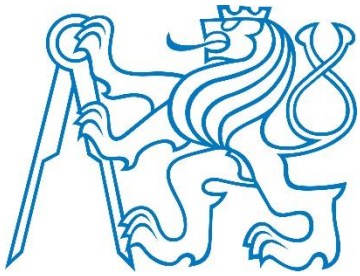

CZECH TECHNICAL UNIVERSITY IN PRAGUE

Faculty of Transportation Sciences

Bc. Adam Vysocký

Analysis of Chinese market with 9-19 seat category aircraft

Master Thesis

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ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE
Fakulta dopravní
d ě k a n
Konviktská 20, 110 00 Praha 1

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Při zpracování diplomové práce se řiďte osnovou uvedenou v následujících bodech:

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Rozsah grafických prací: dle pokynů vedoucího diplomové práce

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Seznam odborné literatury: Air Transportation - John G. Wensveen

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jméno a podpis studenta

V Praze dne ..... 30. června 2017

Poděkování

Na tomto místě bych rád poděkoval všem, kteří mi poskytli podklady k vypracování diplomové práce. Zvláště pak děkuji prof. Weiguo Fangovi a doc. Ing. Jakubovi Hospodkovi, Ph.D. za odborné vedení a konzultování diplomové práce a za rady, které mi k práci poskytovali. Také bych chtěl poděkovat prof. Yuan Gaovi a Shaojun Zhuovi za poskytnutí důležitých informací. V neposlední řadě bych chtěl poděkovat svým rodičům a blízkým za podporu během celého studia.

Prohlášení

Předkládám tímto k posouzení a obhajobě diplomovou práci, zpracovanou na závěr studia na ČVUT v Praze Fakultě dopravní.

Prohlašuji, že jsem předloženou práci vypracoval samostatně a že jsem uvedl veškeré použité informační zdroje v souladu s Metodickým pokynem o etické přípravě vysokoškolských závěrečných prací.

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Abstrakt

Předmětem diplomové práce “Průzkum čínského trhu s letouny kategorie 9 – 19 míst" je popis a zmapování letectví v Číně a predikce jeho vývoje se zaměřením na malá regionální letadla. První část práce se zabývá popisem kategorie letadel s 9 – 19 míst, čínského trhu, a trhu se zmíněnými letadly. V druhé části jsou pak tyto poznatky analyzovány a na jejich základě je predikován možný budoucí rozvoj zkoumaného trhu.

Klíčová slova

Letouny pro Sběrnou Dopravu, Regionalní Letouny, Čína, Letectví, Dotovaná Letecká Doprava, STOL Letouny, Všeobecné Letectví, Analýza Trhu, Porterova analýza pěti sil, PESTE Analýza

Abstract

The subject of the master thesis " Analysis of Chinese market with 9-19 seat category aircraft" is description and mapping of aviation in China and prediction of its development with a focus on small regional aircraft. First part of the thesis is focused on description of the 9-19 seat category aircraft, Chinese market and the market with analyzed aircraft. In the second part, the market details are analyzed and on their basis the possible future development of the researched market is predicted.

Key words

Commuter Aircraft, Regional Aircraft, China, Aviation, Subsidized Air Transportation, STOL Aircraft, General Aviation, Market Analysis, Porter’s Five Forces Analysis, PESTE Analysis

Table of Content

List of abbreviations

CAAC - Civil Aviation Administration of China

CCAR - China Civil Aviation Regulation

FAA - Federal Aviation Administration

MTOW – Maximum Take-off Weight

CAB – Civil Aviation Bureau

ACAS - Airborne Collision Avoidance System

TMA - Terminal Manoeuvring Area

CTR - Controlled Traffic Region

CIA - Central Intelligence Agency

GDP - Gross Domestic Product

STOL - Short Take-off and Landing

HSR – High Speed Railway

IATA - International Air Transport Association

SMS – Safety Management System

EAS - Essential Air Service

RAAP - Regional Aviation Access Program

RASS – Remote Air Services Subsidy

RAIF – Remote Aviation Infrastructure Fund

RAU – Remote Airstrip Upgrade

RASP - Remote Aerodrome Safety Program

RAI - Remote Aerodrome Inspection

ICAO – International Civil Aviation Organization

FBO – Fixed-base Operator

MRO – Maintenance Repair Overhaul

GAMA – General Aviation Manufacturers Association

1 Introduction

The operations of 9-19 seats aircraft are part of general aviation industry which usually reflect the economic status of the country. China is the fastest growing economy in the last decade and most populated country in the world, but the general aviation industry in China is very undeveloped and lags behind many smaller and less developed countries. Chinese market is huge in all ways and the opportunities are limitless.

This thesis is focused on analyzing the environment of Chinese general aviation and 9-19 seats aircraft market and the prognosis of the future development. The aviation is very young industry in China and its development, especially general aviation, is expected to be very intense in following years. From the experiences from other industries, that developed in China in extremely fast way, the general aviation situation can improve, and the country can reach the top ranking in the world perspective in following ten years. General aviation is complex industry and its development must be very sophisticated and multifaceted. The opportunities for aviation companies are huge and this paper evaluates current situation and all the obstacles that general aviation companies must deal with in China.

Current situation and bright future of general aviation in China, with the fact that Czech Republic has a rich history and is very developed in general aviation, resulted in very interesting topic of the thesis. China can be very interesting market for general aviation companies based in the Czech Republic and manufacturers of 9-19 seats aircraft. This research is intended to explore and define these opportunities. The analysis is focused on the whole potential of the market and not on specific type or brand of an aircraft.

The analysis of the market in this thesis is focused on all the obstacles that caused current status of underdeveloped general aviation industry in China and all the possible obstacles that may hinder the future development. The thesis presents aircraft in selected 9-19 seats category and specifies selected ones, describes the legal and competition environment of general aviation and transportation in China, shows the ways of use of such aircraft in other countries in the world, analyzes current situation of the general aviation and 9-19 seats aircraft operations in China. and in the end, concludes the research with complex analysis and predicts possible future ways of development of Chinese 9-19 seats aircraft market. The conclusion of this research is complex analysis and prediction of possible future development of Chinese 9-19 seats aircraft market.

2 Methodology

The analysis of 9-19 seats market in this thesis is focused on overall description of Chinese business environment and current situation of transportation and general aviation in China. The research is mainly based on collecting data about existing situation, processing other researches from all the connected topics and evaluating them and consultations with Chinese experts and professionals in the industry.

The resources of the data collected for the analysis are various reports, researches, aviation companies' statistics and statistical databooks issued by civil aviation authorities and aviation companies associations. Another resource of information about the market are reports focused on transportation network in China and other countries, researches about commuter airlines and subsidized air transportation, articles and research projects dealing with general aviation and official regulations, laws, standards and directives. Finally, the third main resource of information are consultations with experts and professionals in the aviation and general aviation from Beihang University, Czech Technical University and some of the private companies.

The thesis consists of two parts, where the first part describes the current situation of the market and the second one evaluates it and comes up with possible future development. The market description is mainly based on three types of resources, as it was mentioned in previous lines. The conclusion is evaluated by complex tools of PESTE and Porter's five forces analysis, and the prediction of the market with 9-19 seats aircraft potential is based on comparison of different possible future development scenarios.

PESTE analysis is very complex tool, that is purposed to analyze the environment of the business and the market. PESTE analysis describes the conditions in selected regions by dividing them into five factors that influence the market the most. PESTE is abbreviation for the categories. P stands for political factors, E for economic, S for social, T for Technological and E for environmental.

Porter's five forces analysis, as it was already mentioned, is a tool for complex market analysis. Like the title says the Porter's five forces analysis assumes that the market is affected by five forces, that determine the competition environment. The forces are: threat of new entrants, threat of substitutes, bargaining power of customers, bargaining power of suppliers and industry rivalry. Each force represents the ability of players on the market to reduce the others profitability.

3 9-19 seat category aircraft

The thesis is focused on 9-19 seats category turboprop aircraft. The category is represented by many aircraft types, that are produced by various manufacturers. Such aircraft are mainly designed to meet Chinese airworthiness standard CCAR 23 “Certification Specifications for Normal, Utility, Aerobatic, and Commuter Category Airplanes”. Larger aircraft in China must comply with standards CCAR 25 and helicopters with CCAR 27 and 29.

3.1 CCAR 23

Airworthiness standard CCAR 23 is related, as it is evident from the title, to normal, utility, aerobatic and commuter category airplanes. Following lines describe these categories and their limitations.

a) Normal category aircraft is limited by the seat configuration of 9 seats or less not including the pilot seat(s) and maximum take-off weight of 5700 kg or less. The aircraft are purposed for non-aerobatic operations, that include:
    1. Any maneuver incident to normal flying;
    2. Stalls (except whip stalls);
    3. Maneuvers in which the angle of bank is not more than 60°, like lazy eights, chandelles and steep turns.
b) Utility category aircraft is limited by the same seat configuration and maximum take-off weight like normal category aircraft. The utility aircraft operations limitations are extended from the normal airplanes by following maneuvers:
    1. Spins (if approved for particular type of aircraft); and
    2. Maneuvers in which the angle of bank is more than 60°, but less than 90°, like lazy eights, chandelles and steep turns.
c) Aerobatic category aircraft is limited by the same seat configuration and maximum take-off weight like normal and utility category aircraft, but the aircraft operations are without any restrictions, besides those, which were the results of required flight tests.
d) Commuter category aircraft is limited by the seat configuration of 19 seats or less not including the pilot seat(s) and maximum take-off weight of 8618 kg or less. Commuter airplane must be propeller-driven and multi-engine. The aircraft operations restrictions are the same as normal category aircraft have. Unlike other three CCAR 23 categories of aircraft commuter category aircraft may not be certified in more categories. [1]

3.2 9-19 seat category aircraft

The analyzed category of 9-19 seats aircraft belongs to three of four categories of aircraft that are covered by CCAR 23 standard. Nine to nineteen seats aircraft category includes various

aircraft from 9 seat single-engine turboprop normal or utility ones to up to 19 seats twin-engine turboprop commuters. Table 01 lists the most important aircraft of 9-19 seats category, that were in production in 2017 or in development (highlighted yellow).

Table 1: 9-19 seats category aircraft [2,3,4,5,6,7,8,9,10,11,12,13]

Manufacturer	Type	Maximum number of seats	Engine	Number of active aircraft in China
Quest	Kodiak 100	9	Single	6
Pilatus	PC-12	9	Single	0
BGAC	P750	9	Single	3
Cessna	208	9	Single	60
Beechcraft	King Air 350	11	Twin	13
Harbin	Y-12	19	Twin	68
Viking Air	DHC-6 Twin Otter	19	Twin	10
RUAG	Do 228NG	19	Twin	0
Aircraft Industries	L-410 UVP-E20	19	Twin	0
Indonesian Aerospace	N-219	19	Twin	0
Aircraft Industries	L-410 NG	19	Twin	0
Evektor	EV-55 Outback	14	Twin	0

Six of nine selected types of aircraft, that are in production can be found in several pieces in China. Total number of analyzed aircraft in 2015 in China was 150 and in 2016 grew minimally by ten Viking Twin Otters. Besides Pilatus PC-12 and Beechcraft King Air 350 all the aircraft types are not equipped with pressurization of the cabin. Three aircraft (Indonesian Aerospace N-219, Aircraft Industries L-410NG and Evektor EV-55 Outback) are in development or certification process. All the aircraft are powered by one of three types of turboprop engines – GE H80 series, Pratt and Whitney PT6 series or Honeywell TPE331-10 or their older versions. 9-19 seat category aircraft excel in the versatility of use in different conditions and for different purposes. Table 02 and 03 shows parameters of selected currently produced aircraft and table 04 shows the engines specifications.

Table 2: Aircraft specifications [2,3,4,5]

	Kodiak 100	PC-12	P750	208
MTOW (kg)	3290	4740	3402	3629
Maximum Payload (kg)	1603	1684	1769	1393
Powerplant	PT6A-34	PT6A-67P	PT6A-34	PT6A-114A
Cruise Speed (kmh-1)	339	528	259	344
Range (km)	2096	3417	2183	1982

Compared single engine aircraft are, besides Pilatus PC-12, very similar from performances point of view. Pilatus PC-12, as it was mentioned before, is equipped with pressurized cabin and is much faster than other aircraft. All the aircraft are constructed to operate in extreme conditions and take-off from short and unpaved runways and strips. All the single engine 9-19 seats aircraft are powered by PT6 engine. PC-12 and P750 are low-wing aircraft and Kodiak 100 and 208 Caravan are high-wing. High-wing construction is more suitable for untreated strips, as the low-wing can be more susceptible to damage because of the rough terrain. Cessna 208 Caravan can carry even more than 9 passengers, but this seat configuration would not comply with CCAR 23, as the aircraft is single-engine. Caravan is also one of the most widespread aircraft in the world and the service centers network is very developed and parts availability is very good.

Figure 1: Cessna 208 Caravan [5]

Use of single-engine aircraft for commuting is very limited and not only by regulations. For passengers, it is much more convenient to fly with multi-engine aircraft, as it is safer in case of problems with the engine.

Table 3: Aircraft specifications [6,7,8,9,10]

	King Air 350ER	Y-12E	DHC-6 400	L-410 UVP-E20	Do 228NG
MTOW (kg)	7484	5670	5670	6600	6400
Maximum Payload (kg)	1608	1987	1842	1800	2340
Powerplant	2×PT6A-60A	2×PT6A-135A	2×PT6A-34	2×H80	2×TPE331-10
Cruise Speed (kmh-1)	561	340	337	405	433
Range (km)	4945	1340	1480	1500	1111

Between selected twin-engine aircraft stands out Beechcraft King Air 350ER. The aircraft has lower capacity and low-wing construction, but dispones with pressurized cabin and better

range and cruise speed. Other four twin-engine turboprops are high-wing aircraft with similar specifications and performances. Y-12E and DHC-6 Twin Otter have very similar construction, with fixed unretractable landing gear and lower weight and L-410 and Do 228 has the landing gear retractable and are little bit heavier. All the aircraft are as well as single-engine ones constructed to operate in extreme condition and land and take-off on unpaved and short strips. The aircraft mainly differs in versatility of use, passenger comfort possibilities, after sales services and price, that ranges between 4,5 and 8 million USD.

Figure 2: Harbin Y12E [14]

The leader of the versatility of use between the twin-engine small turboprops is the Viking Twin-Otter. The manufacturer offers many variants of the aircraft from amphibian modification to ski equipped landing gear for operations in snowy environment.

The main advantage of L-410 - the spacious cabin, that brings passengers much higher level of comfort than for example Twin Otter's one, that has 65% less volume.

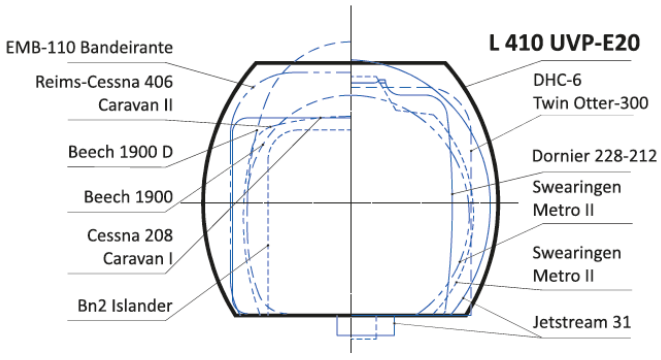


Figure 3: Commuter aircraft cabin space [10]

Harbin recently introduced the newest version of the Y12 aircraft – Y-12F. It is FAA certified and completely different from Y-12E. It has wider fuselage, retractable landing gear and more powerful PT6A-65B engines. This also increased MTOW by 48%, payload by 51% and speed

by 47% on the other hand it also raised the price of the aircraft. There is not a lot of information about the aircraft, but it is expected, that it will be the main commuter in China. Besides this aircraft there have been more commuter aircraft, mainly based on old 19 seaters, developed during last ten years. Aircraft Industries' L-410 NG with more powerful H85 engines, wet wing fuel tanks, composite fuselage parts and extended luggage storage compartment should be certified and enter into service during 2017. The aircraft performance should defeat the competitors in almost every way. Another Czech aircraft Evektor EV – 55 Outback with up to 14 seats have been developed to compete with Cessna 208 Caravan. Light twin-engine aircraft project had problems in financing from the very beginning and in March 2017 the company had to suspend the certification process because of lack of investors who would cover certification and enter into service costs – around 100 million USD. Last aircraft, which is in development and should be mentioned, is Indonesian Aerospace's N219. Nineteen seats aircraft maiden flight is still being postponed, but with performances comparable to other 19 seats commuters and lower purchase price the project can give Viking Air and Aircraft Industries hard time. [15]

Selected aircraft are powered by turboprop engines in 500-1050 horse power category. The PT6A family engines are with over 50000 engines produced since 1960s one of the most common aircraft engines in the world. Engines family is divided into three categories: small medium and large with 500-2000 horse power range. Advantage of PT6A engines over other engines is well developed service centers network so in case of problems with the engine the operator has fast reaction from the manufacturer and is losing less money because of shorter time that the aircraft is grounded. Honeywell and previously Garret produced 13000 TPE331 engines for several types of aircraft. GE H80 engine was developed from Walter M601 engine and has been produced since 2013. Before acquisition by GE, Walter produced over 5500 M601 engines in many different variants, but mainly for Let L-410 aircraft. [15]

4 Legislation

Civil aviation authority in China is called Civil Aviation Administration of China (CAAC) and is delegated by The State Council of the People's Republic of China. The main purpose of CAAC is to "enforce the unified supervision and regulation on the civil aviation activities of the whole country, and in accordance with laws and State Council's decisions, to issue regulations and decisions concerning civil aviation activities within its jurisdiction" [16]

First aviation agency in People's Republic of China was founded in 1949, it was called Civil Aviation Bureau and it was under command of People's Liberation Army's Air Force. Civil Aviation Bureau played role of the regulator of the aviation industry, as well as the aircraft operator, operating both – transportation and General Aviation. From 1969 to 1980 the agency became a part of People's Liberation Army's Air Force and in 1980s the CAB became demilitarized and partially deregulated. In 2002, the agency, after name change in 1993, came fully under command of the Ministry of Transport of People's Republic of China. All the CAAC companies including airlines (Air China, China Eastern, China Southern), China National Aviation Fuel (China Aviation Oil Supply Corp), China Aviation supplies, and TravelSky Technology Limited were reorganized and transferred to the direct control of the state-owned Assets Supervision and Administration Commission. [16]

4.1 Chinese General Aviation Legislation Structure

Civil aviation in China has three levels of legislation. The first and the highest level is Civil Aviation Law of the People's Republic of China issued in 1995. It is the only and basic law in China regarding aviation industry, that manages other aviation regulations. General Aviation and qualifications needed for operating General Aviation are described and defined only in one chapter and six articles of this law. [17,18]

The second level of civil aviation legislation in China are the administrative regulations that were ratified by the State Council. Following table shows regulations related to General Aviation.

