

# **An economic and technical analysis of small (regional) airliners in Europe**

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Bachelor Thesis  
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**Tomas Bata University in Zlín**  
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**Provedte ekonomicko – technické zhodnocení leteckých dopravních prostředků v Evropě.**  
**Popište nutné logistické zabezpečení leteckého provozu.**  
**Popište historii a současné trendy českého leteckého průmyslu s důrazem na vývoj letadel krátkého doletu.**  
**Diskutujte geografické oblasti pro možné uplatnění českých letadel.**  
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## **ABSTRAKT**

Tato bakalářská práce je zaměřená na ekonomicko-technické zhodnocení regionálních dopravních letadel. V úvodu je stručné rozdělení letadel a popis základních prvků letecké infrastruktury. V první části práce popisuje historii evropského leteckého průmyslu včetně analýzy současné situace regionálních letadel na evropském trhu a porovnává proudová a turboprotulová letadla. Druhá polovina práce je zaměřená na historii a současnost českého leteckého průmyslu. Poslední kapitola nastiňuje možnosti zapojení Univerzity Tomáše Bati do leteckého průmyslu.

Klíčová slova: proudové letadlo, turboprotulové letadlo, regionální letecká doprava, letecký průmysl, Eektor, Aircraft Industries

## **ABSTRACT**

This bachelor thesis is focused on an economic and technical analysis of regional airliners. In the beginning it describes brief division of an aircraft and a description of basic elements of air infrastructure. The first part of the thesis depicts a history of the European aviation industry including the current situation on the European market and compares jet and turboprop airliners. The second part describes historical development and the current situation of the Czech aviation industry. The last chapter discusses opportunities for Tomas Bata University in the aviation industry.

Keywords: jet airliner, turboprop aircraft, regional air transport, aviation industry, Eektor, Aircraft Industries

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# CONTENTS

<b>INTRODUCTION .....</b>	<b>10</b>
<b>1 DIVISION OF AIRCRAFT AND INTRODUCTION TO AIR TRANSPORT .....</b>	<b>11</b>
1.1 Division according to power plant.....	11
1.1.1 Propeller piston aircraft .....	11
1.1.2 Turboprop aircraft.....	12
1.1.3 Jet airliners.....	13
1.2 Division based on the width of aircraft body.....	13
<b>2 AIR TRAFFIC INFRASTRUCTURE .....</b>	<b>14</b>
2.1 Airport .....	14
2.2 Air Navigation Services Providers .....	15
2.2.1 Visual Navigation Services on Airport.....	16
2.3 Airline .....	16
2.3.1 Technical section .....	16
2.3.2 Operations section .....	17
2.3.3 Flight section .....	17
2.3.4 Department for training of crews.....	18
2.4 Regulator.....	18
<b>3 HISTORY OF EUROPEAN AVIATION INDUSTRY.....</b>	<b>19</b>
3.1 1948 - 1977 .....	19
3.2 1978 – 1999 .....	21
<b>4 CURRENT SITUATION OF THE EUROPEAN REGIONAL AIRCRAFT .....</b>	<b>23</b>
4.1 Regional aircraft .....	23
4.1.1 Market distribution of regional aircraft .....	25
4.1.2 Price comparison of regional aircraft .....	27
4.2 Business Aircraft .....	27
4.2.1 European business aviation .....	27
4.2.2 Price comparison of business aircraft .....	29
<b>5 HISTORY OF CZECH AVIATION INDUSTRY .....</b>	<b>31</b>
5.1 General overview.....	31
5.1.1 1920 - 1948.....	31
5.1.2 1949 – 1989 .....	31
5.1.3 1989 – 1999 .....	32



5.2	AVIA .....	33
5.3	Aero. ....	33
5.4	LET Kunovice (Aircraft Industries).....	35
<b>6</b>	<b>CURRENT SITUATION OF AVIATION INDUSTRY IN THE CZECH REPUBLIC .....</b>	<b>38</b>
6.1	LET Aircraft Industries.....	38
6.1.1	LET L-410 UVP-E20 .....	38
6.1.2	Export .....	39
6.1.3	Modernization of L-410: The MOSTA Project.....	40
6.2	Evektor-Aerotechnik.....	41
6.2.1	Evektor EV-55 Outback .....	41
<b>7</b>	<b>OPPORTINUTIES FOR TOMAS BATA UNIVERSITY .....</b>	<b>43</b>
7.1	CEBIA–Tech .....	43
7.2	Evektor: The ARTEMIS Project .....	43
7.3	Possible cooperation of Evektor–Aerotechnik and Aircraft Industries .....	44
	<b>CONCLUSION .....</b>	<b>46</b>
	<b>BIBLIOGRAPHY .....</b>	<b>47</b>
	<b>LIST OF TABLES.....</b>	<b>50</b>
	<b>LIST OF FIGURES .....</b>	<b>51</b>

## INTRODUCTION

Nowadays, air traffic is very widespread and common all over the world. Even though it is the youngest mean of transport it is considered as the safest, fastest and the most comfortable. Regional air transport is successively replacing railways, bus services and automobile traffic. In fact, in some countries air traffic is already cheaper and used more than other previously mentioned means of transport. Popularity of regional air traffic is rapidly growing and it will be in the future.

