspace the majority of civil airports will be open for GA aircraft.



Picture 5. China's civil aircraft (169) and Centers of Aviation Industry:

☆ – civil airport (★ – position of the airport is not exactly specified); ★ – China's Aviation Industry Center.



Picture 6. Map of the administrative division of China (the concentration of population)

Analysis of the dislocation of existing airports shows that airfield network existing in the eastern and northeastern provinces of China is fully capable to ensure the growing needs of GA [16] (Picture. 5). As seen from Picture 5, mountainous terrain is a significant part of Chinese territory. In these areas number of settlements are small, density of population is low (Fig. 6), difficult terrain and weather conditions, so is unlikely arise the need for considerable expansion of the airport network. In eastern and northeastern areas of China, that economically are more developed, civil aviation airports often, situated at a distance of 200-300 km. It is obvious that expanding access for GA aircraft on all existing civil aviation airports and the introduction of another 100 new airports within next 10 years will help accelerate the development of GA. Besides, already there is a tendency from the side of private companies for the construction of dirt runway surfaces that require less capital investment and can greatly extend the airport network for GA.

Poor infrastructure of GA is characterized not only by the lack of airports, but also by deficit of enterprises (FBO), which provide services for refueling, hangars, taxi and flight training. In the U.S., for example, there are 5245 of such companies, many of which operate under franchise or are members of networks, such as SheltAir Aviation Services, Signature Flight Support or Million Air. Due to the low level of GA activity similar companies while are rare in China. But several foreign companies have started to create FBO market of China. Swiss Jet Aviation AG has organized FBO joint venture with the Beijing Deer Air Company [3].

Describing the shortage of GA pilots, it should be noted that 10 small flight schools can not significantly affect its reduction. In addition, the pilot's license in China is still very expensive. Education, medical and flight practice cost 160000 yuan (over 22000 U.S. dollars). A flying club memberships will cost 300000 yuan (over 42000 U.S. dollars) for 100 flying hours plus a service aircraft, which is 5% of the value of 200 flight hours [11].

In countries with developed GA system training of private pilots is a reserve for the replenishment of the flight personnel for commercial and military aviation. A striking example is the United States. However, where opportunities of GA are limited, there is the reverse movement – part of former commercial and military pilots become the owners of private aircraft, GA pilots. In China there are various options of the role of the GA in satisfaction of demand of commercial airline in professional pilots.

According to data [17], there are 11000 commercial pilots in China. In 2008 Boeing experts predicted needs of China in 5500 new pilots for commercial airlines within the next 20 years. Flight Academy of CAAC annually graduates about 800 civil aviation pilots. On a background of a prospect of 2008 such number of recruits was quite satisfied for the industry and its leaders could declare: "We do not need GA for pilot training and is able to prepare them by our own forces" [17].

Experts, oriented on experience of the USA, consider that GA will be the donor of commercial aviation. So, in [18] there is a forecast that China is already requires 2500 commercial pilots in a year, during the following 10 years, because the annual air transportation is expected to grow on 11,4%. Thus a deficit is estimated at the level of 800–1000 pilots in a year. Capability of the Flying academy of CAAC must be increased twice, that is difficult without the assistance from the

GA side. Naturally, 10 private flying schools are unable to invest this big contribution to replace the resulting deficit. Therefore the number of such schools in China will grow proportionally to the growth of GA fleet, thus part of graduating students in due course of time will join the ranks of commercial pilots.

Significant reserve for GA pilots and commercial pilots replenishment is the People's Liberation Army of China (PLAC). According to some experts, today in the PLAC Air Force are more than 26000 military personnel. Military pilots in China has good flying practice: the average flight hours of pilots of fighter aircraft is 200 hours per year, strike-fighter – 150 hours per year, bomber – 89 hours per year [19]. Thus, after 15 years of service, the Chinese military pilots spend in the air for 1500-3000 hours. Naturally, with the development of GA part of former military pilots will join the ranks of private pilots.

2.4. Weak support and insufficient supplies of equipment

The fourth group of factors that brakes the progress of GA in China, is divided into three subgroups [3] (Picture. 4):

- Most GA operators has difficulties in achieving profitability;
- Underdeveloped after-sales support, which relies mainly on foreign overhaul and support;
- Management, technology and equipment limit the progress in the field of equipment production for GA.

In order to create more favorable conditions for the operators and private owners of GA aircraft, CAAC also helps to reduce operating costs (this includes the reduction of fees for takeoff, landing and other expenses). It is also planned to reduce import duties and value added tax for GA aircraft and parts [3]. Until recently, the large import duties on GA aircraft (23%) with high VAT (17%) were a significant barrier for foreign technology imports [15]. In 2010, the customs duties in China has been reduced from 23% to 5%, but VAT while has remained equal to 17%. Since 2001, China is a member of the World Trade Organization, regulations of which require provision of equal conditions for trade in aviation technology, leaving, however, a possibility to save customs barriers for certain time. China has both own and joint with foreign companies production of aircraft and helicopters, which can operate in GA. Therefore, in future we can expect that customs and tax barriers will be fixed on the basis of a compromise between the desire to stimulate their own production and the necessity to increase GA fleet. It is quite possible, that duties and VAT accepted in 2010, will remain during several more years.

Problems of after sales customs support and service are most actually for business aviation in China, where today mostly expensive corporate jets are in operation. Currently, handling and line maintenance services for business jets are provided by companies located in Hong Kong, Macau, Beijing and Shanghai. Heavy forms have to be performed outside China, that increases their cost. During past 5-8 years, China has established joint ventures with almost a majority of the world's leading manufacturers of GA equipment. On the base of these productions and representative offices of foreign firms the service centers are created. On questions of maintenance and repair organization regularly conferences are conducted in China, [8, 15, 20], that assist to the development of the system.

The first in the country service «4S» (sale, spare parts, service, and survey – sales, spare parts, maintenance and inspection) for GA aircraft was organized in June 2007. Located in Hangzhou shop is a joint venture between Xi'an Yanliang National Aviation Hi-Tech Industrial Base and China Guangsha Group. Obviously, that for GA development, at least several hundred of similar companies are required.