Table 4: Chinese administrative regulations related to General Aviation [16,17,18]

Name	Year
Provisional Regulation Regarding to General Aviation Administration by the State Council	1986
General Flight Rules of the People's Republic of China	2000
Regulation of General Aviation Flight Control	2003
Regulation of Civil Airport Administration	2009
Regulation of General Aviation Flight Mission Approval and Administration	2013

First mentioned regulation from 1986 was the first document in China, that defined and clarified the General Aviation and its administrative agency. Provisional Regulation Regarding to General Aviation Administration by the State Council also defined the approval procedures of General Aviation operations and approval procedures of General Aviation business licenses. Prior the issuance of Civil Aviation Law in 1995, the regulation was the basic legislation framework for General Aviation, currently it is purposed for internationally operating General Aviation companies.

Regulation from 2003 Regulation of General Aviation Flight Control defines the flight operations connected procedures - applying for airspace and flight plans issuance. This regulation was extended by Regulation of General Aviation Flight Mission Approval and Administration in 2013. This is regulation clarifies the procedure of applying for flight missions.

The third level of civil aviation legislation in China are the CAAC orders. Following table shows the CCAR orders connected with General Aviation. [16,17,18]

Table 5: Chinese Civil Aviation Regulations [16,17,18]

Name	Year
CCAR- 91 - General Flight and Operation Rules	2004
CCAR-61 - Rule of Civil Aircraft Pilot and Ground Instructor Certificate	1996
CCAR-141 - Rule of Civil Aircraft Pilot School Certificate	2004
CCAR-71 - Civil Aviation Airspace Usage	2004
CCAR-135 - Rules on Operation Certification of Small Aircraft Commercial Transport Operators	2005
CCAR-285 - Provision of Non-profit General Aviation Registration Administration	2004
CCAR-140 - Provision of Civil Airport Operation Safety Management	2007
CCAR-158 - Provision of Civil Airport Construction Management	2012

From previous lines, it is obvious that China started to take General Aviation into consideration very late. Majority of regulations and orders are dated after year 2000 and it is still not developed enough to be comparable with other developed regions.

4.2 CAAC Structure

The CAAC consists of seventeen departments and seven regional administrations as it is shown on figure 5. The CAAC is a ministry-level organ and directly reports to State Council.

Seventeen departments of CAAC and seven regional administrations secure the functions of safety administration, market regulation, air traffic management, macro-control, and international cooperation, including drafting laws and regulations for airline industry, formulating rules and policies for the industrial regulation and standards for civil aviation safety and technology, carrying out the safety supervision on civil aviation activities according to Civil

Aviation Law and other laws, regulations and standards for safety and technology. Another responsibilities are ensuring flight safety and security, presiding over and participating in investigations into serious flight accidents, administrating and supervising air transport market and maintaining fair competition, conducting air traffic management, guaranteeing chartered flights, working out overall plan for the industrial development, carrying out macro-control of the civil aviation industry, representing the country in dealing with civil aviation affairs involving foreign countries, and undertaking other tasks assigned by the Party Central Committee and the State Council.

The regional administrations supervise and take care of administration on the civil aviation affairs in their region. Units reporting to CAAC regional administrations are the CAAC Safety Supervision Offices. These Offices supervise the safety and regulate the market of civil aviation companies like airlines, or airports in their regions. The CAAC Safety Supervision Offices are in Tianjin, Hebei, Shanxi, Inner Mongolia, Heilongjiang, Jilin, Dalian, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Xiamen, Henan, Hubei, Hunan, Hainan, Guangxi, Shenzhen, Chongqing, Guizhou, Yunnan, Gansu, Ningxia and Qinghai. [16,19]

Figure 4: CAAC structure [16,18,19]

4.3 CAAC orders connected with operation of 9-19 seat aircraft

Operators in china must be certificated under CCAR 91 – “GENERAL OPERATING AND FLIGHT RULES”, CCAR 135 – “RULES ON OPERATION CERTIFICATION OF SMALL AIRCRAFT COMMERCIAL TRANSPORT” or CCAR 121 – “RULES ON OPERATION CERTIFICATION OF LARGE AIRCRAFT COMMERCIAL TRANSPORT”. CCAR 91 is intended for commercial and noncommercial operators. The commercial operations under CCAR 91 regulation do not include transportation, but include flight training, rotorcraft external

load operation, forestry spraying operation, aerial touring within a radius of 40km, private flights or aircraft trust. [20]

Operators established in People's Republic of China which are CCAR-135 certified are allowed to perform following commercial operations:

1) Scheduled passenger-carrying transportation flights with multi-engine airplanes with MTOW not exceeding 5700kg, single-engine airplane or rotorcraft;
2) Nonscheduled passenger-carrying transportation flights with multi-engine airplanes with not more than 30 passenger seats excluding any pilot seat and maximum commercial load (payload) of not more than 3400kg, single-engine airplane or rotorcraft;
3) Cargo-only transport flights with multi-engine airplanes with a maximum commercial load (payload) of not more than 3400kg, single-engine airplane or rotorcraft;
4) Aerial touring with aircraft described in lines 1) and 2) while taking off and landing at the same airport and radius of more than 40km. [22]

Operators established in People's Republic of China CCAR-121 certified are allowed to perform following commercial operations:

1) Scheduled passenger-carrying transportation flights with multi-engine airplanes with MTOW exceeding 5700kg;
2) Nonscheduled passenger-carrying transportation flights with multi-engine airplanes with more than 30 passenger seats and maximum commercial load (payload) of more than 3400kg;
3) Cargo-only transport flights with multi-engine airplanes with a maximum commercial load (payload) of more than 3400kg. [21]

All three regulations give the operator different level of restrictions. CCAR-91 is the basic regulation and implies to all civil aircraft operations in China. CCAR – 135 and CCAR – 121 are intended only for commercial operations of small and large aircraft and they are based on CCAR – 91, but set higher safety and operational restrictions for the operators.

The CCAR – 135 requires lower level of restrictions, lower level of aircraft equipment and lower requirements on operator's staff and management structure. CCAR – 23 certified commuter aircraft operators should be able to use this regulation, but in China this is not the case. CCAR – 135 practically defines commuter aircraft differently than CCAR – 23, especially for scheduled passenger carrying transportation flights. CCAR - 135 says that scheduled operations can be only operated by single engine aircraft – which can carry only up to 9 passengers according to CCAR – 23 or by multi-engine aircraft with MTOW lower than 5700kg

– so from selected aircraft only Viking Air's DHC6 400 Twin Otter or Harbin's Y-12E. Y-12F, L – 410 or Do 228 can be used just for nonscheduled passenger-carrying transportation flights or Cargo-only transport flights. Scheduled passenger-carrying operation means, according to CCAR – 135, any passenger-carrying operation performed by air carrier or air operator for reward or hire, published to the general public in advance in the form of advertisement or otherwise by the principal or its agent, including take-off location, take-off time, destination, and landing time. There is no exact definition of unscheduled or nonscheduled passenger carrying flights in CCAR-135, but according to CAAC verbal statement – the flights with schedule announced quarterly (not yearly like it is with scheduled flights) and flights where the tickets are sold by third party (travel agency or ticket agent), not the operator itself can be considered as nonscheduled passenger carrying flight. These flights would be possible to operate with all the compared types of aircraft. [21,22]

CCAR – 135 regulation requires the operator to fulfil certain conditions in organizational framework, operational manual, aircraft and equipment, etc. To refer the difference between regulations, next few lines will focus on these three conditions, which are not the only requirements specified in CCAR-135 regulation.

1) Organizational framework - each CCAR-135 certified operator shall have the "management agency competent to effectively control and supervise all of its operation and have sufficient certificated management and technical persons to maintain the highest level of its operation". All the required personnel must be certified, trained and experienced as it is required by CAAC regulations. Required management structure shall contain:
    a. Operation manager – ensures, that the organization of the certificate holder's flight operations complies with requirements of CCAR-135 regulation;
    b. Maintenance manager – ensures, that the certificate holder's aircraft maintenance complies with requirements of CCAR-135 regulation;
    c. Chief pilot – ensures, that the certificate holder's airman training and technical management comply with requirements of CCAR-135 regulation.
2) Operational manual – each CCAR-135 certified operator, except operators with only one pilot performing certificate holder's operations, shall create and maintain operational manual containing certificate holder's procedures and policies in compliance with CAAC requirements. The operational manual is intended to be used by flight, ground and maintenance personnel of the certificate holder. Content of the manual is specified in CCAR-135 regulation in paragraph 135.43 Manual contents.
3) Aircraft and equipment – Aircraft equipment required by CCAR-135 regulation is extended aircraft equipment required by CCAR-91. Each aircraft shall be equipped to

comply with CAAC regulations, otherwise it cannot be used for certain operations. The equipment is specified in chapter C of CCAR – 135: “Aircraft and Equipment”. In aircraft equipment chapter of CCAR-135 regulation is again visible difference between aircraft below 5700kg and over 5700kg. The regulation says that: “No person may operate a turbine-powered airplane with a maximum certificated take-off weight of more than 5700kg or a passenger seat configuration of 10 seats or more, excluding any pilot seat, unless it is equipped with an approved ground proximity warning system.” And “The turbine-powered airplane with maximum certificated take-off weight of more than 5700kg or a passenger seat configuration of 19 seats or more operating under this regulation shall be equipped with an approved airborne collision avoidance system (ACAS II).” GPWS or ground proximity warning system is then required for all selected aircraft besides Cessna 208 Caravan and ACAS is required for L-410, Do 228 and Y-12F operated in CCAR-135 certified holder’s operations. [20,21,22]

Regulation CCAR – 121 is mainly intended to regulate scheduled public or cargo air transportation operated with large aircraft and CCAR – 135 is mainly intended to regulate nonscheduled air transportation operated with small aircraft. Chinese regulations are not really adapted for commuter airlines and CCAR – 135 is not originally designed for short distance public air transportation, however, commuter airlines can operate under this certificate as it is performed for example by Hulun Buir General Aviation Co. in Inner Mongolia. CCAR-121 and CCAR – 135 regulations differ a lot in the level of regulation and it is much more expensive for the operator to operate under CCAR-121 conditions, that’s why CCAR-135 fits more for this kind of small commuter airlines transporting lower number of passengers than airlines operating with big airliners. The principal areas of the difference between the two regulations in the costs point of view are:

1) Operational control – CCAR-121 certified operator shall have licensed operational control center personnel and shall establish a “flight tracking system”, that monitors every aircraft in the fleet and every operated flight, whilst CCAR-135 operator shall only establish “flight locating procedure”, that is based on radio or telephone communication in certain positions of the flight and there is no need for licensed personnel.
2) Administrative personnel – CCAR-121 certified operator’s organizational structure shall contain these personnel: safety officer, chief engineer, maintenance deputy manager with maintenance management personnel qualification certificate courses and operation deputy manager and chief pilot with valid commercial pilot license. On the other hand, as it was previously specified CCAR-135 requires only operation manager, maintenance manager and chief pilot with the same qualification as the ones required by CCAR-121.

3) Equipment – CCAR – 121 requirements determines higher standard of aircraft equipment than CCAR – 135, mainly in safety equipment and equipment used during emergency situations. The exact equipment list is specified in each regulation. [21,22]

There are more differences between these two regulations and small operator focused on commuting short distance routes with small aircraft. Carrying low number of passengers would not be probably profitable if following CCAR-121 regulation.

4.4 Low Altitude Airspace

According to ICAO Annex 11, the airspace can be classed into 7 classes A-G, where the G class is the least limited and A is the most limited class. A-D classes are ATC controlled, E class is partially controlled, and F and G classes are uncontrolled classes mainly used by General Aviation. Each country uses different classes and uses them for different airspace levels and locations. However, the conditions in same class airspaces are the same. Following table shows conditions in airspace classes. [23]

Table 6: Airspace classes [23]

Class	IFR	VFR	Separation	Provided Services
A	Yes	No	All flights	ATC
B	Yes	Yes	All flights	ATC
C	Yes	Yes	IFR from IFR and VFR flights	ATC; Traffic information about VFR flights
D	Yes	Yes	IFR from IFR flights	ATC; Traffic information about all flights
E	Yes	Yes	IFR from IFR flights	ATC for IFR flights, Traffic information about all flights, where possible
F	Yes	Yes	None	Air traffic advisory services for IFR flights; Flight information service on request
G	Yes	Yes	None	Flight information service on request

As it is stated in Civil Aviation Law of the People's Republic of China, Chinese airspace is controlled airspace by State Council and Central Military Commission. This means that there is no space for E-G class airspaces, which are uncontrolled. The CAAC regulation CCAR 71, or "Civil Aviation Airspace Usage" then specifies, that the Chinese airspace consist of A-D classes airspaces. [23]

A class airspace in China is used for high altitude flight levels, B for middle to low altitude flight levels, C for Terminal Maneuvering Area (TMA) airspace intended for approach and departing aircraft around the airport and D for Control Zone (CTR), that is controlled by the airport tower. However, there is no space for E, F and G class airspaces, which are uncontrolled or partly controlled. These classes of airspace are very important for General Aviation, because there

is no such a burden of bureaucracy when planning some flights, for example for parachutist carrying, or short private flights. The reason for uncontrolled airspace blocking and A-D classes airspace usage is according to CCAR 71 ensuring “flight safety, national security, economic benefits, air traffic control service, high traffic flow, adaptability, and international standardization.” In other words, as it is stated in Civil Aviation Law of the People’s Republic of China the regulations are purposed to “safeguard the national sovereignty of territorial airspace.” All the airspace in China must be controlled and all civil activities must be under supervision and administration of the authority.

To perform controlled flight, the operators must undergo flight approval process. This process is very complex and needs to be simplified in the future. The flight control process is made by People’s Liberation Army’s Air Force and all flights must be approved. The General Aviation flight applications are very detailed and require for example complete flight plan with crew members information, flight purpose, flight times and route, call sign, aircraft identification, or alternate airports. In selected circumstances the operator must, besides the approval, ask for special permission. These circumstances include cross border operations, operations in a no-flight zone or within 10km of the border, aerial surveys or photography operations, operations outside coast line or territorial water, foreign aircraft operation or foreigner flying a Chinese aircraft. [24]

Low-altitude (below 3000 feet) airspace is almost closed for civil operations. The partial deregulation has been in process since 2010, but it goes very slow, as the airspace is very protected, and military based. The Low-Altitude Airspace Management Reform Guidance issued in 2010 by State Council and Central Military Commission should lead to whole-country low-altitude airspace opening till 2020 and application of efficient low-altitude airspace management. Anyway, even this plan does not include opening uncontrolled airspace. /13/

4.5 Conclusion

Chinese General Aviation legislation as it was described in this chapter is not very developed and needs to be revised and remade. General Aviation was considered very late, so that many of the restrictions, regulations, laws and specifications are originally made for transport aviation. The regulations of General Aviation are strict and conditions for the operators are very unfriendly. A lot of space, in comparison with developed countries, is given to military who strictly controls the airspace. General Aviation legislation is obsolete and overregulated. Although the aviation deregulation process was faster during the last 20 years, the General Aviation deregulation process is very slow and only partial. The operators are burdened by bureaucracy and the environment is not good. Chinese government should consider freeing the rules to boost the General Aviation market.