A few years ago, air carriers started to face a big obstacle in form of sharp price increases in petroleum. This fact made them seek for more efficient option for regional air services. Due to historical development of regional airplanes, many airlines were using mostly jet airliners, because they were considered to be safer, faster and more comfortable than other types of planes. However, now, when profit and fuel economy are extremely important, air carriers are turning back to turboprops as they are more efficient for short-haul flights than jets. Aircraft manufactures reacted to this situation and started producing new generation turboprop airliners causing removal of formal disadvantages and raise of popularity among passengers. These days, turboprop airliners experience a huge comeback and very likely more of them will start crossing the sky again.

Of course turboprop airliners will not fully replace jets in all fields of air services. The jet airliners can carry higher number of passengers than turboprops and they are more efficient at high speed therefore they are the best option for long-haul flights. However, the best utilization of turboprop airliners is in regional flights with maximum distance of 2000 kilometers as they are efficient in low altitudes and slower speed.

In the Czech Republic, there are two companies dealing with manufacture of regional turboprop airliners, Evektor struggling with certification of EV-55 Outback, and Aircraft Industries lacking the technological modernization of L-410. It is a great opportunity for them to fix these shortages to get the most out of the current situation and try to find their place on the market.

## **1 DIVISION OF AIRCRAFT AND INTRODUCTION TO AIR TRANSPORT**

A system of short haul flights has contributed to improvement of air transport in general by offering very fast transport of people, goods and post. It makes managing of national economy better and easier because it provides quick cooperation among companies, organisations and other institutions inside of the country and also on the international level. It helps to improve political, cultural and social relationships. It makes tourism faster and also more attractive for people. Moreover it is used as a measurement of living standard of a given country. (Křivda 2007, 7)

Regional (short-haul) flights take usually under 3 hours and they are defined by maximum range which is up to circa 2000 km. Regional flights are also limited by number of passengers, an airplane which is used for regional flights can carry up to 100 people. Other types of flights are medium-haul flights (up to 180 passengers, range 4000 km, 3 – 6 hours) and long-haul (up to 600 passengers, range 13000 km, more than 6 hours of flight) (Pruša 2007, 101). There are several types of aircraft which are used for regional (short-haul) flights.

### **1.1 Division according to power plant**

Here is a brief list which divides aircraft into three groups according to a power plant:

#### **1.1.1 Propeller piston aircraft**

These aircraft are driven by piston engine which converts pressure into a rotating motion of propeller. Gradual development of aircraft technology was causing essential changes in efficiency, structure, shape and mainly in engine power of airliners. In late 1930s and 1940s propeller aircrafts started to struggle due to several limitations.

The main problem was limited speed of propeller airliners which could not be higher than 500 km/h and naturally the low speed limited the range of a flight. Another big problem of propeller aircraft was noise which was very unpleasant for passengers. For these reasons the era of propeller aircrafts ended at the end of 1950s. An example of piston airliner is a very famous Douglas DC-3 which was used before the turboprops and jets appeared.

### 1.1.2 Turboprop aircraft

The turboprop aircraft are driven by turboprop engine that belongs into the group of turbine engines. Turboprops were invented in 1950s. They were faster than piston propeller airplanes therefore they could be used even for transatlantic flights. However in that time jet airliners experienced a big boom and due to their efficiency on long-haul flights they replaced turboprops very easily in this area.

In spite of this replacement the turboprop airliners are still frequently used and they are even more efficient for certain types of flights because they have these advantages:

- Very short and short haul flights – The turboprop aircraft are substantially more economical for short-haul flights than jets airliners. It is because a safety check and some maintenance of an airplane are needed before each start and these safety checks of turboprop aircraft are cheaper than the checks of jet aircraft.
- Fuel efficiency - the turboprop engines are much more fuel efficient than regional jets. Turboprop aircraft are designed to be very fuel efficient in low altitudes and slower speed (under 700km/h). The turboprop engine PW100 consumes 25 – 40 per cent less fuel than a jet engine of similar size. (Pratt & Whitney Canada 2011).
- Short field takeoff and landing – It is big advantage of turboprops that they need just a very short piece of land to takeoff or to land. They need approximately 450 meters of runway length while a jet airliner needs at least 900 metres (Křivda 2007, 12). Turboprops are sometimes also called STOL (airliners) which is acronym for Short Take-Off and Landing.

Furthermore the turboprop aircraft are able to takeoff or land in worse conditions than jets. They are capable of landing on snow, dessert, or grass and therefore turboprops are suitable for all regional airports.