It is necessary to focus separately on assessment of the production of GA aircraft, as their role in the development of GA in China will be, if not determinant, then very important.

3. Aviation Industry of China

Aircraft Industry and Cosmonautics of China will certainly have an impact on the development of GA in this country because these are a source of highly skilled personnel and modern technology. Even without affecting the cosmonautics, we can say that the aircraft industry is a separate big topic, to which can concern only, speaking about the prospects of GA.

Today at 100 plants, 42 research institutes and 32 subsidiaries of the Chinese aviation industry is working from 420000 [21] to 450000 [22] employees. In seven major state commercial and industrial companies, in the top four research institutes and in 140 investigational institutions, factories and companies of space industry employed 140000 people, 40% of whom are technical experts [23]. As a result of the 11th Five-Year Plan (2006-2010) the gross output of the civil aviation sector has reached 46.7 billion yuan (7.04 billion U.S. dollars), that is 4,7 times more compared to the 10th Five-Year Plan [25].

The control system of Chinese aviation industry after the proclamation of the CNR in 1949, has been changed not once. In 1993, following the abolition of the Ministry of Aviation and Astronautics of China, there was formed the General Aviation Industry of China (AVIC) and the General Company of space industry. Then, in 1999, AVIC has divided into two associations of Aviation Industry of China – AVIC I and AVIC II. Finally, on the 6th of November 2008 on the basis of these associations a single corporation aviation industry of China (China Aviation Industry Corporation, CAIC) has been formed. It's total assets at the time of the union have been 64 billion yuan (about 7.5 billion U.S. dollars) in 2009 increased up to 200 billion yuan, and in 2010 reached 320 billion yuan (46.9 billion dollars) [26]. This giant is not only has a strong government support, but also accumulates huge financial resources. For example, in 2009, ten Chinese banks have provided CAIC with 176 billion yuan (25.9 billion U.S. dollars) to support the national aircraft industry [10] (data in yuan and U.S. dollars are from primary sources – Ed.).

Up to the mid 90th of the last century the aviation industry has developed mainly on the basis of Soviet experience in the development and manufacture of aircraft. At that time, the Chinese aviation industry has been busy producing mainly

military aircraft and helicopters. In the second half of the 90's began the rapid expansion of cooperation with Western companies. And in the past decade, sector of civil aircraft industry was more included into this cooperation. Today, China produces up to one third of all units and spare parts for civilian aircraft for American company Boeing, manufactures aggregates for European air-buses A 320, releasing the Brazilian regional jets ERJ 145, assembles under license helicopters practically for all world's leading manufacturers of helicopters [22]. Finally, in the second half of the last decade, began the creation of joint ventures for the development and manufacture of aircraft and helicopters for GA [22]. We have all grounds to say that China has accumulated experience of the leading western and eastern aircraft companies, and in this respect the Chinese aviation industry is unique.

3.2. Business jets

Presently there are different estimations of business aviation fleet of China. Company Silk Wing Aviation [5] includes only 27 aircraft to business jets fleet (apparently presents an evaluation of 2006). In [10, 15] states that according to the Rolland Vincent Associates, this number by the end of 2010 has increased to 126 aircraft. Moreover, in [10] noted that one third of the fleet was purchased in the previous three years.



The most popular in China are intercontinental corporate jets Gulfstream

The most popular among Chinese multimillionaires are intercontinental corporate jets Gulfstream. They constitute 37% of the total fleet of business aircraft [10]. The largest operator of business aircraft Deer Jet plans to buy another 10 aircraft Gulfstream [15]. Perhaps, in the middle of the next decade there will be a small business jet manufactured in China. One of CAIC's subdivisions has announced the beginning of its design in 2010.

Forecasts of China's business aviation fleet while differ in a wide variation of values. Silk Wing Aviation 's specialists expect by 2020 the increase of business aircraft fleet up to 1100 aircraft [5]. At Bombardier believe that within the next 10 years, China will buy up to 300 business jets [15]. Teal Group considers that the delivery of business aircraft in China will amount to 1-2% of the global level [15]. In [28] predicted that in the next 10 years, sales of business jets in this country would amount to 3-4% of the world fleet, which is about five times greater than current levels. Thus, we can assume that the average estimation between forecasts of Bombardier, Teal Group and Silk Wing Aviation makes about 630 business jets by 2020.

3.3. Turboprops

One of the oldest departments of CAIC, the company Harbin Aircraft Manufacturing Corporation (HAMC), founded in 1952 and until 2008 were included in the union of AVIC II, since 1985, produces 17-place twin-engine turboprop aircraft Y-12 with engines Pratt & Whitney Canada PT6A-27 (to the modern version of the Twin Panda engines PT6A-34 are installed). Aircraft is exported to the 28 countries, it is used primarily as a light transport aircraft (letter Y in the type denotation testifies this), but it can be adapted for use in GA. China's Jiujiang aeronautics plant also announced that plans to start production of the Polish twin-engine turboprop M 28 (AN-28) in China [29].

As other light turboprop aircraft in the country are not produced and nothing is known about plans for new developments, it is obvious that this market sector in China will be filled mostly by imports. Perhaps, the U.S. company Hawker Beechcraft Corporation's aircraft will be one of the major suppliers, as already a several years is in China. Hawker Beechcraft Corporation's aircraft plans to export to China turboprops King Air 350/B200 C90GTi as well (this model is focused to pilots training for multi engine aircraft) [30, 31]. The company has certified in China a series of jet, turboprop and piston: Hawker 4000, Hawker 900XP, Hawker 850XP, Hawker 800XP, Beechjet 400A, Beechcraft Premier IA, Beechcraft King Air 350, King Air C90GTi, Beech Baron G58 и Regal G36.