5 Analysis of Chinese Transportation Network

China is the most populated country in the world and fourth biggest country in the term of area. Its transportation network is complex and adapted to uneven distribution of population. According to CIA, total population in China was 1,379 billion people in year 2017 and the area was 9 596 960 km², which means that average population density is about 143 people per square kilometer. As it was mentioned, the distribution of population in China is not even and neither is the transportation network. [25]

Chinese area is divided into 23 provinces, 5 autonomous regions, and 4 municipalities. The provinces are: Anhui, Fujian, Gansu, Guangdong, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Yunnan, Zhejiang and as 23th province is considered by Chinese government Taiwan, autonomous regions include: Guangxi, Nei Mongol (Inner Mongolia), Ningxia, Xinjiang Uygur, Xizang (Tibet), and municipalities are: Beijing, Chongqing, Shanghai, and Tianjin. Another parts of China are special administrative regions Hong Kong and Macau, which are more autonomous but share foreign politics and army with mainland China. [25]

Chinese terrain is mostly mountainous with high plateaus and deserts in the west and full of plains, deltas, and hills in the east. Highest mountain in China is the highest mountain in the world located on the border with Nepal – Mt. Everest with elevation 8848 m. On the other hand, the lowest point of china is Turpan Pendi in Xinjiang autonomous region. Its elevation is -154 m. Not only the terrain is very diverse, so is the climate due to the large area of China. The climate goes from tropical in the southern provinces to subarctic in the north of China. [25]

China is country with one of the fastest growing economy in the world. The annual growth of GDP is around 7%. The communist country is also the biggest economy in the world with GDP of 21,27 trillion US Dollars in 2016. On the other hand, China is full of economic disparities and GDP per person in 2016 was about 15400 US Dollars, which makes the country ranked 104th in the world ranking. [25]

5.1 Hu Huanyong Line

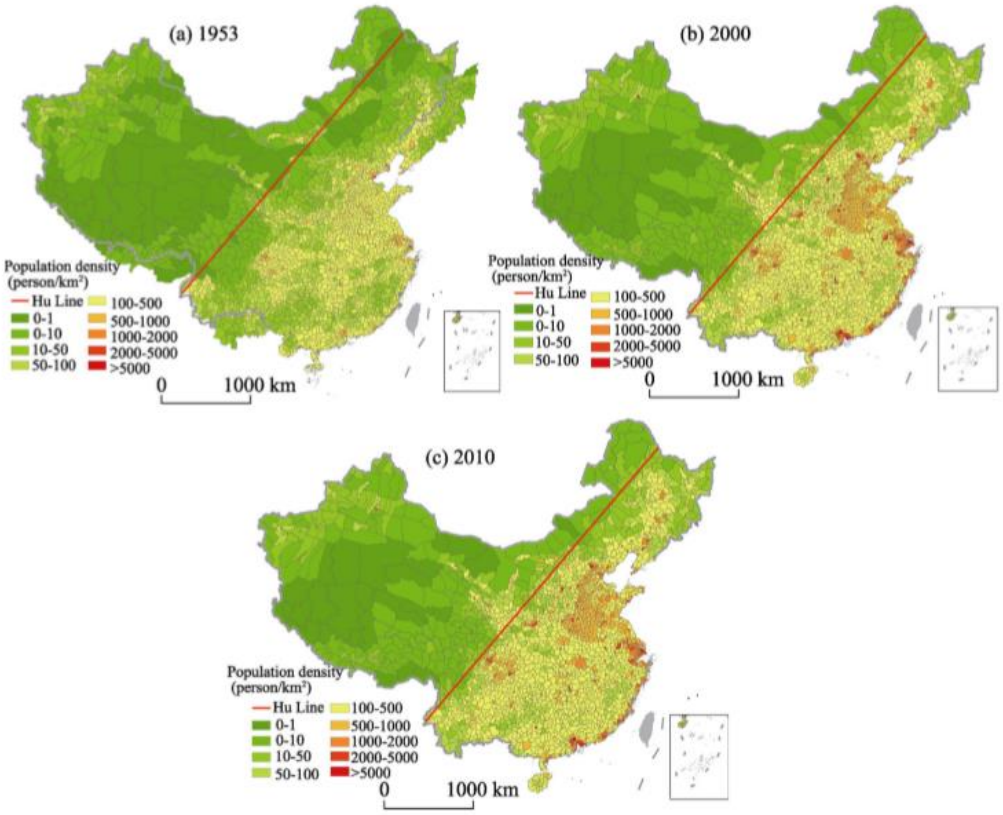
In 1935, Chinese demographer Hu Huanyong published a result of his research about population distribution in China. The result of his research was imaginary line over the China later known as Aihe-Tengchong or Heihe-Tengchong line. This imaginary line runs from Aihui (renamed Heihe in 1983) in Heilongjiang Province to Tengchong in Yunnan Province and divides China into two parts – southeastern and northwestern part. The southeast part represents about 36% of the area and northwestern about 64 %. However, after changes in administrative borders, these numbers were updated and specified to approximately 43%,

respectively 57%, of the total area of China. In 1935, when the population of China was about 458 million inhabitants, the Hu Huanyong's division of population was 18 million people living in the northwest and 440 million people living in the southeast. In other words, 96% of Chinese population lived on 36% of territory and remaining 4% on 64% of China. In 2015, 80 years after Hu Huanyong discovery and Chinese government unsuccessful efforts to balance the distribution, it remained almost the same as you can see in following table. [26]

Table 7: Hu Huanyong line [26]

Year	Southeast			Northwest		
	Area (%)	Population (%)	Population density (people/km2)	Area (%)	Population (%)	Population density (people/km2)
1933	36,00	96,00	135,39	64,00	4,00	5,03
1953	43,24	94,80	139,51	56,76	5,20	5,83
2000	43,24	94,59	303,78	56,76	5,41	13,23
2010	43,24	94,41	325,84	56,76	5,59	14,68

The table also shows the enormous growth of Chinese population during last 60 years, anyway the density of population in northwestern part of China stays more than twenty times lower than the density of the southeastern part.

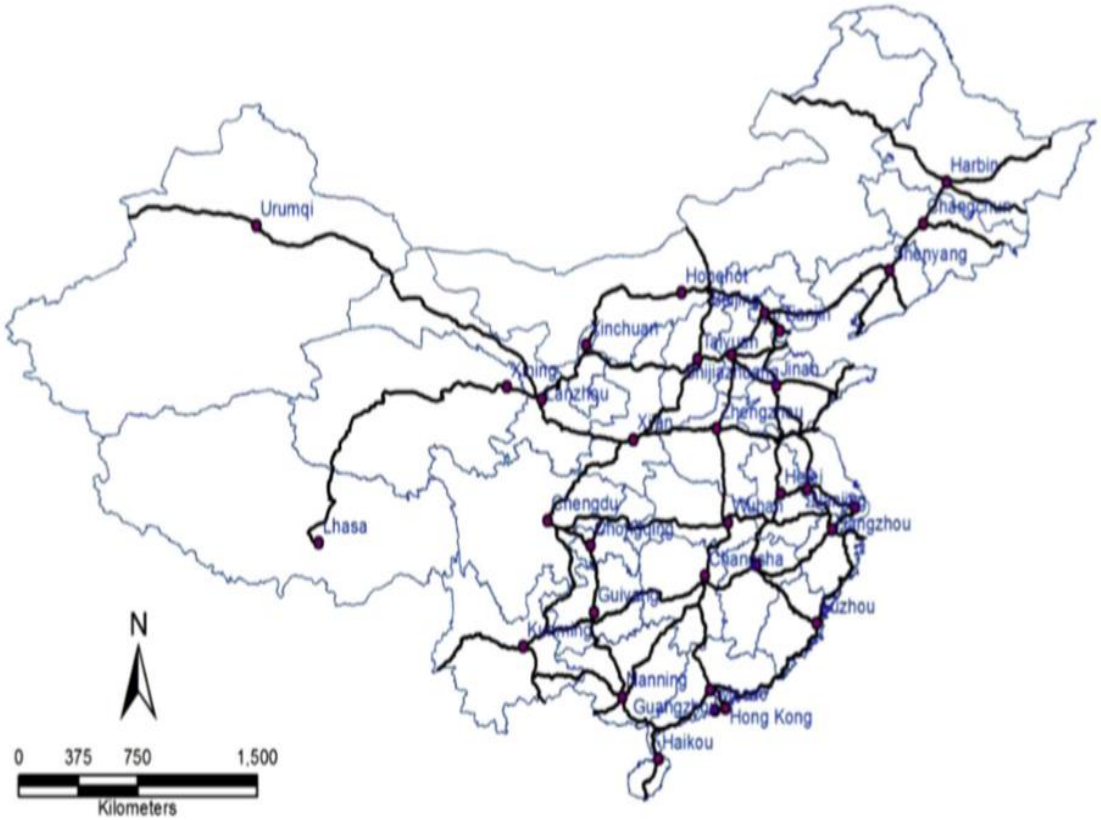


Picture 1: Huanyong line [26]

And as picture 4 shows some of the areas keep the density lower than one inhabitant per square kilometer. The environment in northwest is less friendly and some parts lie in higher altitudes with more difficult accessibility. Commuter airline would fit for these remoted inhabited places in China, as it would make life easier for people living there. These places are hardly accessible by ground transport and commuters with STOL abilities proved its suitability in similar conditions all over the world.

5.2 Motorway Network

By the end of 2014 Chinese road network consisted of 4463900 km of roads and motorways made 111900 km of it. China has built and developed almost whole motorway network in last 30 years as there were only 147 km of motorway in year 1989. As it is obvious in the picture below, the density of motorways in northwest part of China is much lower than more populated southeast, to be precise 85% of 111900 km of highways are in the southeast. However Chinese government focuses on western regions recently more as the motorway growth between 2006 and 2010 was 15,9% p.a. in comparison with 4,7% and 6% in eastern respectively central regions. [27]



Picture 2: The Chinese motorway network in 2010 [28]

5.3 Railway Network

Railway network in China can be divided into two categories – high speed railway network and normal speed railway network. High speed railway is defined by speed greater than 200 km per hour and can reach up to 350 km per hour. Total mileage of Chinese railway was 124000 km by the end of 2016 and by the 2020 it should reach 150000 km. Out of the whole network in 2016 about 21000 km was of highspeed railway, respectively it should reach 30000 km in 2020. The normal railway network connects every city in China with more than 200000 inhabitants. The highspeed railway network in China is the biggest in the world and the aim of 38000 highspeed railways in 2025 should connect every city with more than 500000 inhabitants in China. The picture below shows the railway network in China in 2014 and you can see the same phenomenon as in the road network appears – the railway network is much denser on the southeastern side of Hu Huanyong line than on the northwestern one. The main Chinese train carrier are state owned enterprise China Railway Corporation and its subsidiaries. [29]

Picture 3: China railway network [30]

5.4 Airport Network

According to CIA World Factbook is China 14th country in number of airports ranking in the world. In 2013, China had 507 airports of which 463 were paved. To compare similar area size USA had 13513 airports and Canada 1467 airports. USA is with its number of airport in totally different dimensions than any other country in the world, but 507 airports in China is small number and beside railway and road network the airport one is not developed to fit Chinese standards. The comparison between four chosen countries - two developed (USA and Canada) and two developing (Brazil and India) is shown in table below. [25]

Table 8: Airport density [25]

Country	Area (km^2)	Number of airports	Density of airports (airports/10000km^2)
China	9596960	507	0,53
USA	9833517	13513	13,74
Canada	9984670	1467	1,47
Brazil	8514877	4093	4,81
India	3287263	346	1,05

As you can see in the table above, USA has much higher density of airports than any other country. Followed by Brazil, USA has also the highest number of airports in the world. The point of this comparison is to show that even in developing countries, like Brazil, an air transport network and airport network can be dense. India, another developing country, also has almost double density of airports than China.

There are 2890 registered airliners that are operated by 56 Chinese airlines carried in 2015 436 million passengers and 19.806 billion mt-km. Three main airlines, or as they are called Big Three – Air China, China Eastern and China Southern, routes cover all major cities in China and connect them with international destinations, but there are many other big airlines developing fast. Chinese airlines served in 2015 in total 3326 routes of which 2666 were domestic. IATA expects that by 2025 China will displace US and become the biggest aviation market in the world. [16]

Big advantages of commuter aircraft are their STOL abilities, which make it suitable for majority of airports. This means, that both – transport airport and General aviation airport- can be used and commuter airlines can connect smaller airports with bigger ones and create a comprehensive air transportation network.

The airports in China are under command of local governments except for Beijing Capital Airport and all Tibetan airports. Out of 507 airports in China 218 airports are transportation airports and 70 airports are registered civil General aviation airports, more than 200 other airports and landing platforms are unregistered. [16]

The legislation connected with General aviation airports in China is also not very well developed, as the regulations and specifications for building and operating such an airport are the same as regulations and specifications for large transportation airports. In other words, to build an airport for small Cessna or Diamond, it requires the same time-consuming bureaucracy, same requirements, and same permissions as building an airport for Jumbo jet or A380. Moreover, General aviation airports also need regulations for safety management system (SMS), noise management, and environmental protection (construction, operation emission, fuel/oil storage and disposal, deicing/anti-icing substance disposal, etc.). [31]

Besides developing and constructing big civil aviation airports, Chinese government plans to build, according to the Guidance on the Development of General Aviation industry launched by the State Council in May 2016, up to 500 new General aviation airports till 2020. Some papers even say that the target of Chinese government is to build 1500 General aviation airports till 2030 and connect majority of counties in the country. However, the Chinese government plans are not very detailed and only building the airports will not boost the General Aviation.

Picture 4: Airport network in China [30]

The air traffic in China had been constantly growing between the years 2011 and 2015. As the figure 5 shows the growth of number of aircraft movements at the Chinese airports ranged

between eight and eleven percent per year and in year 2015 reached number of 8565500 movements.

In 2015 the total air transport turnover was 85,165 billion ton-km, which means growth by 13,8% compared to 2014, a passenger turnover was 728,255 billion person-km, and grew by 15,0% compared to 2014, and a cargo and mail turnover was 20,807 billion ton-km, which was 10,8% growth compared to 2014. The domestic routes in 2015 represented about 65% of the total turnover – 55,904 billion ton-km, that was 10,0 % more than in year 2014. [32]

Figure 5: Aircraft Movement at the Chinese Airports [13,33,34,35,36,37]

Total number of passengers transported by Chinese airlines in year 2015 was 436,18 million of which 394,11 million passengers were transported on domestic routes. The passengers flew on 3 326 scheduled flight routes in China, with a mileage of 7 866 000 km. Out of 3326 flight routes 2666 were domestic routes. Total number of cities connected by airport network in China were 204. The international flights of Chinese airlines led to 137 cities in 55 countries around the world. [32]

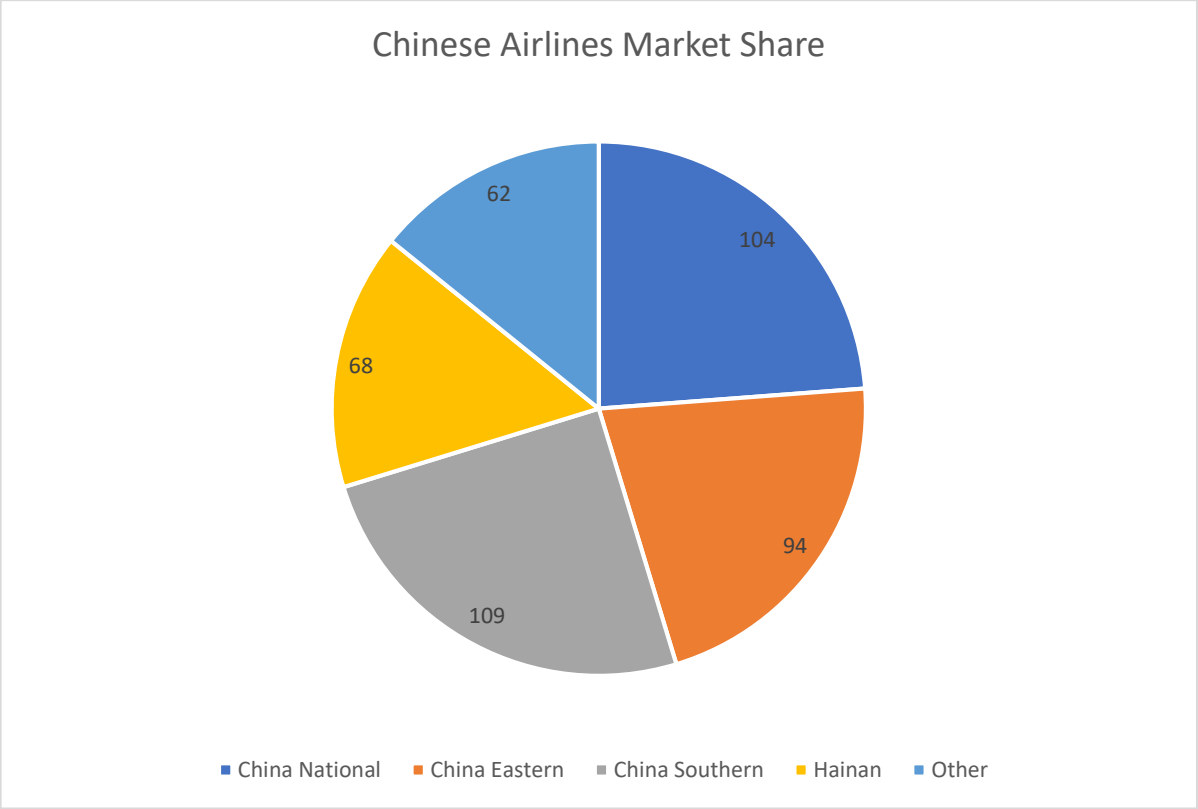


Figure 6: Chinese Airlines Market Share [32]

Chinese airlines market is ruled by four major airlines which carried in year 2015 over 85% of total number of transported passengers (Figure 6). In total there were 55 transportation airlines in 2015, 41 state-holding airlines and 14 private and privately-holding airlines. Seven airlines were all cargo airlines. Four major airlines contained China National Aviation Holding Group, China Eastern Air Holding Group, China Southern Air Holding Group, and Hainan Airlines Group. [32]

5.5 Transportation network evaluation

Transportation network in China has been developing for last 30 years very rapidly and it is expected to continue in future at the same pace. Chinese transportation infrastructure is used by millions of people traveling around China for various purposes and with various requirements. Chinese transportation network is not only required to be able to handle enormous number of passengers, but also must be adapted for long distance between Chinese

cities and regions. Airlines in China mainly compete with very sophisticated railway system. High speed railways easily substitute air transportation, especially in shorter routes in more populated southeast of China. Higher capacity of the trains and easier accessibility of the railway station from the city makes the traveling cheaper and also very competitive in total travel time.