- Low purchase price, operating costs and years of trouble-free service are also big advantages of turboprop airliners.

Turboprops have of course some disadvantages comparing to jets. The propeller system is heavier and noisier and it is not fuel efficient for long-haul flights.

Typical turboprop airliners for regional flights are for example: Dash DHC-8-200 and ATR 42.

### **1.1.3 Jet airliners**

The development of jet airliners started in 1930s in Great Britain and then also in Germany. However they were used mainly for military reasons. They appeared on a commercial market after 1955 but they all were aircraft for 50 and more passengers.

Nowadays jets are being used mainly for medium-haul and long-haul flights because they can carry higher number of passengers and they are more efficient at high speed. There are two huge and well known companies in the world at present which are producing jet airliners for the long-haul flights: Boeing (USA) and Airbus (Europe). Nevertheless, jet airliners are used for short haul flights as well. Those jets are called regional jets. Generally it is more expensive way of flying regional flights than turboprops but on the other hand jets have some advantages as well. They are not as noisy as turboprops, they are faster, and they are capable to carry more passengers. Generally they are able to fly longer journeys for shorter time. Typical regional jet made in Europe is for example Fokker 70. (Pruša 2007, 111)

## **1.2 Division based on the width of aircraft body**

There are narrow-body aircraft which are airplanes with maximum of 6 seats in one row. Characteristic feature for these airliners is just one passengers aisle. These aircraft are not allowed to fly transcontinental or transatlantic flights and that is why they are commonly used for regional flights and they are known as regional airliners.

There are also wide-body aircrafts sometimes known as twin-aisle aircraft. These aircraft are much bigger and they can even have 12 seats in one row. These airliners are usually not used for regional flights. (Pruša 2007, 113)

## 2 AIR TRAFFIC INFRASTRUCTURE

Here are four basic elements which are common in air traffic in most countries:

- Airports
- Air Navigation Services Providers
- Airlines
- Regulator

### 2.1 Airport

An airport can be defined as an initial and final point of transporting process. It is also a breaking point between over land and air traffic. To comply with its function the airport must be equipped with a runway, which is a piece of airport specified for takeoff and landing of airplanes, taxiways, airport apron - “(ramp) which is an area intended to the loading and unloading of passengers, the parking, refuelling, servicing and maintenance of aircraft and any movement of aircraft, vehicles and pedestrians necessary for such purposes.” (Aviation glossary). Then there have to be some fire-fighting and rescue services as well as passenger (cargo) terminals. Moreover some commercial zones with gift shops and restaurants usually occur at bigger airports. (Pruša 2007, 31)

Airports are economic subjects and they are independent on airlines nowadays. Operating costs are mostly covered by landing charges, passenger and cargo fees, security, parking and hangar charges, charges from lease of non-residential premises and others. (ACI 2007)

According to types of users we can divide airports into these groups:

- Public airports – according to their technical and operational capability they accept all airplanes.
- Private airports – accept just aircraft which are determined by operators.
- Military airports – are airports just for needs of an army. (Parlament ČR 1997)

According to technical and operational conditions and basic purpose there are these types of airports:

- Domestic
- International (Parlament ČR 1997)

According to length of the runway:

- Airports for vertical takeoff and landing airliners (VTOL) – So called heliports.

- Airports for short takeoff and landing airliners (STOL) – The runway is usually 700 – 800 meters long, can be made either from concrete or from grass or/and sand. These airports are suitable for turboprop aircraft.
- Airports for conventional takeoff and landing airliners (CTOL) – The runway are at least 1800 meters long. These airports are made from concrete or asphalt and are suitable for big jet aircraft. (Křivda 2007, 10)

Every aerodrome must provide these types of information:

- Aerodrome location indicator and name
- Aerodrome geographical and administrative data
- Operating hours
- Handling services and facilities
- Passenger facilities
- Rescue and fire fighting services
- Seasonal availability – clearing
- Aprons, taxiways and check locations data
- Surface movement guidance and control system and markings
- Aerodrome obstacles
- Meteorological information provided
- Runway physical characteristics
- Declared distances
- Approach and runway lighting
- Other lighting, secondary power supply
- Helicopter landing area
- ATS airspace
- ATS communication facilities
- Radionavigation and landing aids

## 2.2 Air Navigation Services Providers

In the past when there were no modern technologies the pilot had full responsibility for an airplane. That means that the air traffic was fully dependent on skills of a pilot and on weather conditions. First of all there was a navigation which could have been used just during a day because it demanded visibility of a ground. A first commercial passenger

flight, which used radionavigation, happened in 1928 between Key West (Florida) and Havana. At present the navigation services are necessary components of air traffic. (Pruša 2007, 31)

### **2.2.1 Visual Navigation Services on Airport**

There are some visual navigation services which are essential for an airport. These are: wind direction indicator (wind cone), runway marking and lighting, taxiway marking and lighting. All airports must have at least one wind direction indicator (wind cone) which must be at least 3.6 meters long and a diameter of the wider end must be at least 0.9 meters wide. If the airport is being used during the night the wind cone must be lighted. It is usually placed in a central location near the runway or it can be situated in the centre of a segmented circle. An airport beacon is necessary for night time operating of an airport as well. (Křivda 2007, 12)

## **2.3 Airline**

An airline is a company which offers air transport services of people, goods or post to make a profit.