Light aircraft Y-12

3.4. Helicopters

Helicopter industry is developing in China within four decades. During this time in the country were put into production six types of helicopters: Z-5 (Mi-4, Harbin Aircraft Manufacturing Corporation), Z-6 (MI-8), Z-7 (Changhe Aircraft Industries Corporation), Z-8 (SA 321, Changhe Aircraft Industries Corporation), Z-9 (Eurocopter Dauphin), Z-11 (Changhe Aircraft Industries Corporation). In addition, Harbin Aircraft Manufacturing Corporation has developed or there is on the development stage for production of helicopters Eurocopter HC120 (EC120 Colibri), Zhi-15 (EC175) and ZX (new version of the Z-9). The enterprise Changhe Aircraft Industries Corporation produces helicopters WZ-10, CA109 (A109 company Agusta), as well as producing parts and assemblies for helicopter S-76 and S-92 U.S. Sikorsky Aircraft Corporation [31, 32]. In March 2010 trial heavy helicopter, AS313 has made its first test flight, the helicopter was designed in CAIC, also Z-19 is in a process (modification versions of French AS-365N). Thus in [35] indicated that over 40 years of helicopter industry in China have been produced only 650 helicopters (the amount of helicopters produced in China over 40 years is estimated at 600 [36], and not less than 150 Nos. – Z-9 helicopters, including About 50 helicopters – civil version of N410, N410A, N425 (VIP-version) and N450 [19, 38]).

Besides its own manufacture, China buys new (mainly military) helicopters in other countries. In particular, in 2009 in Russia were bought Ka-28 (export version of Ka-27, in 1998, the Chinese Navy has purchased 8 such helicopters) [39]. At exhibition Airshow China 2010 was declared about delivery of three Mi-26TC, 32-MI-171E to China, (24 Mi-171 delivered to China since 2007). Middle-class multi-purpose helicopter Ka-32A11BC certified in China and a contract for supply of a large party of these helicopters for rescue and fire fighting operations in China is made ready [40]. On a bases of joint venture Sino-Russian Helicopter Service Company Ltd. a service center in Qingdao is creating. This center will provide maintenance services for helicopters already operating in China and after-sales service for helicopter manufactured in Russia as well as other variety of services and will carry out repair works. Kazan Helicopter Plant and Hebei Caofeidian Industrial Area signed an agreement on joint production of helicopters Ansat-2, providing the release of 100 helicopters of this type [22].

In 2008 Polish company PZL Swidnik and China's Jiujiang aeronautics plant signed an agreement on delivery within ten years of 150 helicopters of three types: W-3A Sokol, Kania and SW4 [41, 42]. In February 2010 first SW4, assembled in China made its first test flight [29].

In November 2010, China began the factory tests of the first light multipurpose helicopter AS311, manufactured at the facilities of Tianjin (Tianjin), branch of the CAIC. Market requirements on helicopters of this type in the next 10 years is estimated at 500 helicopters [43].

There is information about the negotiations between the company Bell Helicopter, and representatives of the Chinese aviation industry about production of 200 Nos. of Bell 2006 in East China [44].



Light multi-purpose helicopter Agusta A109

Almost for 10 years has been delayed the process of manufacture in China Piston Helicopters Schweizer 300C (Shen 3A), 300CB (Shen-4T) and turbo-prop 333. For the first time about the intentions to deliver these helicopters to China declared Paul Schweizer President of Schweizer Aircraft in 2001. [45]. In 2003 Sikorsky Aircraft Corporation, which has become by the time the owner of Schweizer Aircraft, signed an agreement with Chinese ChuYing Technology Co., Ltd about co-production of these helicopters [22]. In 2004, first two helicopters Shen 3A were shipped to the University of Civil Aviation of China (CAUC) to organize the flight training by company Shanghai Sikorsky Aircraft Company Ltd. [46]. In that year the company planned to release 48 machines of these types per year and sell them on Chinese domestic market at prices ranging from U.S. \$ 280000 [47]. In October 2006 Sikorsky Aircraft Corporation has signed a contract on the production of 200 helicopters Schweizer 300C and 300CB with Changhe Aircraft Industries Group Ltd. (CHAIC) [22]. By data about the number of aircraft in China, these plans are so far not realized. Perhaps due to the fact that prices for Chinese-made Schweizer helicopters were 1,5-2 times higher than in the U.S.: 300C – 3.6 million yuan (537,000 U.S. dollars), 333 – 11.5 million yuan (about 1,716,000 U.S. dollars).



Helicopter Shen 3A (Schweizer 300C)

In September 2004, Hongdu Aircraft Industrial Company and US-based MD Helicopters have been negotiating on joint production in China of helicopters MD500E, MD 530F, MD520N, MD600N [22], but there is no further confirmation of the activities in this direction.



MD 902



R44

The sales of helicopters to the private owners activated in China after May, 1, 2003, when CAAC published the new rules of GA flights organization. Already in early 2004, 10 businessmen in Shanghai, Nanjing, Xinjiang and Shaanxi have ordered helicopters of foreign production at prices ranging from 602000 dollars to 723000 dollars [49], about 40 entrepreneurs and business leaders passed flight training. In particular, the 39-year-old millionaire owner of Robinson R44 helicopter from the city of Xiayang in Shaanxi province, has about 200 flight hours (the helicopter was based in Baiyun Airport in Guangzhou, the provincial capital of Guangdong) [49].

Approximately at the same time the sale of helicopters to private owners in Russia has activated: between 2004 and 2008 the citizens of CIS have bought about 300 Robinson R44 helicopters and turbine helicopters of Western companies [50].

In China, sales of helicopters in the private sector were less active. Perhaps one of the reasons was the trial of China's Hubei Gezhouba Sanian Industrial Co., Ltd and Hubei Pinghu Cruise Co., Ltd against Robinson Helicopter Company, Inc, ended with the recovery of 6.5 million dollars from the American company. In this amount the court estimated the damage from the loss of the Chinese side caused by the crash of R44 helicopter, which occurred in March 1994 in the floodplain of the Yangtze River. Process that began in 2001 ended only in 2009 and could have the influence to the activity of Robinson Helicopter Company in China [49]. However, purchases of foreign helicopters for GA in China proceed [51]. In addition to light helicopters a few very light helicopters are delivered to China, in particular, Mosquito XE.



Eurocopter EC135

In total, according to data, by 2009 in operation in China there were 142 civil helicopters of 18 types, most of which is imported from Russia, Europe and USA.