HSR entered into service in China in 2007 and since then it has been competing with airlines the same way as it is in Europe or Japan. According to Morgan Stanley transportation analyst Edward Xu, HSR is Highly competitive with air transportation on routes shorter than 800 km and competitive on routes from 800 to 1500 km long. HSR competition can cause hard time for domestic airlines as 50% of 500 km flights and about 20 percent of flights between 800 km and 1000 km can become unprofitable as the director general of the Civil Aviation Authority of China (CAAC), Li Jiaxiang indicated. However, Airlines will keep its market position mainly in connecting distant destinations, domestic airports with international hubs, or remoted regions with difficult accessibility. [64]

Commuter aircraft is mainly purposed to connect remoted areas with low level of accessibility with hub airports in bigger cities. As it was obvious from pictures of all kind of transportation networks in China, the least accessible areas lie on the northwest side of Huanyong line, specifically in the mountainous or deserted areas of Tibetan and Mongolian Plateaus. These areas are sparsely populated and the environment and terrain are making its accessibility very difficult. Connecting the remoted counties with commuters is much more efficient than building expensive infrastructure in unfriendly conditions and provides the inhabitants faster and more reliable connection with outside world. By the experiences from Nepal, commuters also help the tourism in remoted regions. Inaccessible mountainous areas are very popular to visit by travelers and Tibetan plateau as an unexplored region full of pure natural environment and original culture and customs fits todays trend of adventure holidays. Another advantage of air transportation to remoted regions is its usability even during and after natural disasters and bad natural conditions like wintertime. Air transportation is the best to be used by emergency rescue teams for first help and first rescue operations after the disasters and then for logistics of rescue material. The lack of air emergency service in China was proved in 2008 during the earthquake in Wenchuan, Southwestern China. Ground transport was impossible due to damaged ground transportation network and air transport was the only option to connect affected regions. General Aviation is very important in these kind of occasions as it can be used for evacuation, search and rescue operations, medical services and relief supplies delivery.

On the other hand, a lot of Chinese remoted regions lie in higher altitudes for which the pressurized aircraft is needed. All the commuters, besides only 11 seats Beechcraft King Air and 9 seats Pilatus PC-12 which are still in production, are not equipped with pressurized cabin and their use is limited by altitude. Maximum altitude it can fly without using additional oxygen source for the passengers and crew is 3400 meters above sea level. The aircraft is made to fly in higher altitudes, but the flights would have to be served with oxygen masks, which is not possible on schedule commuter routes. For this reason, such routes are served by larger aircraft like Modern Ark 60, even if the payload factor is very low.

Remoted and hardly served by ground transportation regions with potential for commuter airlines in China are according to unnamed General Aviation professional from China mainly located in Xinjiang Autonomous Region, Inner Mongolia Autonomous Region, Bohai Bay Triangle, Parts of Sichuan, Tibet, Guizhou Province, Hainan, Sansha Islands, Guangxi province, or Yunnan province.

As it was mentioned in previous paragraph it is very inefficient to build whole land transportation infrastructure to connect remoted areas, it is very time consuming to get to these areas using land mean of transport and sometimes it is even not possible to build railroad or paved roads. Moreover, air transportation infrastructure is less expensive, especially for commuter transportation with aircraft with STOL abilities. Commuters do not need huge developed airports, as they carry only small number of passengers, not even paved runways, so they can use General aviation airport. This fact is very important, as one of the Chinese government aviation development target is to connect all the counties via small General Aviation regional airports.

Connecting remoted regions to secure livelihood for local people requires subsidies from government. Also, local governments must analyze the situation in the region, locate these kinds of remoted areas like it works in other countries in the world and push for launching such routes.

6 9-19 seats aircraft operations in the world

Commuter aircraft, such as C208, DHC-6, Do 228 or L410 are used by hundreds of operators around the world for different purposes. The aircraft of this size can be used for chartering for short or sightseeing flights, cargo and mail transportation, passenger commuting to remoted locations with difficult serviceability, aerial services, aeromedical and search and rescue services, parachutists carrying, or sometimes even for agricultural purposes, such as spraying or seeding.

6.1 Subsidized transportation to and from remoted regions

One of the key operators of 9-19 seats size aircraft are commuter airlines. Following paragraphs deals with subsiding the air routes to remoted regions. Operating 9-19 seats aircraft on routes to such places would be impossible without any subsidies, as the buyer power is not that high and the fares for the flight tickets would be inadequately expensive for the local people and communities. In many remoted regions in the world the air transportation plays an indispensable role. Somewhere it is the only way how to transport people and cargo, and somewhere it is the most efficient way of movement compared to other means of transport. Commuter airlines connecting remoted areas can settle effective transportation of human and natural resources through hub airport to remote destinations. Air transport itself is a product which is delivered partly as intermediate products for other industries, partly as final demand like leisure travels (Halpern and Bråthen 2010). Air transportation service is a catalyst for other industries in the regions as it allows full utilization of human and natural resources.

Air transportation to and from remoted regions is very specific business that is usually needed to be supported by subsidies. Airlines would not be able to serve such regions in today's liberated air transportation environment without any funding, as it would not be profitable for them. Subsidized transportation to remoted regions can be operated with all sizes of aircraft, so it is not only commuter airlines, that serves for such purposes. Different routes demand different capacity, frequency, type of aircraft, or level of subsidy conditions.

USA, Australia and Europe unify subsidized transportation by giving it universal rules. In the USA, the program covering subsidized transportation is called Essential Service Program, or EAS, in Europe, it is called Public Service Obligation and relates also to road, rail and sea transportation and in Australia it is called Regional Aviation Access Program, or RAAP.

Subsidized transportation is based on need for public transport. And this is the first obstacle for unifying the rules. It is very subjective and hard to define universal definition for remoted region in need of publicly funded air transportation. The subsidized transportation programs are sometimes offended by the public for its expensiveness, but it is important not only to focus

on the direct effects, but also to consider indirect, inducted and catalyzed effects of subsidized air transportation to the local economies and industries. The subsidized air transportation is not intended just to satisfy local communities by providing lifeline transportation services, but it is also important for local companies and tourism, which generate profit and thus contribute to public budget by paying higher taxes. The allocation of the air transportation funding must be well analyzed before launching any subsidized air route. The level and way of subsiding the air transportation differs around the world. Usually the subsidies are set to cover the loss of the airlines and to reduce the price for the passengers. The thing that differs is level of the reduction, the level of the subsidy and some of the countries also provides reward for launching the route or financing of the aircraft. All these parts of contribution differ according to country and market willingness to pay.

The subsidies are not intended only for aircraft operators, but also for the remoted airports and its operational costs. It is important to have reliable and developed network of airports to provide safe and quality air transportation services. The airport facilities and equipment can be also used to improve the life of the locals by sharing rescue and fire services, etc... This way also reduces the operation costs.

6.1.1 Essential Air Service Program in the USA

After the deregulation of USA's airlines market in 1970s the aviation authorities and government had to deal with a problem of connecting remoted areas with the rest of air transportation network. To support such routes and small communities, US Transport Department established EAS Program and with slight changes it is working till today. The companies are being chosen in tendering process, that assigns number of daily flights, weekend frequencies, size of the connecting hub, aircraft equipment, fare schedule and the maximum number of intermediate stops. Then the authorities chose the carrier by comparing four selected criteria: service reliability, contractual and marketing arrangements with a larger carrier at the hub, interline arrangements with a larger carrier at the hub, and community views. The level of subsidy is not between the criteria, but it is considered during the process. One of the criteria, as you can see, is also the opinion of the community, which carrier they prefer. The contract is usually set for two years and the financing is based on arrears on a per-flight-completed basis.

Since 1990 the rules for EAS sponsored routes have been unified. And in 2011 they were revised. The main location rule is, that the community must be located at least 70 miles from the nearest large or medium hub airport. If the community distance from closest alternative transportation center is less than 210 highway miles, the subsidy cannot be higher than 200 USD per passenger per flight segment. The average rate of subsidy during last fiscal year

cannot exceed 1000 USD per passenger at the end of each EAS contract. And the last rule is to transport at least in average 10 passengers per service day during the latest fiscal year, unless it is further than 175 driving miles from the closest medium or large hub airport. The rules above do not apply on Alaska and Hawaii due to more difficult accessibility of the communities. [39]

The funding of EAS comes from FAA revenues from users' fees. In the 2014, the budget of EAS was 249 million USD. The commuter airlines served the communities mainly with small aircraft with capacity of less than 19 passengers and the total number of communities was 163 of which 43 were in Alaska. [39]

6.1.2 Public Service Obligation in Europe

System of Public Service Obligations is defined by European economic community regulation no 1008/2008. PSO, as it was mentioned in the beginning, it is not related only to air transportation, but also to rail, road and sea transportation. The Public Service Obligations mechanism have been working in EU, Norway, Lichtenstein, and Iceland since 1992. The PSO, as it is applied in many countries, does not have very specific and unified rules and the level of provisions differs a lot across the Europe.

The PSO routes can be selected by central government departments or authorities of individual member state. The financing of the PSO routes is funded by central or by regional government directly or through associated agencies. Central national government department takes care of air transport PSO in the Czech Republic, Finland, Greece, Ireland, Portugal and Sweden, while in France, Germany, Italy and Spain, administration is done by regional authorities. Majority of over 300 PSO routes in Europe are domestic – about 90%, but there are also international PSO routes, as an example can be mentioned connection between Derry in Northern Ireland and Dublin (2014).

Tender for new PSO subsidized route has to be announced in Official Journal of the EU and usually contains minimum services level and maximum fares of the flight tickets during the whole period of the contract. Each tender consists of two rounds – first round is set to find out if there is any carrier willing to serve the route without any subsidies, if there are not such airlines, second round is set to find carrier that would operate the route with subsidies. The tender winning carrier usually gets a contract for four years.

According to "Comparison of Approaches for Supporting, Protecting & Encouraging Remote Air Services" the tenders are not very clear and meet criticism, that are suited for long-established carriers. This means very hard position for new entrants.

The largest number of domestic PSO routes in Europe had Norway in year 2014 - 61 and France – 41. Other countries with significant numbers are Spain, Portugal and Scotland with 10-12 routes each. In Portugal 40% of all domestic air transportation was PSO subsidized followed by 23% of Irish domestic air transportation. France or Norway offered about 10% of seats in domestic air transportation subsidized. On the other hand, Germany, Iceland and Sweden subsidized only insignificant number of domestic seats. The average distance of PSO routes was longest in France - about 600 km and shortest in Norway – about 200 km. The seating capacity of aircraft used for PSO routes in Europe varies between 8 and 150 passengers – from small turboprops to aircraft in size of Boeing 737. The average level of subsidy varied in year 2014 from 20 EUR per person in France and Portugal to 120 EUR per passenger in Germany. [38,40]

The dark side of PSO is that it is sometimes limiting the competition, as not all the PSO routes are established on non-profitable flights. This means that subsidized carriers can offer higher frequencies of the connection and lower prices of flights than non-subsidized ones and push them from the market. Too high frequencies then cause low load factors of PSO routes, that varies between 30% and 40% in average.

6.1.3 Regional Aviation Access Program in Australia

Region Access Program is focused on subsiding infrastructure and connection of remoted areas in Australia. The foundation of RAAP is ensured by Australian Government and administered by the Department of Infrastructure and Regional Development. RAAP consist of five parts: the Remote Air Services Subsidy (RASS) Scheme; the Remote Aviation Infrastructure Fund (RAIF); the Remote Airstrip Upgrade (RAU) Program; the Remote Aerodrome Safety Program (RASP); and the Remote Aerodrome Inspection (RAI) Program (Departmental funding). Following lines will focus on RASS, that is scheme of air routes funding.

The Remote Air Services Scheme is designed to connect remoted areas in Australia such as small farms or isolated indigenous communities of 6 to 200 people with the world. Under different contract with Australia Post the aircraft connecting the communities also carry a mail. Australian government funded in 2014 regular weekly air transport of passengers and cargo to 363 communities of which 257 were served directly and 106 neighboring communities received mail through one of the 257 directly served. Indigenous communities were 86 of 257 directly served locations. All of 257 communities were in Queensland, Northern Territory, South Australia, Western Australia and Tasmania. Any isolated community in Australia can apply for RASS connection, if it can prove the need for a weekly service and prove its

remoteness from closest population center or neighboring community receiving a weekly transport service. A community can apply for RASS assistance at any time. [41]

Six operators taking part in RAAP program in 2014 got 18,2 million in subsidies directly from Australian government. The program funding is lower and more transparent than in USA or Europe, so it is not that criticized as in previously mentioned regions. Contracts with the operators are signed for a fixed term after a selection that is in accordance with the Commonwealth Procurement Rules. Operators involving in RAAP can also participate in Airservices Australia Enroute Charges Payment Scheme program, that is funding the air operators for providing aeromedical services to regional and remote locations. [41]

6.1.4 Other countries

Around the world, there are many other countries, that subsidy the air transportation. From big, mainly continental countries can be mentioned Russia, Canada or Brazil and other South American countries. These countries provide funding for routes to remoted parts of its territories under different conditions. On the other hand, there are countries, that consists of number of islands, where the air connection is sometimes the only efficient way how to transport people, cargo and mail in reasonable time, mainly Pacific countries like Philippines, Malaysia or Indonesia and some of the Caribbean countries.

6.1.5 Conclusion on importance of subsidies in commuter transportation

This chapter pointed out how important it is to support remoted areas by connecting them with the main airport network. In many developed countries with liberated air transportation, this model works well, only the transparentness of the tenders is sometimes doubtable. China, as a still developing country in aviation, should learn from mistakes of other countries and choose the best from the other countries programs. Very developed and very complex program in Australia would be a great model.

The message is that this part of aviation is still not developed in China and as China is following developed world, connecting remoted regions will be important part of China's air transportation network development. Subsidies, liberalization of the airspace and the industry and better legislation structure for General Aviation will attract new operators and speed up the development of general and commuter aviation. Commuter aircraft with 9-19 seats are then important players in this field and if China will follow this path, there will be a need and demand for such an aircraft.

6.2 Commuter Aircraft Operations in Taiwan

Taiwanese airline Daily Air can be used as an example for China. Taiwan is an island located to the south-east from mainland of China. The island has complicated relationship with the

People's Republic of China. Twenty-three million Taiwanese people live on an area of around 36 thousand square kilometers. Taiwan consists of main island and other smaller islands found around it. Connection of these small islands is the subject of following lines, as it is very good example of island remoted regions connected by commuter airline, which is very close to China and the conditions are in many ways similar to the Chinese ones.

6.2.1 Daily Air

Daily Air is Taiwanese commuter airline based in Taipei Songshan Airport. The airline operates subsidized flights to remote islands. The airline commuter fleet consist of several Viking DHC 6-400 Twin Otters, that are replacing the aging fleet of Dorniers Do 228.

Following table 9 shows the flight routes operated by Daily Air, fares and flight times. The destinations, as it was mentioned, are islands. Different mean of transport than air connection is not efficient for passengers. Prices listed in the table are prices for not local people living on the islands. Prices for locals are even more subsidized.

Table 9: Daily Air Routes [42]

Connection	Flight time	Price (NTD)	Price (CNY)
Gaohsiung - Wangan	0:40	1981	447
Gaohsiung - Qimei	0:35	1869	422
Taidong - Lan Yu	0:25	1428	322
Taidong - Green Island	0:15	1070	241
Makung - Qimei	0:15	1074	242

Even though the prices are higher for such short flights, the average load factor of all the routes between 2005 and 2015 was about 72% according to Daily Air. This is caused by the fact that prices for local people are lower due to the subsidies.