Essential activities of airlines are:

- Air transport
- Maintenance of aircraft – airlines are responsible for the condition of airplanes they fly. They need to do regular checks and repairs.
- Commercial services – product marketing, selling of tickets, passenger handling
- Ramp services and aircraft presentation – de-icing, aircraft interior cleaning, cabin dressing, cabin maintenance, carpet provisioning, aircraft washing, technical/deep cleaning, central control, disinsection.
- Management of a company

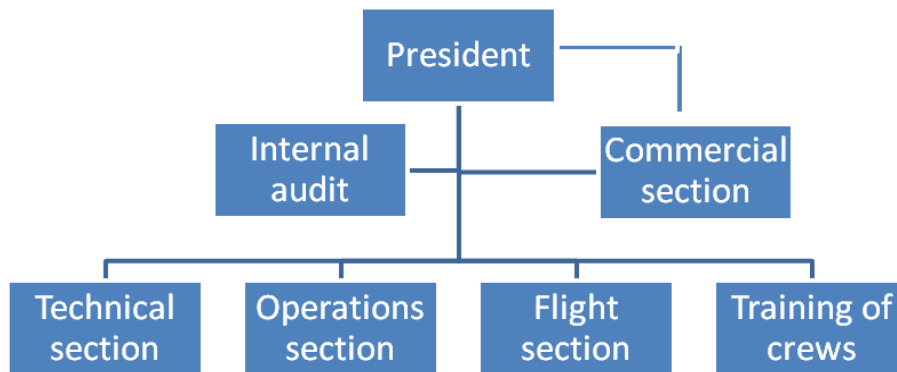
### **2.3.1 Technical section**

A technical section of an airline provides maintenance and repairs of aircraft. It assesses condition of aircraft which the airline considers suitable for use in their aircraft fleet. It repairs aircraft on its own or with a help of licensed suppliers. It cooperates closely with aircraft manufacturers and evaluates their reliability. A technical section also administrates



documentation about aircraft (number of takeoffs and landings, operating time of aircraft, performed repairs).

Figure 1 A basic structure of an airline



Source: Žihla 2010, 161

### 2.3.2 Operations section

An operations section provides ground handling according to Ground Operational Manual. That includes aircraft ground handling (ramp control, load control), passenger handling and ramp services. This section also de-ices aircraft in wintertime. Furthermore, it provides baggage handling, which means loading and unloading of baggage. An operation section also gives pilots and crew certain information about flight including meteorological information. Moreover, it provides passenger boarding stairs and refuelling.

### 2.3.3 Flight section

A flight section deals mainly with organization of flight operation. Flight operation includes planning, managing, securing and evaluating of flights. Another responsibility of a flight section is changing of aircraft for flights, directing or cancelling flights. In connection with this, flight section coordinates short term and long term planning of airliners and crews into operation. It allocates certain crews to given flights according to the Civil Aviation Act which determines allowed daily hours, annual time in service, validity of their licence and physical examination. It provides navigation and operational evaluation of new areas. Flight section also provides pre-flight preparation of crews and organizes relevant training courses for them.

### 2.3.4 Department for training of crews

A department for training of crews secures professional competence of crews. Every member of a crew must attend refresher training or some other type of training such as training connected with certain type of an aircraft. Refresher training contains ground training, flight simulator training, emergency and rescue equipment training and Crew Resource Management.

## 2.4 Regulator

A regulator is a statutory body with an authority to check whether activities of airports and airlines are safe and follow the regulations of air traffic. In the Czech Republic this body is called Civil Aviation Authority (CAA CZ).

“CAA CZ executes the state administration in civil aviation matters in the main following areas:” (Úřad pro civilní letectví)

- aircraft and personnel register
- certificate of airworthiness of aeronautical products, aircraft and of individually manufactured aircraft
- performing of airworthiness review
- personnel licensing
- type of airport determination and airport operating permit issuance
- special building authority for aviation structures
- issuance of air operator certificate
- airworthiness Directives (Úřad pro civilní letectví)

### 3 HISTORY OF EUROPEAN AVIATION INDUSTRY

#### 3.1 1948 - 1977

In the period between the World Wars a leading aircraft propulsion system was propeller-piston engine. Problems which occurred during further development of piston engines induced a need for evolution an alternative type of drive unit. Units which occurred were different forms of piston engines, gas-turbine driven turboprops and turbojet powered systems.