Centre for Development of the State Council predicts that the needs of the country in helicopters by 2013 will amount to more than 2000 helicopters (mostly light). Experts from AVIC II – designers of helicopters in China, tend to the more limited estimation: 1200-1500 helicopters in the next 10-15 years (estimate 2007) [30].

Obviously, this prognosis could come true, provided that all listed projects on helicopter manufacturing in China will be realized with the sale of products within the country with the additional import of foreign-made helicopters.

3.5. Light piston aircraft

From 1947 to 1958 in China was manufactured two-place trainer CJ-5 (Yak-18, was built 379 aircraft). Since 1960, there were CJ-6 in production with a more powerful engine and the chassis nose support. There were manufactured from 2000 to 3000 aircraft [51] (by 1986 produced 1796 CJ-6 [8]). This aircraft was exported to nine countries in the world, and it is still in production.



CJ-6

In addition, from 1958 to 1970 were produced 728 Shijiazhuang Y-5 (AN-2). It is considered that currently are in operation from 50 to 300 aircraft of this type [19]. In the 70 th was produced small party (50 aircraft) of twin-engine piston seven-place Y-11 (some of which was adapted for aerial chemical works) [53]. In future the production was stopped in connection with the production of Y-12 turboprop.



Y-5

Thus, China has many years experience in the production of light piston aircraft on two state enterprises. However, modern light aircraft while only in the process of preparing to the production.

Currently, the CAIC develops a four-six place -piston aircraft, and in the plans was the beginning of its production in 2010 [15], but there is no other information about this project. Perhaps we are talking about four-six-place amphibious aircraft "Hyo-300» (Seagull-300), that made the first flight on November 10, 2010 in Shitszyachzhuane city, the administrative center of Province Hebei, in North China [53]. The aircraft was developed in record terms for China (12 months have passed between the release of the first drawing and the first test flight). It is planned that the aircraft will be offered for sale in 2011.



«Хайюу-300» (Seagull-300)

Hongdu Aviation Industry (Group) Corporation in association with the Russian experts develop two-place training aircraft L-7 (Chinese version of the Yak-152), it's first flight was scheduled for December 2010 [54]. Originally it was planned to start production of this aircraft with the Romanian version of the Soviet M-14 engine, and then, when the Chinese version of HS-6 engine will be adjusted up to 400 hp, L-7 will be manufactured with engines of own production. Aircraft has to replace the trainer CJ-6 in China Air Forces.



L-7

There is information about the design and development of light aircraft in private companies. So in the next two years, Zhuhai Aircraft Company "Yanzhou" plans to release two six-place amphibians produced from carbon composite. It is planned to invest about 200 million yuan (30.3 million U.S. dollars) in the project and included arrangement of equipped production facilities (25 hectare) simultaneously with the development. Despite the fact that only 2.8% of China's territory is covered by water, the two major rivers – Yellow River (5,163 km) and Yantsy (5600 km) and a large extend of seashore (8000 km) are able to make amphibians popular in China.

In spite of own developments and ongoing production, to satisfy the expected demand for light aircraft only with Chinese products is not possible for a while. Therefore, in the past few years have been created several joint ventures to produce aircraft on the licenses of foreign companies.

The best known projects of production in China are the production of two-place all-metal aircraft Cessna 162 Skycatcher and four place composite single-engine DA40 and DA42 twin-engine of Austrian company Diamond Aircraft Industries GmbH.

The decision on production of the airplanes in China was made by Austrian Diamond Aircraft Industries GmbH in 2005 after first fifty aircraft of the company have been sold on the local market. In December 2006 between the company Diamond Aircraft Industries GmbH and Chinese Dagao General Aviation City, Ahua County (province of Shangdong) was signed an agreement about the joint production of aircraft DA40 and DA42 [22]. Currently a joint venture between Shandong Bin Ao Aircraft Industries Co., Ltd, located in 350 km from Beijing [58]. The company employs 200 people, 100 of them were trained in Austria. On the area of 30000 square meters located the production and training center, where the first simulator DA40 was delivered in 2010. Originally was scheduled to produce 500 aircraft per year [22, 58], but there are plans to release 200 aircraft per year with total production of at least 1000 aircraft in China. Thus, in the next 10 years at the plant can be manufactured from 1000 to 5000 four place aircraft.



DA40 and DA42 production in Shandong Bin Ao Aircraft Industries Co., Ltd

Decision to withdraw the assembly of 162 Skycatcher aircraft of Cessna Aircraft Company was made already in 2007. Prototype of Skycatcher made first flight in the U.S. in March 2008 and production aircraft made its first flight in May of the same year. However, the disaster in September 2008 and the accident in March 2009, delayed the terms of project realization. Nevertheless, China's first Cessna 162 made its first test flight on September 17, 2009. The aircraft was assembled in the Shenyang Aircraft Corporation (SAC), which until November 2008 worked for the AVIC I, the union, occupied mainly by the development of military aircraft. Originally it was planned that starting 2010, China will produce from 300 to 400 Skycatcher aircraft [59], but at the end of 2010 it was announced that construction of the plant Shenyanga Cessna Factory on production of this type of aircraft will be completed only by the end of 2011 [60]. Thus, at the facilities of this enterprise until 2020, may be produced up to 3500 Cessna 12 Skycatcher. But in 2010, from China to the United States delivered only 48 aircraft Skycatcher [64].



Cessna 162 Skycatcher

Some Western companies plan to supply their products without making joint production. In 2008, Hawker Beechcraft Corporation's aircraft received CAAC certification for piston aircraft Beech Baron G58 and Regal G36 (first Bonanza delivered in the third quarter of 2010 in Province Shandong in northern China) [30]. Another leading piston aircraft manufacturer - American company Cirrus Design, planned to open at the airport of Shanghai Academy of Social Sciences (Shanghai's GA airport) sales center of their SR20 and SR22 [61,62] in early 2006, but there is no further information on this project. Nevertheless, in August 2010 the opening ceremony of the FBO operator on Cirrus aircraft

maintenance in the Aviation Industrial Park near Jinwan took place, simultaneously company Zhuhai Tianyi Aviation Trading Co has signed a contract for the purchase of three Cirrus SR22 aircraft [62].