Figure 7: Daily Air Routes [42]

7 Current situation of General Aviation and commuters in China

7.1 General Aviation in China

International Civil Aviation Organization (ICAO) defined in 2009 General Aviation as “all civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire”. This definition means that hired commuting would not be part of it. On the other hand, commuter aircraft are certified under CCAR 23 and operated under CCAR 135, which means that it is considered as General Aviation. This question is very common, and it is hard to define exact position of hired commuter operations or for example business aviation. In this paper, operation of such an aircraft will be considered as a part of General Aviation and following lines will focus on its problems and opportunities in China.

General Aviation in China suffers from various problems. Many of these problems were already mentioned in previous chapters and this one will sum it up, add some others and evaluate the Chinese General Aviation environment.

7.1.1 General Aviation Legislation

As it was stated in chapter Legislation, the legislation in China is not very General Aviation friendly. The laws and regulations are not suited for General Aviation and are not perfect and too limiting for small operators and commuter airlines.

7.1.2 General Aviation Airports

Closer look on general aviation airports was made in Analysis of Chinese Transportation Network chapter. Main problem of general aviation airports in China is the overregulation and luck of legislation and specifications connected with such small airports. But there is a bright future for the general aviation airports, as the number of registered general aviation airports should grow from current 70 to more than 1500 in 2030.

Another big problem and opportunity for development is huge lack of facilities and equipment connected with general aviation operations. The General Aviation Airports and Transportation Aviation Airports do not dispose with appropriate facilities such as Fixed-Based Operators (FBO) and other ground handling services or companies providing Maintenance Repair and Overhaul (MRO) services. Total number of FBOs in whole China was in 2015, according to Dr. Yuanyang Gao, only 5.

7.1.3 General Aviation Operators

In 2015, there were 230 General Aviation operators in China flying in total 779338 flight hours during the year. This number is not very high in comparison with the General Aviation super power USA, where the total amount of flown general aviation flight hours in 2015 were

18103000. Following figure 8 shows the distribution of the General Aviation traffic in China. Majority of the flight hours were flown for other than industrial or agricultural and foresting purposes. This other general aviation category for example covers the flight and pilots training, business aviation, etc.… Total time of General Aviation traffic in China that is related to training was 504309 hours, which is almost two thirds of all the General Aviation flight hours flown by aircraft registered in China. Industrial aviation has with 85468 hours the second highest share of totally flown hours and it includes aerial photography, inspections, sensing, explorations, or services connected with oil business. The last category were agricultural and forestry flights, that mainly includes seeding and spraying. [13]

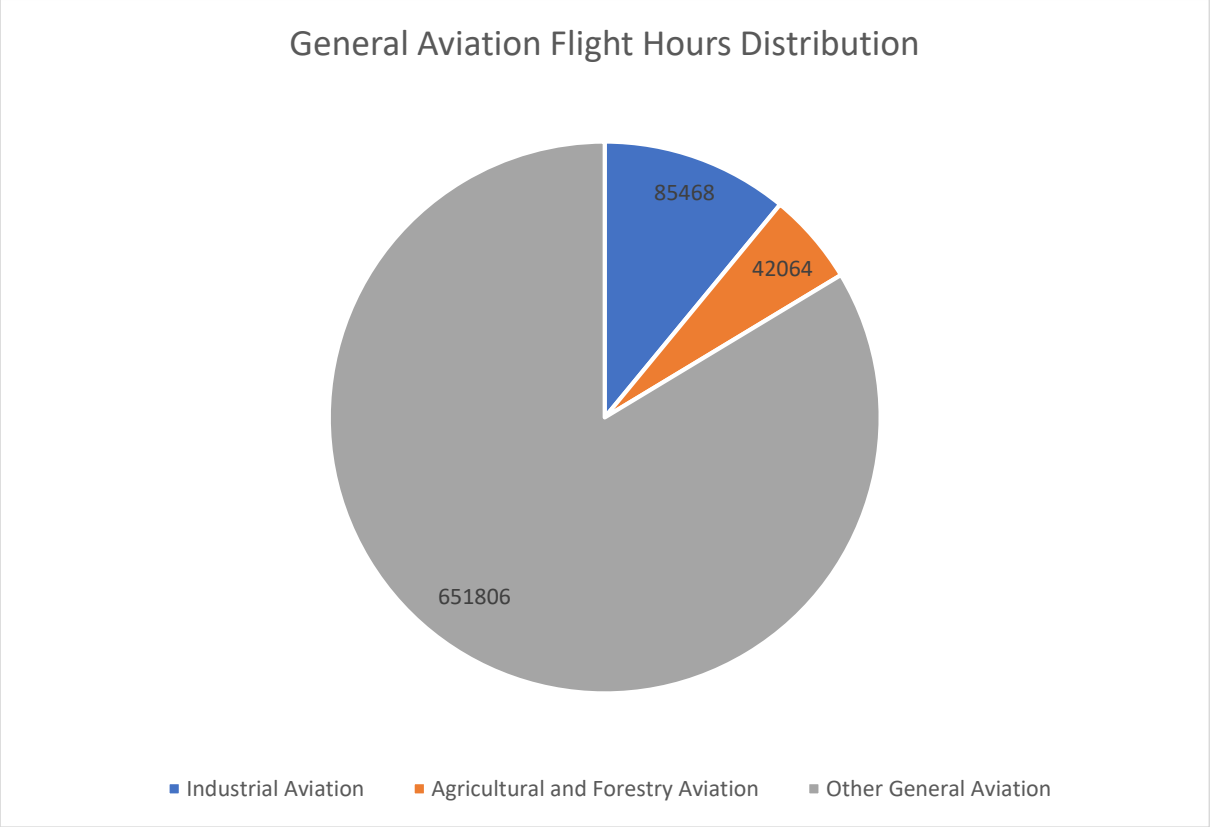
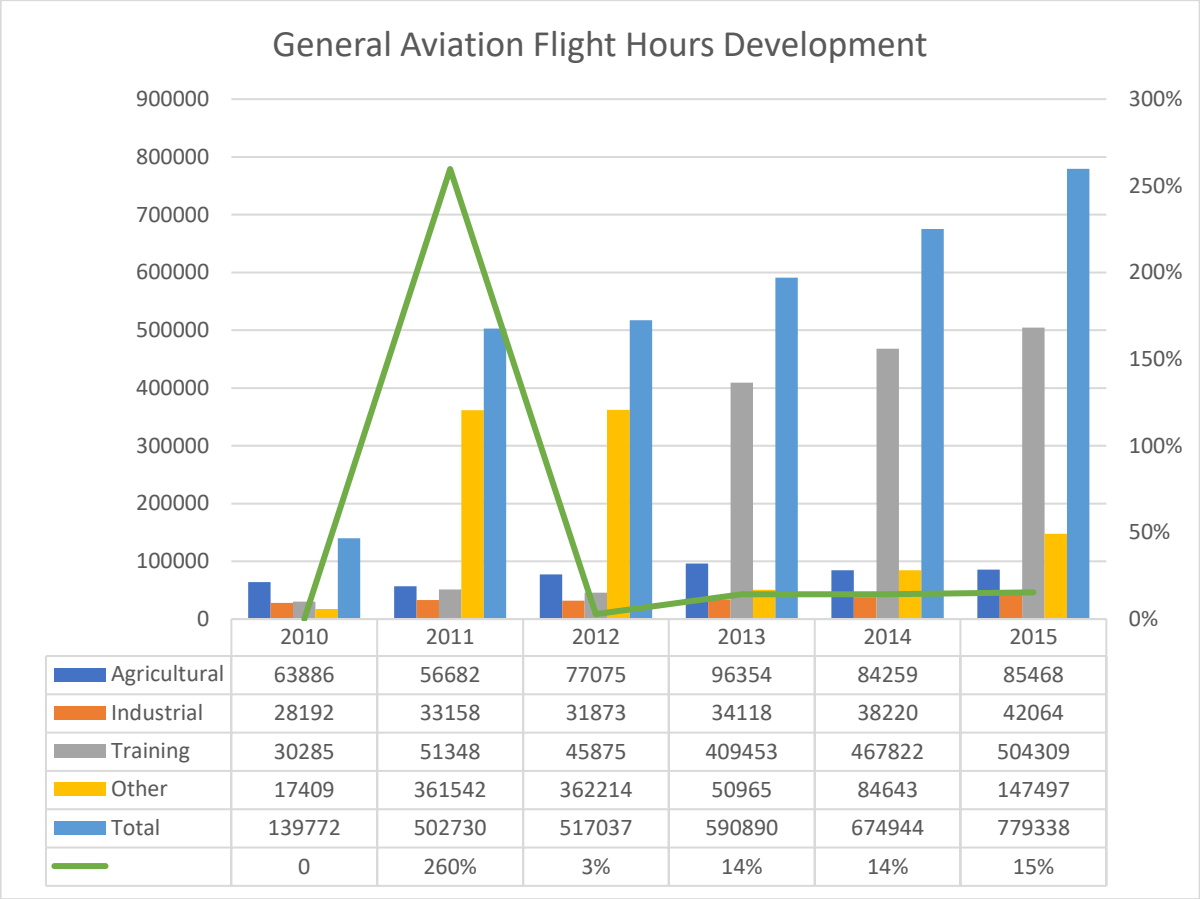


Figure 8: General Aviation Flight Hours Distribution [13]

Mentioned statistics show that general aviation activities for private purposes are very rare in China. Majority of the General Aviation traffic in China is made by the training schools, and not counting the industrial and agricultural and forestry purposes, the other general aviation operations lasted only 147497 hours. These other General Aviation operations also include the operation of commuter aircraft. This number again underlines the underdevelopment of General Aviation in China.



	2010	2011	2012	2013	2014	2015
Agricultural	63886	56682	77075	96354	84259	85468
Industrial	28192	33158	31873	34118	38220	42064
Training	30285	51348	45875	409453	467822	504309
Other	17409	361542	362214	50965	84643	147497
Total	139772	502730	517037	590890	674944	779338
	0	260%	3%	14%	14%	15%

Figure 9: General Aviation Flight Hours Development [13,33,34,35,36,37]

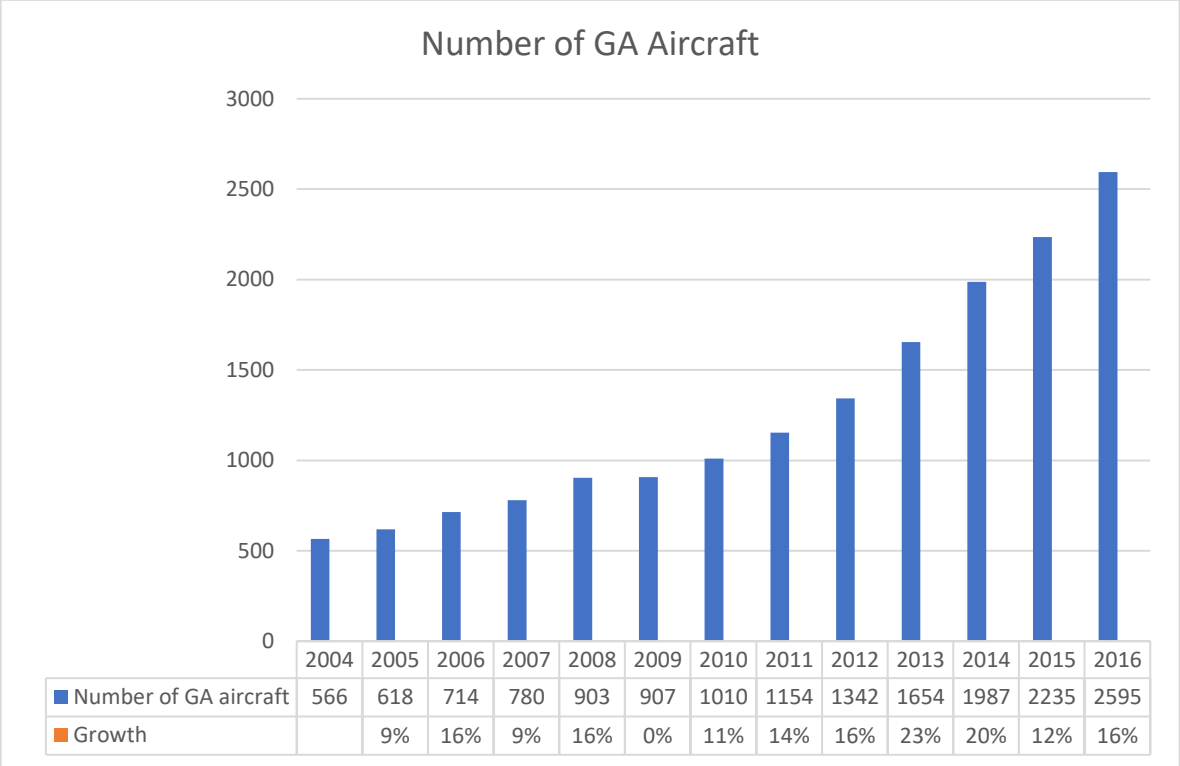
The development of flight hours flown by general aviation aircraft shows changes in classification of flights. The greatest share is flown by training companies but the statistics show very big difference between years 2012 and 2013. This difference is caused by putting some of the training schools to category other before 2013 and in 2010 not counting these schools as a general aviation traffic.

One of the biggest problem in General Aviation companies' development are again strict requirements and problems connected with company foundation. One of the problems is that Chinese government does not like people showing off their wealth. Flying private aircraft is sometimes in China understood as showing off. Another obstacle is Chinese need of absolute control of the airspace and people movement. Many of these regulations and lack of market

liberty causes low attractiveness and sometimes impossibility for private companies of entering it.

7.1.4 Aircraft

Total number of registered General Aviation Aircraft in China was according to CAAC in 2015 2235 of which 508 were used for training purposes. These statistics include for example small sport aircraft, agricultural aircraft, training aircraft, commuters, business jets (including 5 Boeing Business Jets and 6 Airbus Corporate Jets) or helicopters. Mr. Pan Linwu, executive vice-president of AVIC commented for ChinaDaily, that China will need about 10000 light aircraft within the next five years. He expects the same boom of small aircraft, like boom of private cars: "This is not a daydream. The number is forecast based on our market calculation. The light aircraft is something like the private car - 15 years ago, most Chinese people dared not believe they would have one or more, but it has now become common in Chinese families".



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Number of GA aircraft	566	618	714	780	903	907	1010	1154	1342	1654	1987	2235	2595
Growth		9%	16%	9%	16%	0%	11%	14%	16%	23%	20%	12%	16%

Figure 10: Number of GA Aircraft [13,32,33,34,35,36,37]

The figure 10 shows that General Aviation had been getting more popular in last decade in China. The number of General Aviation aircraft between 2004 and 2016 grew from 566 to 2595, that means around 360% growth. The annual percentage growth is not stable, but if the growth will continue in average by 15% every year the number of General Aviation aircraft should get over the 5000 aircraft in 2021. This number is not very high compared to population of China but due to limited conditions of General Aviation it is not likely to be higher. Everything depends on the government and military approach to liberate the General Aviation in China.

This fact is underlined by statements of Chinese General Aviation experts whom states that a lot of newly purchased and registered aircraft are not actively utilized due to the lack of infrastructure and General Aviation friendly law environment. This can be proven by the fact that out of 2235 general aviation aircraft in China in 2015 508 were purposed for pilot training. These 508 aircraft flew almost two thirds of all the general aviation aircraft flown flight hours in 2015 and remaining one third was flown by more than 1700 general aviation aircraft.

The recent growth of the General Aviation can also tell a lot about the age of the General Aviation aircraft and commuter aircraft fleet in China. More than two thirds of current fleet were purchased and registered after 2004, so aging of the fleet will not be problem in near future. The oldest registered commuter aircraft are Chinese made Y-11 and Y-12. In total, there were 72 active Y-11 and Y-12 in 2015. However, the lower age of the current active fleet is not an obstacle for aircraft manufacturer's sales in China. The size of the fleet is so low that the need for new aircraft, would be in certain circumstances very high anyway.