As said in the article The evolution of turboprop engine industry: “The search for alternative forms of propulsion systems was driven by the military need to operate at higher altitude and speed in order to avoid counter-air defence” (Bonaccorsi and Guiri 2000, 853). This need and effort to meet these requirements resulted in formation of two propulsion systems: “turboprop, using an internal combustion gas turbine to drive a conventional propeller, and turbojet, using an internal combustion gas turbine as gas generator and a reaction propulsion nozzle as thrust producer” (Bonaccorsi and Guiri 2000, 853).

Each propulsion system has particular qualities and was designed for certain scopes of operating conditions (aircraft speed, altitude, air density and temperature, passenger capacity). Military was not so interested in turboprops because the turbojet technology guaranteed higher performances, however turboprops started to be more popular than jets among air carriers.

The 60-seat Vickers Viscount powered by four Rolls-Royce Dart engines was the first turboprop aircraft. Its first flight was realized in 1948 and it entered market in 1953. Two years after that in 1955 the first 40 - 50 seat F27 by Fokker was launched powered by two Rolls-Royce Dart engines. In 1957 American manufacturer Lockheed introduced 90-seat aircraft L-188 Electra, powered by Allison 501, which was build to compete British Vickers Viscount which was very successful on the American market as well.

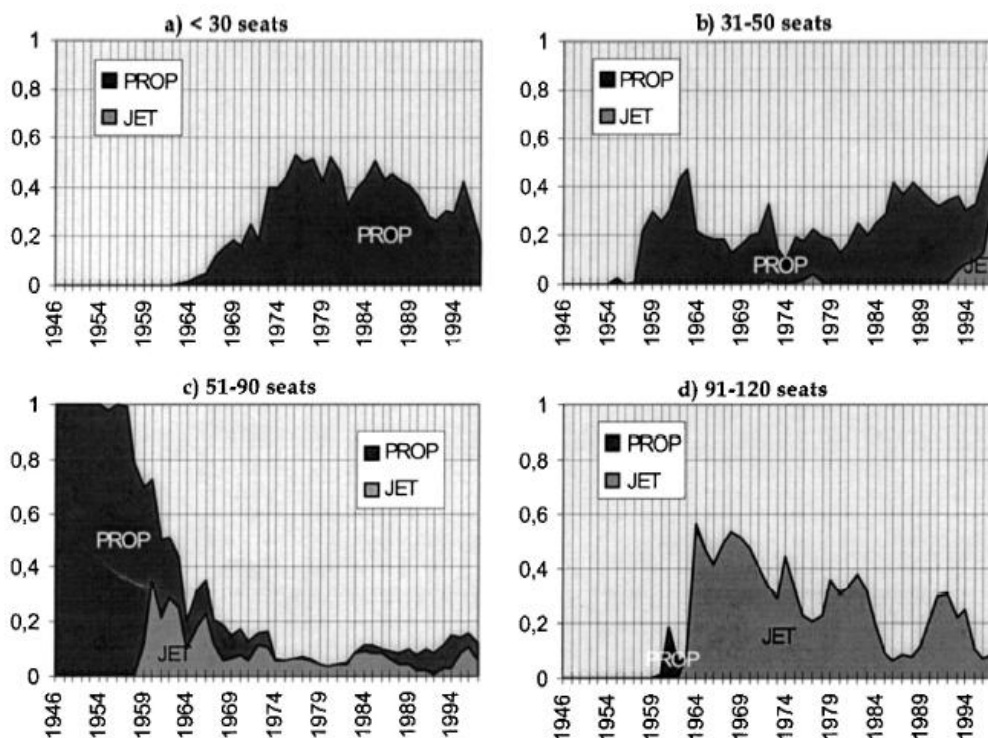
The first commercial turbojet airliner was 56 - 109 seat De Havilland Comet manufactured by BOAC (British Overseas Airways Corporation) powered by four Rolls-Royce Avon Mk 524 turbojet engines. It first flew in 1949 and came into service in 1952. Turbojet engines offered ability to power larger and heavier airplanes and also to fly in higher speed, but the costs for short routes were extremely high. However it provided bigger savings on the longer flights. Moreover, at speed over 720 km/h the turbojet engine

was more efficient than piston-propeller engine. Nonetheless, at medium speed and altitudes the turboprop engine was the most efficient. (Bonaccorsi and Guiri 2000, 854)

In 1960 a British short/medium range turboprop aircraft called Vickers Viscount was introduced. It was 90 – 120 seats airliner powered by four Rolls Royce Dart turboprop engines. Nevertheless, there were many innovations of the turbojet engines, at that time, which provided higher efficiency for these huge and heavy types of airliners such as Vickers Viscount. That is why Vickers Viscount disappeared from the market after five years.

Here are four figures which represent the market share of turboprops and turbojets between 1940s and 1990s. They are focused just on the airliners with less than 120 seats. These figures are separated into four sections which are specified by the seat capacity of an aircraft. Those sections are: less than 30, 31 – 50, 51 – 90 and 91 – 120 seats.