Cessna 172



SR22

Another American company Thorpedo Light Sport Aircraft plans to produce single-engine aircraft T-211 with the engines capacity of 85 hp. and 120 liters, and also with the engines of Continental O-200 – capacity 100 hp. About creation of joint venture of IndUS, that will be located in Weinan (Weinan) in the central part of China, was announced in September 2010 [63].

German company Flight Design will expand its presence in China – a leader in sales of LSA category aircraft in the U.S. market (320 aircraft as of October 2010) [64]. If in 2010 the company sold in China only one CTLS, then in 2011 delivery of 20 aircraft are expected.



IndUS in Weinan will assemble T-211



CTLS

Despite the intensification of the world's leading suppliers of light aircraft, many private Chinese companies plan to invest in production of light and ultralight aircraft. Editors of "GA" aware of proposals for joint production of Russian amphibians and Ukrainian aircraft of LSA category in China, from at least three Chinese companies, engaged in high-tech production in the automotive and other engineering industries. In this case, similar projects are being planned investment at the level of 30-40 million dollars. In addition to technology acquisition and development of production, in plans are also the construction of enterprises, airports, pilot training centers, sales centers.

If we sum production plans within the well-known projects, it appears that within the next 10 years in China can made not less than 10000 light aircraft and LSA. However, the modern experience of the first joint venture on production of foreign aircraft in China shows that between the beginning of the project and the first stable deliveries shall pass 5-6 years. In addition, not all products of joint ventures will be realized on the domestic market. Up to date, created major pre-conditions for a significant increase in the fleet of light aircraft for GA in China.

3.6. Engines

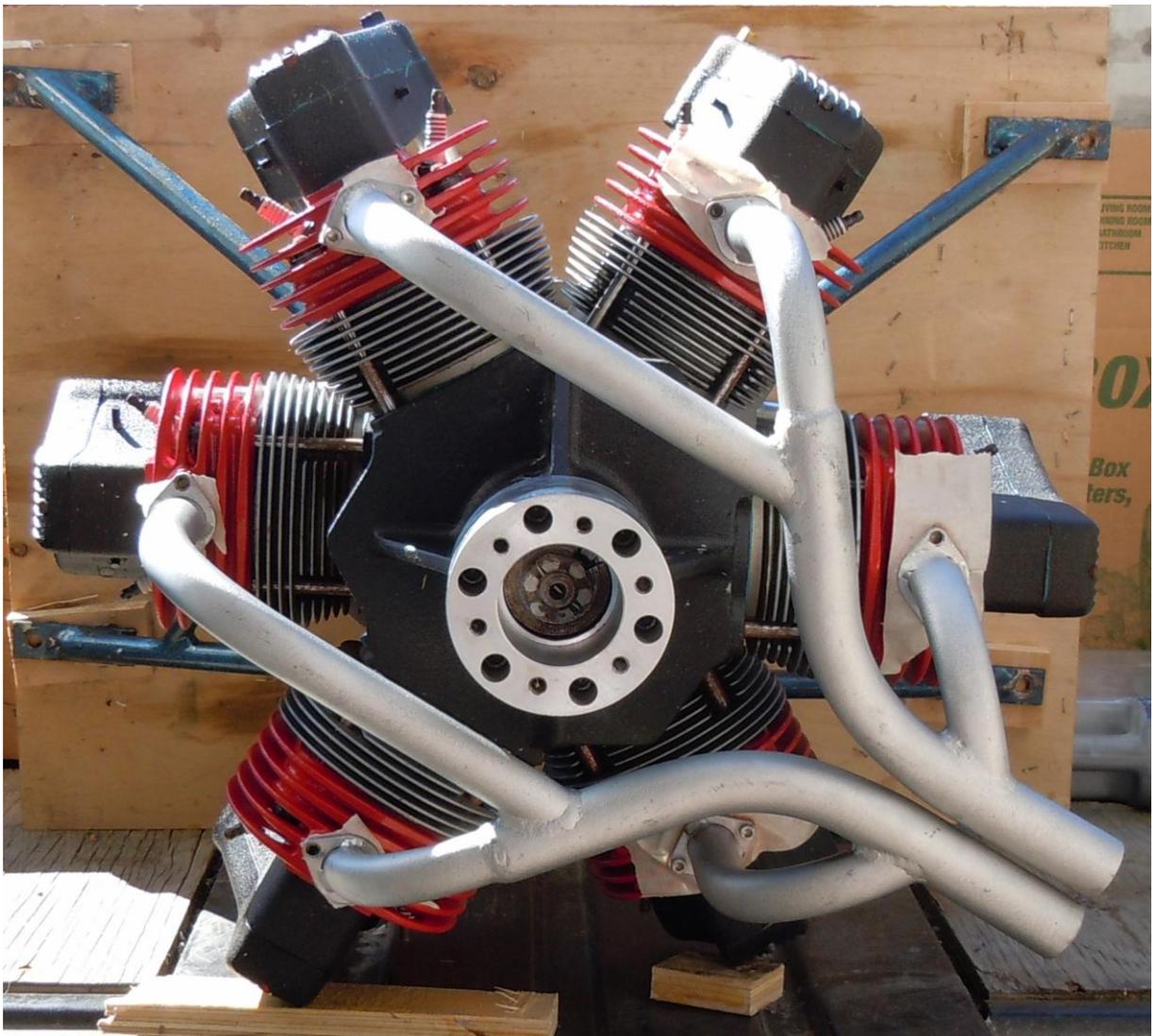
Growth of light aircraft production would require the increase of piston engines manufacture (in a ratio not less than 1:1,5 and even 1:2). That is, in the next decade China will require from 15000 to 20000 internal combustion aircraft engines. The enterprise China National South Aviation Industry (Group) Co., Ltd produces ninecylinders Huaosai 6 – analogue of the Soviet M-14 engine. 4100 sets has been produced since 1958, the volume of annual production is 200 engines. Currently, engine of 6th-series is in production – Huaosai 6K with the capacity of 400 liters that will be installed on CJ-6

(Yak-18) and L-7 (Yak-152) [65]. Previously Huosai-5 was manufactured – analog of DB-62 with capacity of 1000 liters, but today high-powered piston engines replaced turboprop and turboshaft engines.