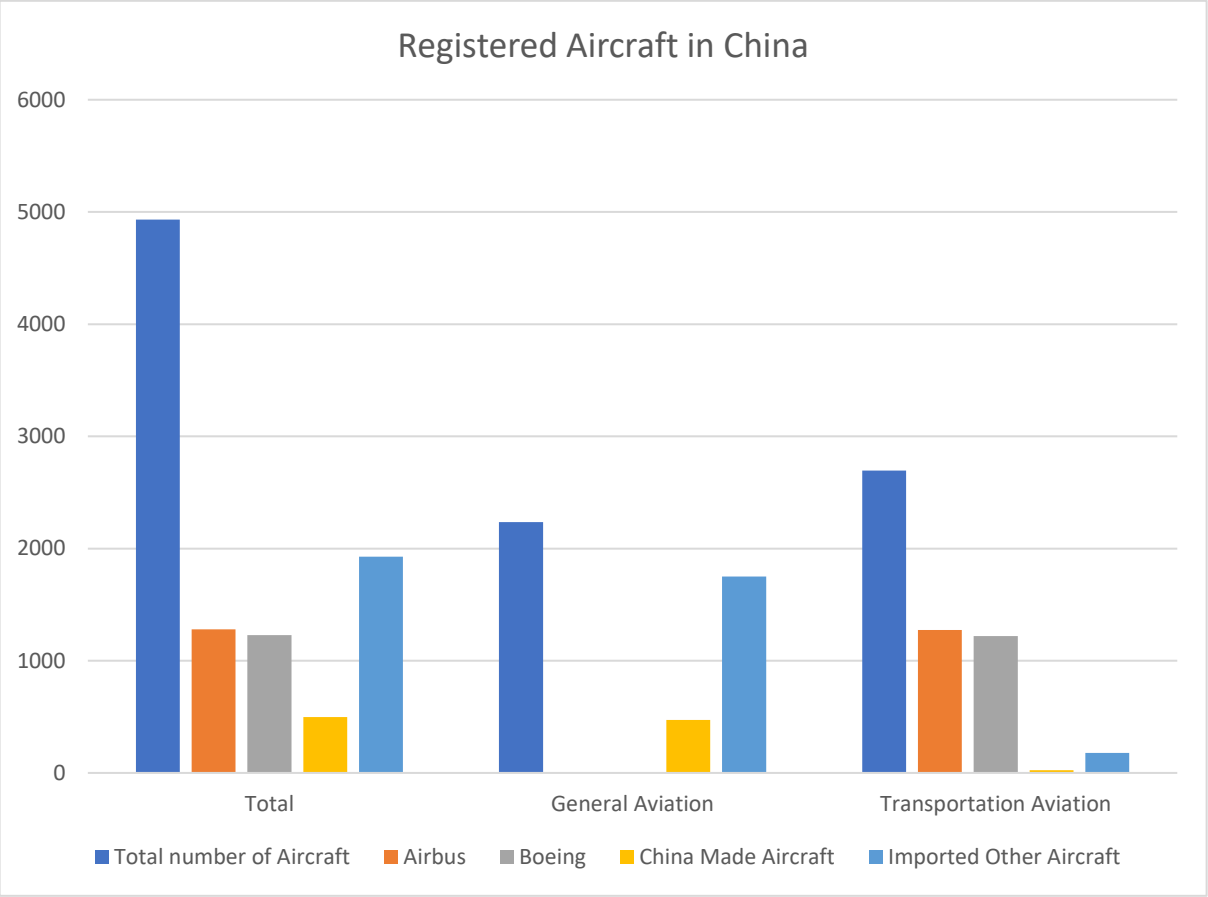


Figure 11: Registered Aircraft in China [13]

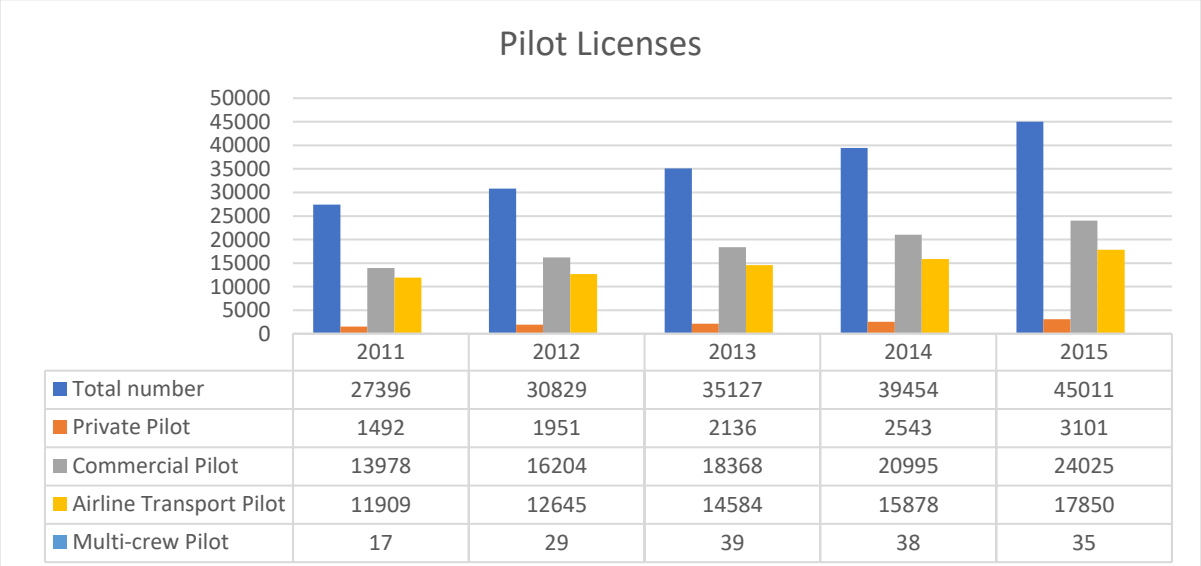
473 of 2235 registered General Aviation aircraft were made in China and 1751 registered General Aviation aircraft were imported. China is developing many new General Aviation Aircraft for different purposes, but the development is slower than demand for such an aircraft.

From commuter projects the new Harbin Y-12F can be mentioned, that should be in comparable quality with Dornier Do 228, Aircraft Industries L-410 or Viking DHC-6 Twin Otter. The aircraft production is still in its beginnings, so it is hard to say if it will not be as problematic aircraft as the previous versions of Harbin Y-12. Chinese government prefer the Chinese companies (operators) to use Chinese product (aircraft). For this reason, the import of General Aviation aircraft is more complicated and high taxed and so the aircraft final price is higher. Not only because of that, but also because of lower costs and high expectations on Chinese and Asian demand, the aircraft manufacturers are dealing with Chinese companies about manufacturing licensed aircraft in China or doing the assembly works in China. This would make the aircraft domestic product and reduce the price by import taxes.

7.1.5 Pilots

Not only the infrastructure and regulations can cause hard times in General Aviation future development in China. General Aviation as well as transportation aviation in China are on rise. More aircraft need more pilots and aviation personnel. Legislation connected with pilot training is covered in CCAR-141 and CCAR-61. The CCAR-141 is focused on flight schools and CCAR-61 on training organizations. Anyway, the number of all the Chinese training organizations and instructors is very low and China is partly dependent on overseas training organizations.

Following table and figure shows development of number and share of pilot licenses between the Private Pilot Licenses, Commercial Pilot Licenses, Airlines Transport Pilot Licenses and Multi-Crew Pilot Licenses between 2011 and 2015 in China. The numbers include both – the aircraft and helicopter pilots.



	2011	2012	2013	2014	2015
Total number	27396	30829	35127	39454	45011
Private Pilot	1492	1951	2136	2543	3101
Commercial Pilot	13978	16204	18368	20995	24025
Airline Transport Pilot	11909	12645	14584	15878	17850
Multi-crew Pilot	17	29	39	38	35

Figure 12: Pilot Licenses [43]

The figure 12 shows that number of pilots, as well as number of general aviation aircraft in China, grew during 2011-2015. The distribution shows that private pilots – mostly connected with General Aviation operations - represent a minority between all the pilot licenses categories. As it is obvious from figure 13, the distribution in USA is totally different and Private Pilot Licensed pilots represent much higher share between all the pilots. The CCAR-135 operators, which are in charge of the commuter aircraft operations, employed in total 1225 pilots in 2015 of which 525 held ATPL license and 700 CPL license. [13]

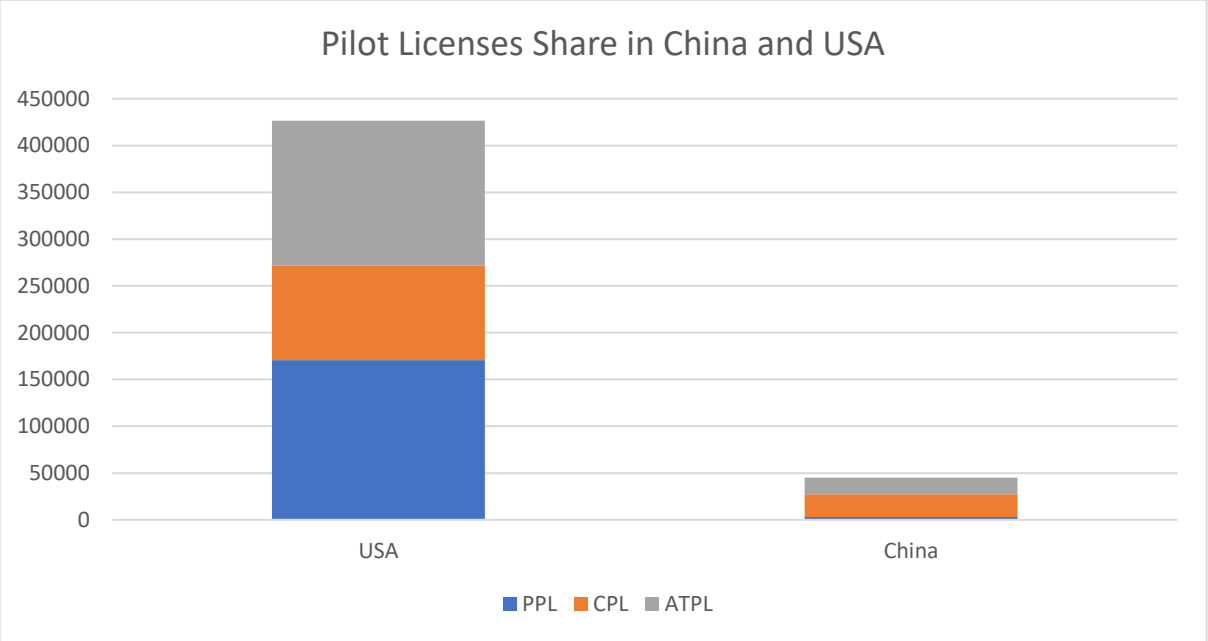


Figure 13: Pilot Licenses Share in China and USA [13,44]

As it was mentioned, Chinese CCAR-141 certified training schools are not able to meet the demand for pilots of the Chinese market. Because of that, a lot of student pilots are trained abroad, mainly in USA, Canada, Europe and Australia. In 2015 1711 CCAR-141 certified instructors trained 2852 students in 13 CCAR–141 certified training schools in China. Another 3700 students were trained in 26 overseas CCAR-141 training schools. [13]

Table 10: Chinese Student Pilots per Country [13]

Region	Training Capacity	Students in Training
China	3300	2852
USA	2650	2312
Canada	640	427
Australia	604	539
EU	200	114
Others	150	308
Total	7544	6552

Chinese lack of pilots is great opportunity for overseas pilot training companies and schools. Same as the other problems, this one is also connected with weak infrastructure and overregulated airspace. The capacity of Chinese training schools is low in comparison with the demand and even if the regulations become less strict, the number of instructors and homeland Chinese training schools will not meet the demand that fast.

Not only pilots and instructors are lacking in China. Also, the aircraft ground personnel resources are not according to Dr. Gao very rich and the planned future development of General Aviation will require to train such professionals. This will not be easy in such short time and will need support of foreign companies and skilled professionals. From the lacking personnel, maintenance personnel, ATC personnel, airport service personnel or professional managers, that are experienced in such industry, can be mentioned.

7.1.6 Fees and costs

Another issue of General Aviation in China are high fees and costs. This issue is according to the report of Xiaoshi Hu caused by many factors. The first problem is problem of import taxes connected with purchasing not China-Made aircraft. Chinese regulations favor big public companies, that usually buy large transport aircraft and the lighter aircraft are burdened by higher import taxes. Second problem are the fuel expenses, which are due to complicated regulations, very high for smaller companies that cannot afford their own fuel stocking and transporting infrastructure at the small airports. Another problem are the landing and other airport fees which are inadequately high in China. According to this paper 90% of companies operating charter services are in deficit due to this fact, as the customers would not be able to pay such charges for landing fees, which would sometimes make more than one third of the chartering charge.

7.1.7 Information and data availability

The information about the airspace and airports and statistical data availability is another problematic part of General Aviation in China. The aviation in China is still not very developed and even the airspace is very controlled, the data about the air traffic and state of the aviation in China are not very accessible, or it differs with the resource. Even the reports issued by CAAC are not very clear and different reports show different data about the same indicators. This fact causes not very easy position for new entrants on the market, as it is very hard to analyze it.

7.2 9-19 seats aircraft in China

General Aviation market in China is still in development and this is also reflected in number of 9-19 seats aircraft operators. There are 15 General Aviation operators operating 9-19 seats aircraft mainly purposed for unscheduled flights, such as artificial rainfall projects, aero

geophysical surveys, aero remote sensing, agrochemical operations, aerial forest fire protection, power line patrolling, advertising flights, charter services, aerial photography projects, air travel, ocean monitoring, feeder services, afforestation by aerial seeding, air ambulance service, polar research, scientific research projects and flight training. Following table shows number of registered aircraft in this category in China and the operators.

Table 11: 9-19 seats aircraft operators (Source: Author's Research)

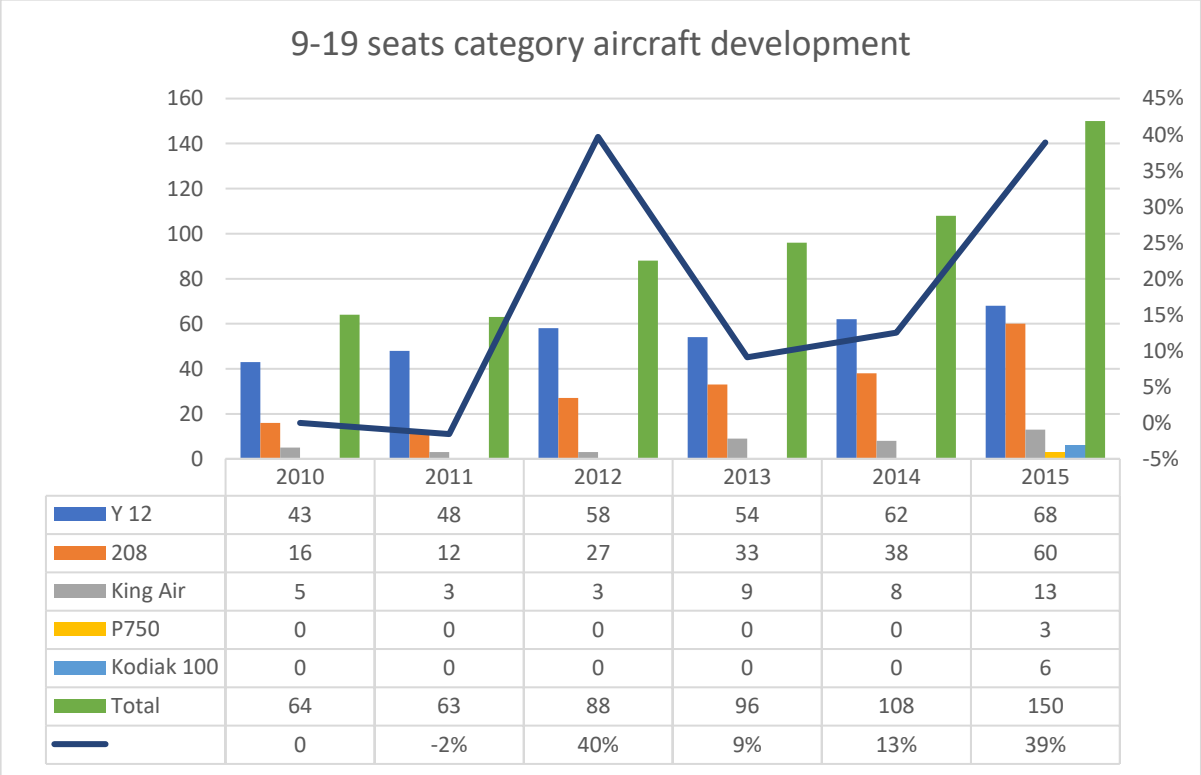
Aircraft	N°	Operator 1	Operator 2	Operator 3	Operator 4	Operator 5	Operator 6
Cessna 208	60	AVIC JOY GENERAL AVIATION CO., LTD.	Petrel Airlines	Inner Mongolia General Aviation Co.	AVIC HEBEI GENERAL AVIATION CO., LTD.	Zhongshan Xiongying General Aviation Co.	Astro Air Co., Ltd
Viking Air DHC-6 Twin Otter	10	Reignwood Asia Aviation Co., Ltd					
Harbin Y12	68	ORDOS GENERAL AVIATION CO., LTD.	AVIC ZHUHAI GENERAL AVIATION CO., LTD.	CHINA FLYING DRAGON GENERAL AVIATION CO., LTD.	Inner Mongolia General Aviation Co.	BEIDAHUANG GENERAL AVIATION CO.	
Beechcraft King Air 350	13	CHINA FLYING DRAGON GENERAL AVIATION CO., LTD.	XINJIANG GENERAL AVIATION CO., LTD.	AVIC HEBEI GENERAL AVIATION CO., LTD.			
Quest Kodiak 100	6	XINJIANG GENERAL AVIATION CO., LTD.	JIANGSU RUNYANG GENERAL AVIATION CO., LTD.	JIANGSU ZHONGLUHANGXING GENERAL AVIATION CO., LTD.			
BGAC P750	3	SHANDONG GENERAL AVIATION CO., LTD.					