Figure 2 Distribution of the total market for small aircraft by technology



Source: Bonaccorsi and Giuri 2000, 855.

In the Figure 2a we can see that the turboprop engine is the only efficient solution for aircraft with less than 30 seats. French twin-prop Nord 262 with capacity of 29 passengers was the first airliner in this category. It emerged in 1964 and it was equipped with two Turbomeca Bastan engines. Aircraft in this category was originally designed to replace

piston-engine powered Douglas DC-3, with capacity of 21 – 32 passengers, which was used 1950s. In 1970s there were other manufacturers which occurred on the market with new airliners in this seat category such as Pilatus BN2A III Trislander, Casa 212, Let L-410 and Short 330. (Bonaccorsi and Guiri 2000, 855)

The section with 31 – 50 seat aircraft was dominated by turboprop airliners as well, as seen in the Figure 2b. The only exception in this section was jet-powered VFW 614 (Fokker) with 44 seats which was introduced in 1975 on the market.

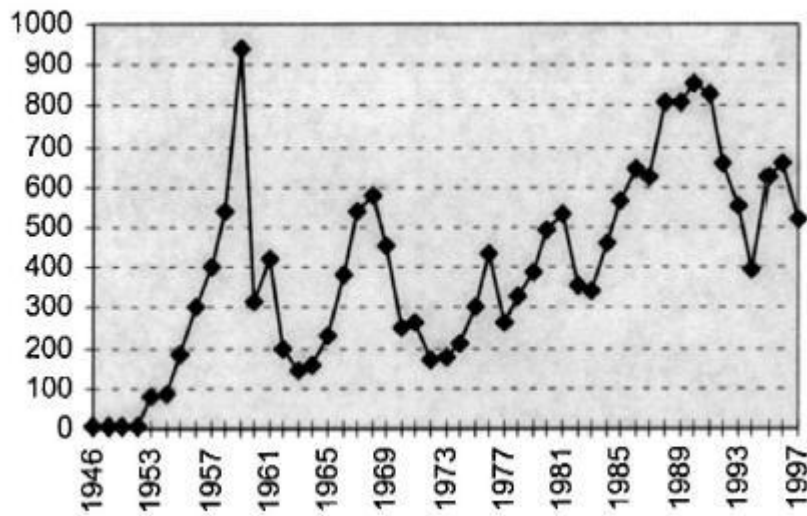
The most competitive market share can be seen in the Figure 2c. At the beginning only turboprop airliners occupied the market. A representative of turboprops in this category is for example Fokker F-27. This category of turboprop aircraft created also the vast majority of the whole market with jets and turboprops. However, in 1950s the turbojets appeared in this category and rapidly reduced the share of turboprops. First successful jet manufactured in this category was Caravelle created by Sud Aviation.

In the Figure 2d it is visible that category with 91 – 120 seats is dominated by jet airliners. There is just inconspicuous presence of turboprop aircraft before these big jets occurred. As previously stated it is because jet engines are more efficient for bigger airliners which are mainly made for long-haul flights.

### **3.2 1978 – 1999**

At the beginning of this period in 1978 the Deregulation Act was signed in the United States but it influenced Europe as well. The deregulation led to economic liberalization of air transport. Consequently, the hub-and-spoke system was formed. This system works on the principle of the main airport (hub) and other regional airports around the central one (spokes). This system affected the development and production of turboprop airliners. A demand for turboprops with 31 – 50 seats, which would carry passengers from the spokes to the central airport and the other way round, arose. On the other hand, there was a need for airplanes which could carry passengers from a hub airport to another hub where distances are usually longer. For these criteria the best solutions were regional jets. At the same time a great development of new technologies in turboprop sector was in progress. The production of turboprop engines increased more than twice in the decade after 1978 which is shown in Fig. 3.

Figure 3 Total market for turboprop engines



Source: Bonaccorsi and Giuri 2000, 856.

During 1980s new turboprop airliners were appearing in segment of 31 – 50 seats such as ATR 42, Fokker 50, Saab 340 or de Havilland Dash 8. In the segment of 51 – 90 seats some turboprops were introduced as well even though this group was previously operated mostly by jets. Moreover, very popular regional jet BAe 146 with capacity of 82 – 112 passengers was introduced in 1983. As we could see in Figures 2a and 2b the groups with less than 50 seats were dominated by turboprops until 1990. Nevertheless after 1992 some companies started introducing jet airliners in this segment including regional jet by Canadair, ERJ by Embraer or Dornier 328 JET which was developed from turboprop version Dornier 328.