In December 2010, the company Continental Motors from Teledyne Technologies announced the sale of subdivision for piston engines production to China's AVIC International. The deal worth \$ 186 million will be completed in the first quarter of 2011. It is obvious, that the certification and production of diesel engine TD-300 with capacity of 230-250 hp. will be completed by the Chinese owner [66-68]. Sales of the leading American company on piston engines production – a very serious step, because Teledyne Continental engines are installed on Cessna's Corvalis 350/400, Cirrus SR20/22, Beechcraft Bonanza and Baron, Diamond DA20, Liberty, Mooney and piston aircraft Piper. It is also clear that in China, this acquisition will support the programs of light aircraft production.

Teledyne Continental – is not the only American engine supplier that changes the residence. In October 2009, American Superior Air Parts, Inc. was bought by Qingdao Brantly Investment Group, Ltd. (Province of Qingdao). In June 2010, Superior Aviation Beijing Ltd. was created as a joint venture between Weifang Tianxiang Technology Group and the Chinese government. This company bought 100% of shares from Qingdao Brantly Investment Group, Ltd., which has bought Superior Air Parts, Inc in 2009. [69, 70]. Tim Archer, the former CEO of Superior Air Parts, Inc., will work in China and control the processes of engine certification, the new plant in Beijing building and the start of production of sets Vantage and XP (capacity from 150 to 200 h.p., Volume 320, 360 and 400 cu. inches). As you know, Superior engines represents a modification of engines Lycoming, adapted to run on gasoline. These engines are widely used in the sector of home building. It is likely that after the certification and development of manufacturing in China, these motors will be installed on production aircraft.

Production of engines of another American manufacturer Sadler Radial Engine is mastering by company in Shanghai Chen Industrial Co., Ltd., founded in 2004 [71] as a manufacturer of diesel and gas generators.



R1765 Sadler Radial Engine with capacity of 65 h.p. [71]

Some other private companies have developed or developing the production of various piston engines for ultralight, light, and unpiloted aircraft. One of them, JSTOL (Industry) Beijing of China produces a range of engines with capacity in the range from 10 to 16 kW, which installed on the paramotor and unpiloted aircraft [72].



Paramotor (Air China 2002)

In addition to piston engines, China plans to master the production of gas turbo-engines for light aircraft and helicopters. In particular the Ukrainian "Motor Sich" sold GTD AI-222-25, received an offer for the licensed production of these engines in China. Today, this plant supplies up to 200 engines for training aircraft in this country. Thus, China has created a strong base for the production of various aircraft for GA.

3.7. Systems

In this article the questions of navigation and avionics systems providing for GA are not affected. Producing of similar equipment is mastered in the aircraft building complex of the country, companies within the industry working with leading world manufacturers such as Honeywell. Taking into consideration the mass production in China of various digital and electronic techniques, manufacturing of micro-components base, it can be supposed that the program of GA aircraft manufacture in China at an early stage may be provided due to an imports, and further can be established the producing of their own navigation systems and aircraft equipment .

3.8. Ultra light and domestic aircraft production

In a country where half a million people is working in the aerospace industry and there are at least 20000 military and civil pilots, make sure there are people of other professions who want to realize their interest to aviation. Naturally, China has its own production of trikes and ultralights, as well as homemade aircraft [73-75]. In addition, militaries are also interested in the production of ultralight airplanes [76].

An example of a company, operating in the field of light aviation is Sumai Bicycle Co., Ltd., founded in 1992 and now has become the largest producer of trikes in China [73]. Another similar company – China Jiansu Vehicle Co., Ltd, founded in 1996, produces today, paramotors and trikes [74].

At present there is not sufficient information on production volumes of paramotors, paragliders, ultralights and "homemade" in China. Taking into account the ambitious plans for the development of GA, we can assume that this sector will also grow, but refrained so far from the quantitative estimates of its share in the total fleet of GA



Chinese «homemade» and ultralights

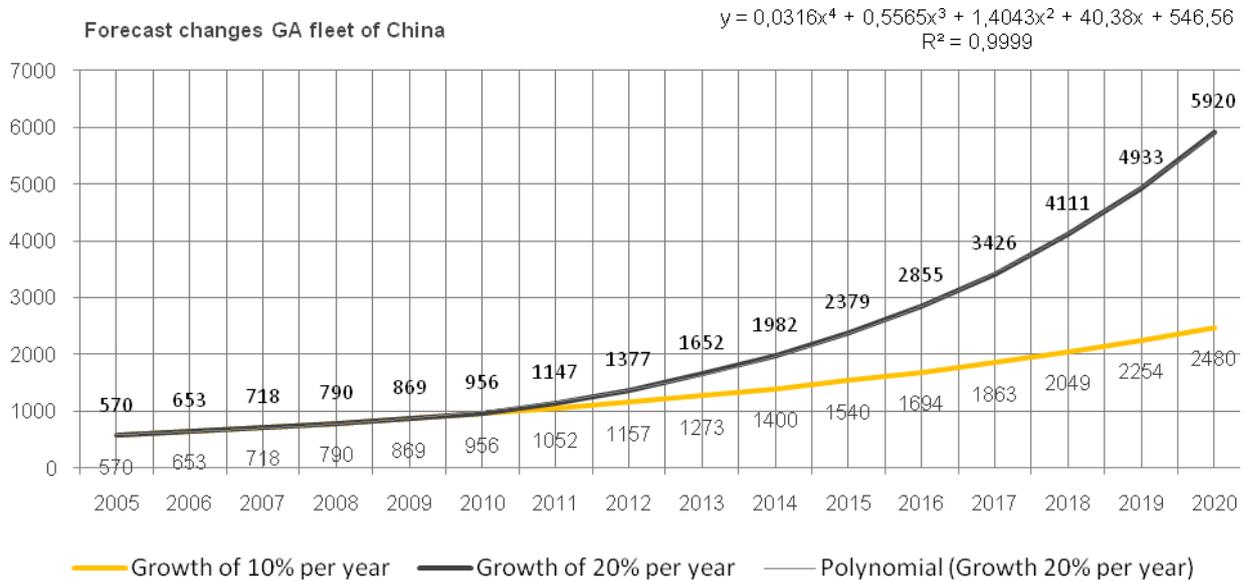
FORECASTS

This analysis can confidently say that GA fleet of China will not consist 12000 aircraft neither in 2011 nor in 2012, as it was forecasted by some institutions in 2006-2010, simply because the prepared facilities cannot produce such quantity of equipment in such a limited timeframe. Nevertheless, China has the conditions to achieve this level by 2020.