Total number of registered commuter aircraft in China was in 2016 160. The numbers above are incomparable for example with USA, where over 1000 Cessna 208 and hundreds of Twin Otters, Quest Kodiaks or Beechcraft King Airs are registered. Other aircraft like Aircraft Industries L-410 or Dornier Do 228 have not been certified in China yet. Harbin Y-12 in different versions was the most common 9-19 seats aircraft in 2016. The operators use this aircraft mainly for charter passenger and cargo flights, but also for other purposes mentioned in previous paragraph. The Y-12 is followed by Cessna 208 which serves similar purposes.

Beechcraft King Airs, Quest Kodiaks and BGAC P750s are mainly used for charter tourist flights.

In 2016 Reignwood Asia Aviation Co., Ltd. purchased first 10 Viking Air DHC-6 400 Twin Otters in China. Total order counts 50 aircraft until 2020. Reignwood Asia Aviation Co., Ltd is planning to do the commuter business in Zhengzhou, Henan province. This company is exclusive operator of this aircraft in China with an agreement with Viking Air of building and developing a factory-endorsed completion and service center (FECSC). This center will be completing aircraft purposed for Chinese market and customize the aircraft according to the customer's needs.

It is also important to consider Chinese version of Antonov An-2 – Y-5. This almost 70 years old aircraft plays important role on Chinese General Aviation market now. Total number of the Y-5 in operation was 192 aircraft in 2015. This aircraft can be used for similar purposes as other mentioned aircraft. On the other hand, Y-5 does not look as convenient as the other aircraft in this category and is not as comfortable. These subjective factors play important role in civil aviation as the airlines need to look trustfully for the customers. This higher number of old Y-5 gives a great opportunity for aircraft manufacturers, as they will need to be replaced in the future by more modern aircraft. [13]



	2010	2011	2012	2013	2014	2015
Y 12	43	48	58	54	62	68
208	16	12	27	33	38	60
King Air	5	3	3	9	8	13
P750	0	0	0	0	0	3
Kodiak 100	0	0	0	0	0	6
Total	64	63	88	96	108	150
	0	-2%	40%	9%	13%	39%

Figure 14: 9-19 seats category aircraft development [13,32,33,34,35,36,37]

Previous figure shows that development of number of 9-19 seats category aircraft is not stable and differs every year. Another thing that the figure shows is the development of variety of aircraft types and dominance of Cessna 208 and Harbin Y 12.

Aircraft which is not covered in the table above, but can be used for similar purposes, is little bit smaller Pilatus PC-12. First pieces of this aircraft should be delivered to China in 2017 to XINJIANG GENERAL AVIATION CO., LTD. and will be intended for tourist flights.

Other companies, like RUAG with Dornier Do 228 or Aircraft Industries with L-410 overslept in certification process. Viking and Textron (Cessna) are already building its position on the market and it will be maybe problem for RUAG and Aircraft Industries to catch up with them in the future.

7.2.1 Commuter airlines in China

In 2017, the air commuter business in China has not been very developed yet. There were a few pilot projects mainly in Xinjiang and Inner Mongolia, but the volume is very limited. Other like commuting routes were mainly served as charter or unscheduled flights. Following table shows selected operators and routes they operated.

Table 12: Commuter Airlines (Source: Author's Research)

Operator	Location	Routes
AVIC JOY GENERAL AVIATION CO., LTD.	Zhoushan, Zhejiang province	Chengsi seadrome, Zhoushan-City beach seadrome, Jinshan ; Zhujiajian airport, Zhoushan- City beach seadrome Jinshan ; Chengsi seadrome, Zhoushan-Zhujiajian airport, Zhoushan
Inner Mongolia General Aviation Co.	Hohhot; Hulun Buir, Inner Mongolia	Hailar-Genhe (7h22min by train 29,5 Y) Hailar – Manzhouli (2h12min 28,5Y) Hohhot- Bayannur- Wulate (2h41min 41,5 Y) Hohhot- Ordos
AVIC HEBEI GENERAL AVIATION CO., LTD.	Shijiazhuang	Zhengding(Shijiazhuang)-Pingquan(Chengde)

The Inner Mongolia General Aviation Co. is transformed from AVIC Hulun Buir General Aviation Co., Ltd. In 2015, it was operating four routes in Inner Mongolia, Hailar-Genhe; Hailar – Manzhouli; Hohhot- Bayannur- Wulate; Hohhot- Ordos. And it has five more routes which has gotten authorized and will be operated in the future. All these routes are scheduled, and the price is from 299 to 380 CNY promotion price can decrease down to 59 CNY including transportation to and from the airport. By 2015, this airline fleet consisted of 14 aircraft and has operated 1491 flights. Xinjiang General Aviation use the Modern Ark 60 to do the commuter

flights. This kind of flight is managed under CCAR-121 not CCAR-135, so it is not the part of GA market. The reason of using this kind of aircraft is the terrain altitude in this region, which is higher, so the conditions requires aircraft with pressurized cabin. This problem was already mentioned in chapter about transportation network in China and will be considered in later evaluation. [45]

The buyer power in Inner Mongolia and other Chinese regions is not that high and mentioned ticket fares would not cover the operating costs of the aircraft. For this reason, various government subsidies are applied. As the majority of operators are government owned, the government helps them with financing the purchase of the aircraft and then subsidize the operating costs to develop the commuter network in the regions. These subsidies policies were issued by CAAC in 2013 and are covered by Interim Measures of Regional Aviation Subsidies from 2008. According to this document, the commuter airlines can get 24-216 CNY subsidy per person, depending on average payload factor on the route and type of the route. Following table shows comparison between ground and air transportation options in Inner Mongolia. [45]

Table 13: Selected routes in Inner Mongolia [45,46,47]

Route	Railway		Road		Air	
	Time	Price	Time	Price	Time	Price
Hailar - Genhe	7:12	29,5 CNY	5:37	-	1:10	299 CNY
Hailar – Manzhouli	2:01	28,5 CNY	2:39	-	1:00	299 CNY
Bayannur- Wulate	-	-	2:16	-	0:30	380 CNY
Hohhot- Ordos	-	-	2:42	-	1:10	299 CNY

The data in the table 13 contains the shortest connections via railways and roads compared with the flight times. First two city pairs can be connected by all three ways of transportation and the other two miss the direct railway connection. The trip times by roads in China generated by the maps applications must be taken with a reserve because the condition of the pavement is not always considered. As it is obvious, besides the first route from Hailar to Genhe the trip times of the land connection are not that long, when compared to the price difference. Prices of the flight tickets are incomparable higher, but as it was mentioned before the airlines are promoting the flights and sometimes discount the prices down to 59 CNY. Anyway, the pay load factor is according to Chinese experts very low and better organization made by experienced professionals is needed.

In November 2016, National Development and Reform Commission (NDRC) issued the Notice on the Work of GA Demonstration and Promotion, including 10 demonstration projects of air commuter which lie in Inner Mongolia, Jilin, Heilongjiang, Sichuan and Xinjiang provinces.

Reignwood Asia Aviation Co., Ltd. chose Shangjie Airport as the operating base for its DHC-6 Twin Otters. In the future, Reignwood Asia Aviation Co., Ltd is planning to serve the commuter routes including Shangjie, Henan-Changzhi/Yuncheng, Shanxi; Shangjie, Zhengzhou-Jining, Shandong; Shangjie, Henan-Anyang, Henan.

8 Analysis of the market, Evaluation and Prognosis

8.1 PESTE analysis

PESTE analysis in this paper is mainly focused on factors related to commuter aircraft market and facts, that can or will influence its development in the future.

8.1.1 Political factors

Political factors are very closely connected with the legislative factors. China is a communist country with very high political stability. On the other hand, the country and the market is burdened by restrictions and regulations. Aviation is one of the most regulated industries in China, mainly because of the fact, that a major role in its control plays Chinese Peoples' Liberation Army.

From the market overview follows that there are two main problems connected with political factors. One of the problem of general aviation in China is the overregulation of an airspace with total absence of uncontrolled categories of it. The airspace in China is fully controlled by State Council and Central Military Commission to ensure according to CCAR-71 "flight safety, national security, economic benefits, air traffic control service, high traffic flow, adaptability, and international standardization."

Another big problem connected with political factors are the legislations and taxing issues and imperfections. The research showed that current regulation and legislation policies are not very adapted for general aviation, nor for commuter airlines. The taxing policies are favoring big airlines and discriminate the small aircraft operators. These factors are the main problems of general aviation in China and the future development mainly depends on the legislation changes.

Political support in development of various industries in China is based on five years planning strategy and thanks to very rich resources are the plans usually fulfilled very successfully. This can be for example seen on extremely fast development of high speed railways in China that came into service in 2007 and by the end of 2016 China had the most developed high-speed railway network in the world with 22,000 kilometers of high speed railways. General aviation in previous five-year plans did not have such attention, but actual plan counts with very intense development of general aviation airport network. Currently there are 70 registered general aviation airports and the actual five-year plan counts with reaching number of 500 general aviation airports by 2020.

The regulation and supervision of civil aviation in China is exercised by Civil Aviation Administration of China, that reports directly to Party Central Committee and the State Council.

Supervision of individual operators is then performed by CAAC regional offices, depending on the operator's location.

8.1.2 Economic factors

Economic factors important for this analysis are mostly related to actual economic situation of the country, possible customers and market players. China is the fastest growing and the biggest economy in the world. GDP of China was in 2016 21,27 trillion US Dollars and the average GDP per person was 15400 US Dollars. Total GDP is the biggest in the world, on the other hand in the ranking of GDP per capita is China on 104th place in the world. According to McKinsey & Company, 76 percent of China's urban population will be considered middle class by 2022 (income of 9,000 - 34,000 US Dollars per year). However, there is relatively large group of extremely rich people in China and many times bigger group of poor people, mainly in rural areas of China.

According to professor Gao research there are over 875,000 multimillionaires and 55,000 billionaires in Mainland China. His investigation also shows that one sixth of these people plans to buy a private aircraft. The total number of general aviation aircraft in China is extremely low (2595 aircraft in 2016) in comparison with the population and economic environment of China is not the obstacle for further development.

Subsidized operation of commuter aircraft to connect remoted regions is not very developed in China as well, but after the improvement of the general aviation legislation and development of the infrastructure it is expected to grow. As the general aviation development is very important point in current five-year plan, the government will probably support the commuting as well to boost the industry.

8.1.3 Social factors

Social factors in the analysis are mainly represented by the factors that are influenced by Chinese population. China is the most populated and fourth biggest country in the world by the area. The distribution of Chinese population is very unequal, so is the transportation network. China is divided by imaginary line between Aihui (renamed Heihe in 1983) in Heilongjiang Province and Tengchong in Yunnan Province into two parts. Southeast part of China covers about 36% of the total area and northwest part about 64 %. Even though the first part is smaller, about 95% of entire Chinese population live there. And the transportation network reflects this phenomenon as well.

The distribution of the inhabitants in China, and the disequilibrium of the transportation network between the east and the west is a great opportunity for air transportation and commuter airlines. Building small airports in remoted sparsely populated areas is less expensive than

building the railways and roads. Modern land transportation to such areas would be sometimes very complicated to build and aircraft can connect it in reasonable time. These hardly accessible places are also in very dangerous situations in case of natural disaster, because of lack of fast connection with rescue teams.

Another social factor is, as it was mentioned in economic factors, that there is very large group of rich people in China, that would like to fly their own aircraft. On the other hand, there is great lack of pilots and pilot instructors, which can be very big problem for the future development, but also a big opportunity for foreign companies and pilot schools.

8.1.4 Technological factors

Technological factors are in such complex industry, like aviation is, very important. Good and well maintained technological conditions are very important for the development of aviation industry and the market health. Technological factors are in this analysis mainly related to the infrastructure and the aircraft.

The research showed, that number of general aviation aircraft as well as 9-19 seats turboprop aircraft, or commuters is very low in China. Chinese commuters fleet consist of less than 200 (160 in 2016) aircraft of about six types. Other aircraft types like Aircraft Industries L-410 or RUAG Do 228NG are not certified to operate in China or are not operated by single operator in China. Chinese aim is to be self-sufficient and to manufacture and develop its own aircraft types and limit the imported ones. This attitude is reflected in import tax policies and fleet compositions. The most common type of commuter in China is Chinese Harbin Y-12 (68 aircraft in 2016) followed by Cessna 208 Caravan (60 aircraft in 2016), which is not originally from China, but Cessna assemble the aircraft in China from imported parts, which makes the aircraft partially made in China. The number of aircraft is expected to increase in following years, but growth rate depends on many variables and will be more described in the final conclusion.

Another problematic technological factor in China is the current status of the airports, mainly the general aviation ones. There are 507 airports in total in China. 218 airports are transportation airports and 70 airports are registered civil general aviation airports, other more than 200 airports and landing platforms are unregistered. The general aviation airport status should get better and by 2020 there should be 500 general aviation airports in China. Chinese approach in general aviation is very questionable, because according to consultation with Chinese experts China is building such number of airports with no sureness of improvement of legal environment at the same time. The legislation connected with building airports is not adapted for general aviation airports as well and should be reviewed first.

Aircraft operation requires good technical background and is linked to many other services such as aircraft maintenance, ground handling and other airport and aircraft operation related services. However, providing such services involves experienced professional personnel and good quality facilities and China miss it. There are not a lot of companies providing these linked services and totally not enough to cover expected future development. Along with building new airports and enlarging the fleet it is important to focus also on these services and simultaneously develop them. This can be also very good opportunity for foreign companies and experienced Chinese ones.

8.1.5 Environmental factors

China is country of diverse geography. In the west of China, the terrain is mostly mountainous with high plateaus and deserts and the east is full of plains, deltas, and hills. The climate goes from tropical in the southern provinces to subarctic in the north of China. China is very big country with beautiful nature and many touristic places. However, the nature is not very well maintained and environmental interventions are very widespread. The beauty of the nature in China is usually destroyed for industrial purposes or for human's comfort, instead of using more environmental-friendly solutions. Very big problem connected with aviation is air pollution in China. High level of air pollution reduces the visibility and worsens the conditions for flying. The pollution is very common in wide surrounding of big cities and the level is extremely high. Sometimes the pollution cause zero visibility.

The mountainous terrain and dense population in the west of China are very good conditions for establishment of commuter air transportation. Building modern land transportation infrastructure, that would give people connection with civilization in reasonable time, would be the mountainous areas in China are in very high altitudes that requires to be overflown with aircraft with pressurized cabin. Current offer on the commuter aircraft market does not include a large selection of pressurized 9-19 seats airplanes. Beechcraft 1900 and Fairchild Swearinger Metroliner are not in production anymore and Pilatus PC-12 and Beechcraft King Air 350 can carry only 9, respectively 11 passengers.

8.2 Porter's five forces analysis

Porter's five forces analysis is focused on the competition environment of the market. The analysis examines and define all the players on the commuter aircraft market in China and their roles.

8.2.1 Threat of new entrants

By new entrants on the market can be considered other manufacturers with aircraft type, that is not operated in the region yet, or with totally new aircraft type. The commuter aircraft market is not very big when compared for example with jet engine aircraft market. On the other hand,

the operators have relatively large commuter aircraft selection. Commuters can be divided into two groups – aircraft with capacity around 10 passengers and aircraft with capacity around 19 passengers. The first category is greater and there are also more types of aircraft in this category (Cessna 208, Beechcraft King Air 350, Quest Kodiak 100, BGAC P750 and Pilatus PC-12) already registered and operated in China. From the other category, there are only two types of aircraft operated on Chinese market (Viking DHC 6 Twin Otter and Harbin Y-12) and globally there are only three more possible players in the category (Aircraft Industries L-410, RUAG Do 228NG and PZL M28).

The market with around 19 seats aircraft has been unstable in recent years. There is not high demand for such aircraft and the purchase prices are increasing. On the other hand, the manufacturers are developing new versions and new aircraft in this category. The new versions of Harbin Y-12 and Aircraft Industries L-410 have recently entered into service or are expected to enter very soon. Completely new player on the market should be Indonesian company Indonesian Aerospace, that is developing new 19 seats aircraft Indonesian Aerospace N219 based on CASA C-212. This aircraft should attract potential customers with its low price.

The opportunities for commuter aircraft manufacturers are very wide in China. The threat of new entry relates only to the aircraft, that haven't been certified in China yet. The potential in the Chinese market is so huge that these manufacturers are already undergoing or preparing for the certification process in China. All in all, the first power will not really influence the market very much. The companies, that are already selling their aircraft to China and did not oversleep the start have a great advantage now.

8.2.2 Threat of substitutes

The substitutes for commuter aircraft is very important topic and one of the main problems, why the industry is not very developed in China yet. In recent years China focused mainly on development of road and railway network. Land transportation is the possible substitute for commuter air transportation.

Majority of China is connected by railways or roads. A large share of the railways are high-speed railways, that are big competitors of air transportation. China is very populated and number of people that are moving within the country is very big. Trains have big advantage in their capacity and high-speed trains easily compete with aircraft in total trip time on routes up to 800 kilometers long.

Anyway, China is geographically very diverse and very big country and as it was mentioned before, there are less inhabited parts which are located in inaccessible regions and building expensive land transportation infrastructure in such areas would not be effective. Thus, commuter transportation is very good substitute for land transportation that would save people

in these regions a lot of travel time and during natural disaster even their lives, because of easier and faster rescue team accessibility.