Generally, after 1990 there was a breaking point in the regional aircraft market. Demand for turboprop airliners started to decline rapidly which can be seen in Figure 3 and they were being replaced by turbojets. Even turboprop manufacturers converted to jets and some of them were forced to exit the market such as Saab and Fokker. German company Dornier was acquired by American company Fairchild Aircraft in 1996. (Bonaccorsi and Guiri 2000, 857)

## 4 CURRENT SITUATION OF THE EUROPEAN REGIONAL AIRCRAFT

### 4.1 Regional aircraft

At the beginning of this millennium specifically during the period between 2000 and 2005, it looked like the turboprop regional airliners are definitely on their way out of the market. It was due to the fact that jet airliners were considered as very modern and fashionable. Turbojets were popular among the customers of the airlines especially because they were faster, quieter and more comfortable than turboprops. The year 2005 was the darkest hour for turboprop manufacturers, with an example of ATR the French-Italian aircraft manufacturer which built just 15 airliners in that year. However, things seem to be better now, in 2011 they made 53 aircraft, in 2012 they want to reach 70 pieces and in 2014 ATR is aiming to build 85 of them. (The Economist 2012)

As stated in the article Air travel and the turboprop revival in The Economist there is just one problem called “Turbo aversion”. It means that passengers, mainly those who experienced the earlier generations of turboprops, consider them as noisy, uncomfortable and less safe than jets. This aversion, according to the article, depends on a region, for example in South America it is not a big deal, but the aversion is very strong in growing Middle East market because of the delusion that turboprop airliners are more likely to have an accident. (The Economist 2012)

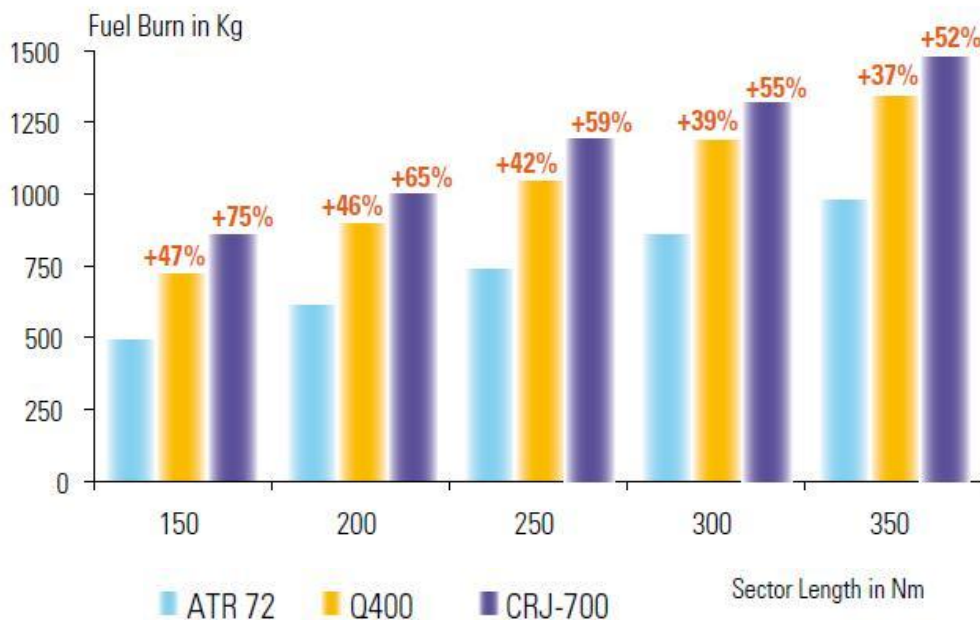
However, turboprop manufacturers started to produce new generation of turboprops which should solve all already mentioned disadvantages. Bombardier and ATR, the main manufacturers of turboprop regional aircraft, started developing new models of airplanes after 2005. Bombardier developed the new Q400 with 71 – 80 seats and ATR developed their new 600 series airliners which are available in two sizes, the ATR 42-600, a 48 – 50-seater aircraft, and ATR 72-600, a 68 – 74-seater aircraft.

In last few years the turboprop market has been experiencing huge comeback. The turboprop airliners are desired again and there is a big demand for them. The reason of this revival is simple. It is because of the rising price of oil and that means that the price of aviation fuel is rising as well. And as it is generally known the turboprop aircraft consume circa 30 – 35 % less aviation fuel than the turbojet airliners. As Filippo Bagnato, ATR’s CEO, explains “the turnaround began when crude oil rose above \$35 a barrel in the years following the Iraq war” (The Economist 2012). It started to be very uneconomic to fly

regional jets with less than 70 seats, so the most of these jets are nowadays being replaced by turboprop airplanes which seem to be a better option for regional flights. That is why the new generation of turboprops appeared, it represents both, the comfort for passengers and financial viability for airline operators. (Msnbc 2008)

As indicated earlier, nowadays everything is about fuel consumption and it is logical. Nobody wants to pay extra money for petrol; particularly the airlines want to have costs as low as possible so they can make profit. Here is a figure which compares the fuel consumption of the main turboprop rivals in this sector (ATR 72-600 with 68 - 74 seats, Q400 with 71 – 80 seats) and very common regional jet CRJ–700 with 66 – 78 seats.