Booz & Company estimates the total number of aircraft of GA in China will grow annually by 10-20%, and by 2015 should reach more than 2500 aircraft [3]. If we take the current level and take these growth rates it appears that by 2020 the aircraft fleet of Chinese GA will not exceed 6000 aircraft (Picture 7). In order that in 2020 China had 12000 in GA fleet, the annual growth of the fleet should be 28,8%. In the history of the world GA there are examples of fleet increase up to 30% per year, but there is no country in the world that has such stable growth for a decade.

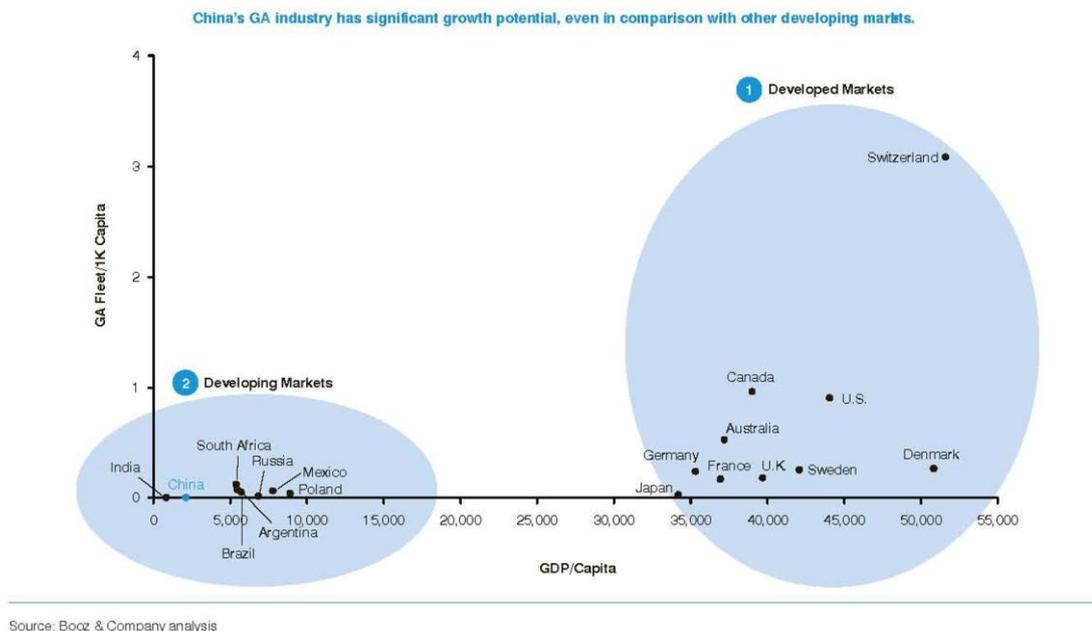
However, having an idea about the plans and capabilities of the aviation industry in China and leading foreign companies, we can conclude that while the growth rate of the GA fleet in China is 20% per year it is difficult to cover the

cost of investments in the sector. In other words, the forecast [3] seems to be rather pessimistic. Taking into account pre-production for aircraft and helicopters, made in China in the past five years, we can expect higher rates of deliveries in 2012-2016 years with a gradual decrease as far as satisfaction of demand. In addition, examples show that none of the joint ventures did not exceed the planned production volumes in the originally set terms. However, so far we have considered the possibility of production, and did not assess the demand and purchasing power of the Chinese population.

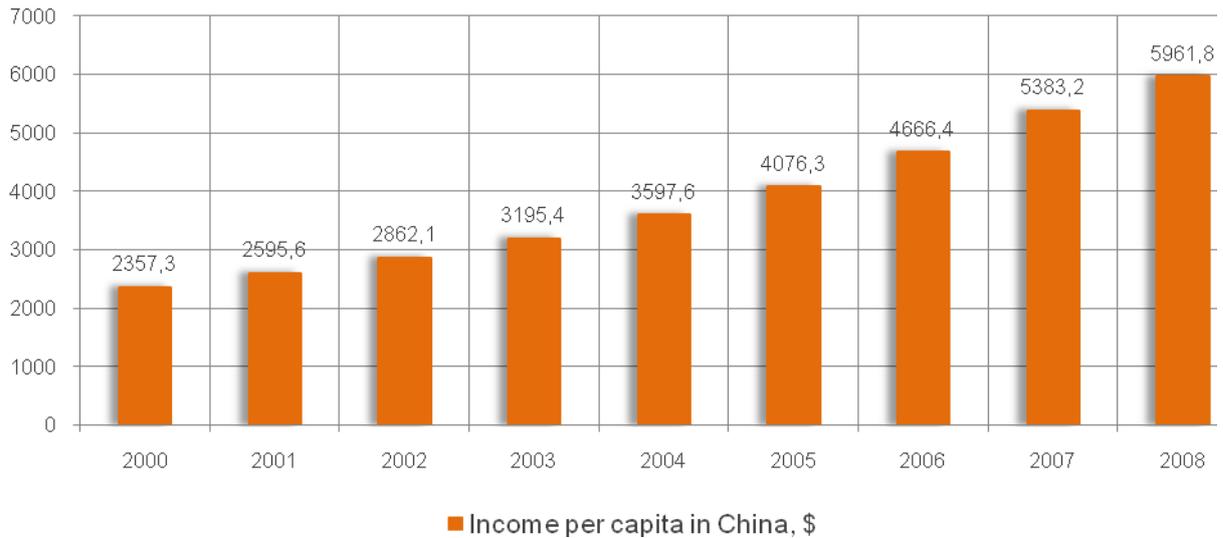


Picture 7. Forecast on GA fleet growth [3]

In this work there is a diagram [3] showing the dependence of the aircraft fleet for GA per capita income (Picture. 8). However, this diagram shows only that there is very weak cross-correlation dependence between income per capita and the number of aircraft in GA fleet. More so that the data on which it is based is outdated (in particular, this applies to China and Switzerland). For example, statistics of the World Bank gives a fairly high growth in per capita income in China (Picture 9, [77]).