The research showed that even in developed countries like USA or Canada is place on transportation market for commuter aircraft and airlines. Chinese market is very huge and the opportunities for the commuter aircraft are huge as well, even though the other means of transport at the moment are more developed.

8.2.3 Bargaining power of customers

Bargaining power of customers is defined by their position during the negotiations between the seller and the customer. The customers of the commuter aircraft manufacturers are the aircraft operators. Due to wide range of commuter aircraft use the operators' composition is very diverse, but the main purpose of the aircraft is passenger transportation and the main customers are commuter airlines.

The customers' position on the market is close to equivalent to the sellers' one, little bit better for the sellers. Some of the conditions are more advantageous for the customers, other for the sellers.

Following paragraph sums up the advantages for the customers. The commuter airlines market in China is very small and the number of the commuter aircraft operators as well. The selection of commuter aircraft offered by the manufacturers are quite wide. The wide selection is good for the customers who can choose the aircraft that suits its operations the best. Another advantage for the customers is expected high volume of the commuter aircraft deliveries to China in the following years. The general aviation aircraft number increase in China, as the research showed, was in average 13,5% per year between the years 2004 and 2016. Even if the general aviation market development continues in the same speed and do not, as it is expected, speed up. The number of commuter aircraft (in case of the continuous same share of aircraft types) will almost double until 2021. In 2016 the number of commuter aircraft registered in China was 160. If the increase follows the previously mentioned conditions, the number in 2021 will be around 301 aircraft – this means 141 new commuter aircraft in next five years. Thus, the customers' position in the negotiation is good, because their demand will be probably for more aircraft.

On the other hand, the position of the seller (commuter aircraft manufacturer) is also very good on the market. The market is new and the operators are not that experienced. The sellers have good chance to introduce their product without any bad reputation from the past. The customers are not very price sensitive, because of the government subsidies possibilities in China. Chinese government is aiming to boost the industry and subsidizing it is one of the expected ways. Low price sensitivity is a good sign for the sellers and make the negotiations

easier for them. The last but not least important advantage for the sellers are very high switching costs to other product. Choosing the type of aircraft is very important decision of the operator and includes very high linked costs, switching to other type would require spending these costs again. If the operator is operating specific type of aircraft, it is very likely that its next aircraft will be the same type.

8.2.4 Bargaining power of suppliers

The suppliers are in this analysis represented by the companies and people important for successful operation of commuter aircraft in the region. These companies include the MRO (Maintenance Repair Overhaul) providers, the airports, FBOs (Fixed Based Operators), or pilot training schools and between the important people that can be perceived as suppliers are the pilots, aviation personnel or the customers of the commuter airlines.

As it was mentioned many times in this paper, the general aviation is very undeveloped in China and so are the linked services. The linked services such as general aviation airports, or maintenance providers and missing aviation personnel were already mentioned in technical factors of PESTE analysis. In general aviation exist companies that cover majority of the linked services, and sometimes fulfill also the function of operators and flight schools – FBOs. Total number of 5 FBOs in 1,3 billion inhabitants' China perfectly reflects the situation of general aviation there.

Increasing number of aircraft will require higher number of pilots. Pilots and training schools can be also considered as suppliers, because without pilots the aircraft cannot fly and if the aircraft does not fly, it is useless. The research showed, that total number of pilots is steeply increasing in China. It also showed the distribution of pilot licenses held by Chinese pilots. The distribution is very unequal and differs a lot from other countries in the world, as an example is mentioned USA. In China, the share of pilots holding private pilot license is about 7%, in USA it is 67%. These numbers are one of the proofs of underdevelopment of general and private aviation in China. The demand for airline pilots is so high in China that even the pilot schools and training centers located in China cannot fulfill it. For this reason, more than half of current Chinese pilot students are trained abroad in USA, Canada, Australia or Europe. The lack of pilots can cause problems in fast development of general aviation in China and so in the aircraft sales. Similar situation exists in the number of all the other aviation personnel.

Customers of the customers who will buy the aircraft can be also considered as suppliers. These customers include the passengers, postal and delivery services providers, or rescue teams. The supplier power for the manufacturer is represented by buyer power of mentioned entities. And the buyer power is very high here. Normally this power could be visible on the payload factor of the operated flights and the aircraft usage, but not in subsidized industry.

Commuter air transportation is commonly very highly subsidized and the possible loss and lack of demand is covered by the subsidies.

8.2.5 Industry rivalry

The rivalry between the manufacturers is very high on the 9-19 seats aircraft market. There is a lot of manufacturers producing similar aircraft. At the moment, the market is not big enough for this many manufacturers, a lot of them have to reduce the production and look for other opportunities. Expected growth of Chinese general aviation market can mean a bright future for them.

Each commuter aircraft offers different advantages but in the end, they are very similar. The aircraft compete mainly in the versatility, capacity and comfort, purchase and operating costs and performances. There is not one best aircraft in this category, and the operators can adapt their selection to specific operating conditions.

Some of the commuter aircraft types are already operated in China and some are not operated there yet. The ones that did not oversleep and certified the aircraft in China have great advantage of time that they can use for building MRO infrastructure, pilot and other aviation personnel training and reputation earning. As it was already mentioned, aircraft that are fully or partly made in China (Cessna 208, Harbin Y-12, BGAC P750) have a big advantage.

8.3 Summary of the analysis

Some of the reviewed factors are creating good environment for general aviation and commuter aircraft sales increase. On the other hand, some of the factors mentioned above can be an obstacle. To sum it up, the condition, which are general aviation development friendly, are the economic, social and partially the environmental ones and the factors that can complicate the development are political and technological factors. The most powerful variable in the future development is the legal background. Everything depends on the way China will proceed in improvement of the general aviation regulations and requirements.

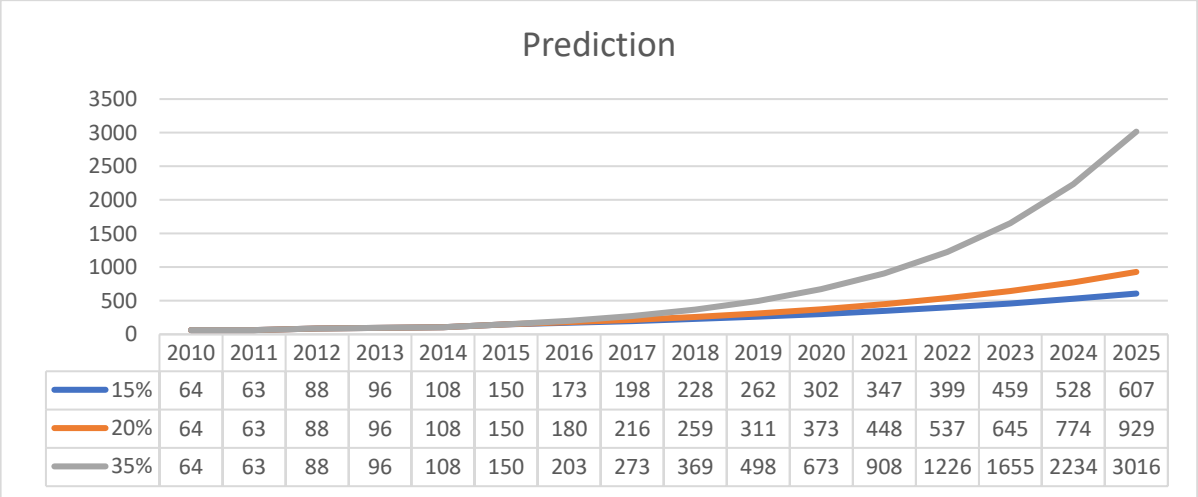
It is needed to consider that Chinese market is not free. Analyzing the competitive environment is very hard then and the porter’s five forces analysis can be doubtable. The analysis performed in this paper focused more on the 9-19 seats category aircraft market from the global perspective with factors typical for the Chinese market. It mainly describes the environment and the consideration in the analysis, that everything in China is regulated and everything depends on authorities’ attitude, is limited. China would like to be self-sufficient in all the ways and prefers to use home made products. On the other hand, aerospace industry and aircraft manufacturing are very complex and technology-demanding, and China and its manufacturers are not as developed as other ones around the world. Limiting the market for

Chinese made aircraft only would be in predicted development of the market also impossible as the capacity of the manufacturers is limited and the reliability of the Y-12 aircraft is not very high according to the operators. Globally the competitive environment on 9-19 seats category aircraft market is very healthy and everything depends on marketing and sales departments of the manufacturers. In China, as it was mentioned, the competition is limited, some of the manufacturers have advantage that their aircraft is already certified in China but the market has such potential that there is place for all of them.

8.4 Market development prediction and prognosis

The analysis showed that factors which are limiting the future development are the technological and political ones. The prognosis and prediction are based on future changes and development in these areas. The future market demand is predicted according to three different scenarios according to level of liberation and market openness.

Average annual growth of number of 9-19 seats category aircraft in China between 2010 and 2015 was about 20%. Annual growth of all general aviation aircraft in China was 17%. This means that the numbers of analyzed aircraft grows slightly faster than the numbers of all general aviation aircraft. In 2015 9-19 seats category aircraft made 6,7% share of all general aviation aircraft in China. It is hard to find detailed statistic about share of 9-19 seats aircraft in other countries. All the aircraft in analyzed category are turboprop aircraft. The 2016 GAMA databook says that turboprop aircraft makes in the USA less than 5% of total number of general aviation aircraft. And this share also contains other than 9-19 seats aircraft, like agricultural or smaller passenger aircraft. The growth in both cases wasn't stable or somehow regular. Following prediction is focused on ten years between 2015 and 2025. As it was mentioned the development is not regular, so the analysis will count with average annual growth, that will be in all three scenarios same for the whole period. [48]



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
15%	64	63	88	96	108	150	173	198	228	262	302	347	399	459	528	607
20%	64	63	88	96	108	150	180	216	259	311	373	448	537	645	774	929
35%	64	63	88	96	108	150	203	273	369	498	673	908	1226	1655	2234	3016

Figure 15: Aircraft Number Development Prediction (Source: Author's Research)

The figure 15 shows the possible development of number of 9-19 seats category aircraft. Three scenarios are predicting 15, 20 and 35% annual growth for the years 2016-2025. The reasons for such predictions are written in following paragraphs.

8.4.1 First scenario

First scenario is the most pessimistic and counts that the future development of general aviation in China would be worse and slower than recent development. Very slow legislation changes and obstructing foreign companies providing linked services to general aviation would lead to decrease of the growth. Examples of the most likely obstacles in faster development are mentioned in following lines.

One of the obstacle for future development would be slower expansion of general aviation airports network. China plans to build 500 new general aviation airports till 2020 and 1500 till 2030. The infrastructure is very important for development of general aviation and smooth running of construction of such number of airports should be accompanied by legal changes. Nowadays the legislation regulates the general aviation airports with the same strict regulations as it regulates transportation airports. All the general aviation airports are then paved and equipped with expensive and too complex equipment for such an airport. Simplification of the legislation would lead to faster development and construction.

Another big obstacle is the strictness of the airspace control. According to the Chinese professionals Chinese CAAC issues new regulations simplifying the airspace control, but it is not enough, as it is mainly controlled by the army. Fully uncontrolled parts of Chinese airspace are probably not possible state, but less complicated and less strict flight approval process possible is. If the government and army will not continue in liberating the airspace, the general aviation development can slow down and the growth of number of 9-19 seats category aircraft as well.

Even if China build such number of airports in time and liberate the airspace enough, there is another obstacle for continuous fast growth and it is lack of professionals, aviation staff, pilots, technologies and companies providing linked services. The country is not able to grow such number of experts and companies in such short time. One of the way is to outsource the training from abroad. This is the way that is China practicing at the moment, but the capacities of currently used foreign institutions are not limitless and China has to find another one. Another thing is that freshly graduated and trained people lack the know-how and experience and this can cause some troubles as well. All the lack of professionals and facilities would lead to slower development of general aviation, than the current one.

Not only the legislation connected with the airports obstructs the growth of general aviation in China. Whole general aviation legislation is obsolete and needs to be remade. Regulation

CCAR 135, that is connected with operation of 9-19 seats category aircraft and that is not adapted for commuter airlines as the research showed can be mentioned as an example.

If the development of Chinese general aviation continues in the way that was described above, it would absolutely slow down and the growth of number of 9-19 seats category aircraft as well. The decrease of 5% compared to the current growth is appropriate, because as it can be seen at the moment, China is willing to buy new aircraft, even though they stay on the ground.

8.4.2 Second scenario

Second scenario counts with the same development, as it was between years 2010 and 2015. To continue with 20% growth, it is important to continue with general aviation legislation environment changes, develop the infrastructure and train professionals.

The difference between first and second scenario is deeper partial liberation of general aviation market and the airspace. Important conditions for such development are legislation changes and wider openness for foreign companies. Second scenario does not count with all the improvements and changes described in scenario one between 2015 and 2025, but it counts with rational development of general aviation.

In case of the 20% annual growth of number of 9-19 category aircraft there would be 929 aircraft in 2025 and 17% annual growth of number of general aviation aircraft there would be about 10743 aircraft. The share of analyzed category aircraft would grow from 6,7% to 8,6%. As you can see, this development is also predicted by Chinese experts, who predicts 10000 general aviation aircraft in 2025 in China.

8.4.3 Third scenario

The third scenario is probably the most unlikely to happen. The development of this size in such a short time would need complete liberation of the market and the airspace, completely new legislation, that is more than friendly to general aviation and aircraft commuting and very developed infrastructure. To reach this state China would have to get inspired from abroad and let foreign companies to apply their know-how on the market.

All the mentioned conditions do not correspond with behavior of Chinese government and army and this is the reason why it is the most unlikely to happen. Potential of Chinese market is huge and in the future, it can reach such a number, but not in ten years. It is also doubtable, if the aircraft manufacturers would be able to produce such number of aircraft in such short time.

The 35% annual growth of the number of 9-19 seats category aircraft would mean over three thousand aircraft in 2025 and 30% annual growth of number of general aviation aircraft over thirty thousand aircraft in 2025. As it was mentioned, the potential of Chinese market is even

for higher number of aircraft, but the development will be probably because of many complications slower.

9 Conclusion

The paper complexly analyzed Chinese 9-19 seats category aircraft market and showed future opportunities in China. It described Chinese general aviation environment and 9-19 seats aircraft category and evaluated current market situation. Research processing was very complicated and limited due to diverging Chinese sources of general aviation data and their unavailability. However, the author researched all the resources, consulted the topic with Chinese experts and successfully completed the analysis and whole thesis.

The overview of Chinese transportation network showed developed, but disbalanced system of railways and roads. High Speed Railway network in China is the biggest in the world and high-speed trains are the biggest competitors of regional aviation and commuter airlines. On the other hand, the land transportation network connects big cities mostly in eastern part of China, but there is a lot of remoted regions with difficult accessibility. Connecting these regions is huge opportunity for commuter airlines with small aircraft.

Airport network in China is lagging behind the world, but it is expected to develop in following ten years. From this point of view, China is prepared for the development of general and commuter aviation that is currently very poor. Regional air transportation on the level of 40+ seats category aircraft is complex in China, but commuter airlines operating 9-19 seats category aircraft almost do not exist. This fact is caused by many factors including complicated legislation and regulations, limited access of airspace or underdeveloped technological environment and lack of aviation specialists.

Chinese 9-19 seats category aircraft fleet is growing every year. Between 2010 and 2015 the average growth of number of this category aircraft was 20% and reached 150 aircraft by 2015. Composition of the fleet also develops and from the fact that around 90 aircraft were purchased after 2010 is obvious, that the fleet is in average very young. Also, the usage of the aircraft is very low according to Chinese general aviation experts mainly because of the unfriendly general aviation legal environment in China. In 2016 Chinese Civil Aviation Authority registered six types of 9-19 seats category aircraft – Cessna 208, BGAC P750, Beechcraft King Air, Harbin Y-12 and Viking Air DHC-6 Twin Otter.

As it was mentioned, commuter airlines are not very common in China and only few of analyzed category aircraft are used for commuting purpose. There are three commuter airlines projects in China that mainly use Cessna 208 and Harbin Y-12. The airlines operate in remoted regions with mountainous, or other type of complicated terrain. In 2016 Reignwood Asia Aviation Co., Ltd. purchased first 10 Viking Air DHC-6 400 Twin Otters in China. Total order counts 50

aircraft until 2020. Reignwood Asia Aviation Co., Ltd is planning to do the commuter business in Zhengzhou, Henan province.

Future outlook of general aviation and market with 9-19 seats category aircraft seems to be very positive, but it depends on the development of the market environment, especially of the legal and technological factors influencing the environment. Chinese general aviation and commuter aviation legislation is not very friendly for the operators and suffer from various unnecessary restrictions and regulations and lack of experienced aviation personnel, aviation managers and companies providing services linked to aviation. Most probable scenario of development of Chinese general and commuter aviation is that it will continue in the same speed as it developed between 2010 and 2015. This would mean opportunity of at least 749 new 9-19 seats category aircraft in following 10 years, but everything depends on the attitude of Chinese regulatory authorities and government and future changes of Chinese legal environment.

Content of figures

Content of tables

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