Picture 8. Number of GA fleet per 1000 residents as a function of per capita income [3]



Picture 9. Growth in per capita income in China [77]

In the work [50] it was shown that more accurate indicator of the aircraft in GA fleet are the number of millionaires (HNWI) as an indicator of the level of concentration of capital among the population and the number of airports, which may be used by GA fleet. Analysis of Table 1 shows that according to parameter HNWI, today China is able to have the park the GA fleet of 10000-12000 aircraft. It can be achieved even with the current number of airports, and with an increase in their number in 10 years up to 250-270 is guaranteed (for example Republic of South Africa and Australia).

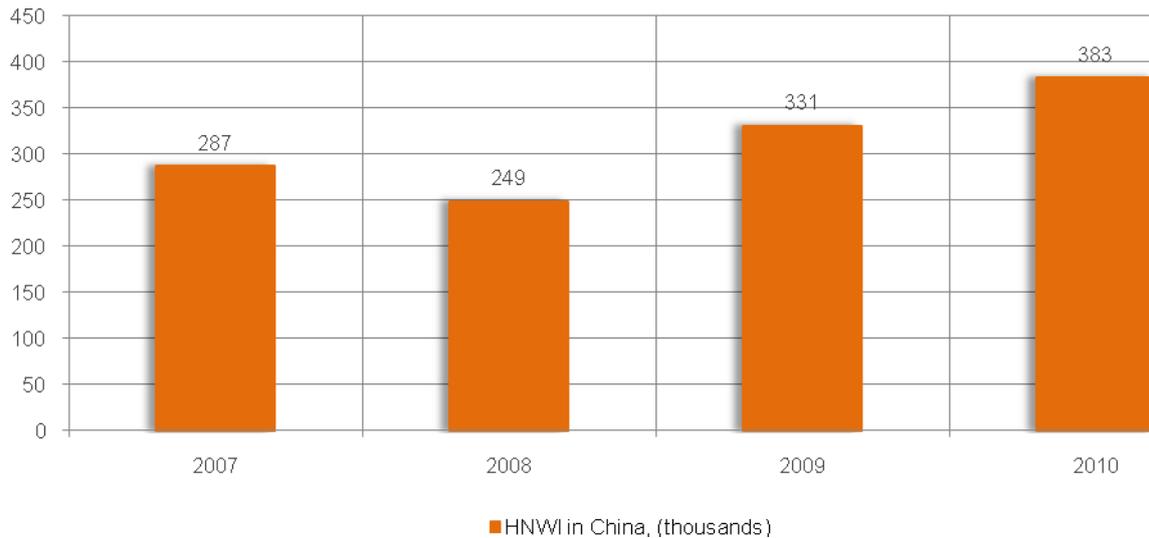
If to estimate the rates of concentration of capital among the population in past years and to interpolate them on next ten years, it will be possible to say that by 2020 income per capita in China will reach 20000 USD. This is twice as much then the current level of the same figure in Brazil, Republic of South Africa and Russia, each of them has now from 10000 to 16000 aircraft in GA fleet. Today there are 63 billionaires in China' and the number of millionaires is three times more than in each of the listed countries. Interpolation of the number of HNWI in China suggests to say that maintaining the economic growth of the country the number of Chinese millionaires in 2020 (over 3.6 million HNWI) will exceed the current number of millionaires in the U.S.

Table1

Comparison of GA fleet in different countries on economic and geographical indicators (2009)

	NGAA	P	GDP	IPC	LE	AC	D	HNWI	NA
USA	228663	304,06	14256	46350	78	9363,00	32,2	2460	19729
Canada	32933	33,74	1336	41980	81	9976,14	3,3	213	2452
Great Britain	19890	61,84	2175	41370	80	244,82	248,2	362	482
Germany	21327	81,88	3330	42450	80	357,02	230,8	810	584
Brazil	16576	193,73	1573	8040	72	8511,97	22,3	131	737
Republic of South Africa	10693	48,69	286	10116	51	1219,91	36,1	100	86
Australia	11750	21,85	925	43770	81	7686,85	2,7	129	270
New Zealand	4000	4,32	127	27260	80	268,68	15,3	15	209
Switzerland	3800	7,73	492	65430	82	41,29	183,0	185	67
PRussia	10733	141,85	1232	9340	68	17075,40	8,3	101	330
Ukraine	460	46,00	114	2800	68	603,7	76,7	6*	68*
China	900	1331,46	4985	5962	73	9640,82	139,6	331	169

NGAA (Number of General Aviation Aircraft) in 2008 –Nos.; **P** (Population) – mln. people; **GDP** (Gross domestic product), \$ milliards; **IPC** (Income per capita) – in 2008 r., \$; **LE** (Life expectancy) – years; **AC** (The area of the country) – thousands sq. m; **D** (Density) – p/sq.km; **HNWI** (High Net Worth Individual) – (\$), thousands people in 2008 r.; **NA** (Number of airports); *, ** – inaccurate data



Picture 10. Number of millionaires in China (HNWI) [78-80]

Summarizing, we can say that in the next decade the ratio of supply and demand may lead to an increase of GA fleet in China up to 6000-12000 aircraft and more. It is difficult to provide more accurate prediction today. In many instances it depends on factors that are difficult to quantify (the mentality of the target group, the ability of joint ventures to adapt rapidly the technical documentation prepared in English or Russian, Chinese, and a number of other factors). But objectively China today comes to the forefront of the global GA. American car market has already made the way to China, and in the next decade, China may well become the most active and capacious market of GA.

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