Figure 4 Comparison of fuel-efficiency in the regional market



Source: ATR 2008.

In the figure 4 we can see that the turboprop airliners are definitely more efficient for the regional flights than the jet airliner. In the first column which represents 150 nautical miles (approximately 280 kilometers) the difference is most visible. As the distance is growing the difference is shortening but even the last column which symbolizes 350 nautical miles (650 km) the difference is still significant, ATR is still 52 % more fuel efficient than its jet rival CRJ-700.

Speaking about those two turboprops, ATR is more efficient one. In the third column which stands for 250 nautical miles (465 kilometers) the fuel consumption of ATR 72 is



about 735 Kg (247 US gal) and the consumption of Bombardier Q400 is about 1043 Kg (351 US gal). That shows the ATR is still 42 % more efficient than the Q400. ATR claims that this efficiency is caused by light structure of the airplane, optimized speed and well-suited engine.

In the Flightglobal magazine an interview with a pilot, who works for a regional flight operator and who swapped regional jets for turboprops, was published. He explains that he used to fly with Embraer ERJ-145, a 50-seat jet, and now he flies with Bombardier Q400, an 80-seat turboprop. As he describes, the costs for flying Q400 are exactly the same but it has up to 30 seats more than the ERJ-145. That means they can sell up to 80 seats instead of 50 seats on the same flight and they have same costs. He also explains that Q400 is very quick; the basic cruising speed is around 360 kt (670 km/h) which is only about 90 kt (160 km/h) slower than the ERJ-145. The pilot describes that the cruising altitude of the Q400 is 7 600 meters and it takes roughly 12 minutes to get to this height, whereas the cruising altitude of the jet is around 10 600 meters and it takes about 20 – 25 minutes to climb there. This fact reflects in total cruising time. The pilot states that, even though Q400 is slower the cruising time of the turboprop airplane is not longer than the cruising time of the jet airliner. (Kirby 2011)

#### **4.1.1 Market distribution of regional aircraft**

The largest number of all regional airliner deliveries received by European market was in 2010. The majority of these deliveries were created by regional jet aircraft but the revival of turboprop airliners stays strong. Turboprops constitute 44% of regional airliner deliveries globally in 2010. According to Flightglobal research using the ACAS database, there were 234 deliveries of regional airplanes made by ATR, Bombardier and Embraer during 2010. As shown in a Figure 4, Europe represents the biggest single market receiving 50 jets and 31 turboprops. 39 out of these 81 airliners were Embraers, 36 were Bombardiers and just those 6 aircraft left were ATR. (Kingley-Jones 2011)

Just to compare, the second largest market with 57 regional airliner deliveries was Asia-Pacific. It received 26 ATR turboprops, 23 E-Jets by Embraer and remaining 8 Bombardier airliners. Nevertheless Bombardier was most successful in North America where it delivered 28 aircraft out of 32 regional airliners which were shipped into this region in 2010. (Kingley-Jones 2011)

Here is a figure which shows regional aircraft deliveries by manufacturers globally in 2010.

Figure 5 Regional aircraft deliveries by manufacturer

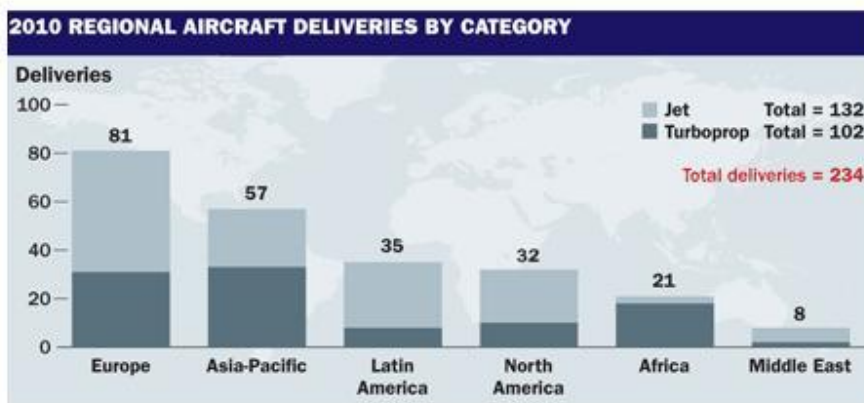


Source: Flightglobal: serious about aviation 2011.

As Max Kingley-Jones claims in his article: “Although both regional aircraft categories enjoyed a strong year, the turnaround in the jet segment pushed sales above the turboprop types in 2010, reversing the situation of the year before” (Kingley-Jones 2011). However year 2010 is dominated by jets by percentage split 56/44.

Here you can see a figure which represents regional aircraft deliveries by category:

Figure 6 Regional aircraft deliveries by category



Source: Flightglobal: serious about aviation 2011.

In the figure 6 you can see that the biggest demand for turboprop airliners is in Asia-Pacific and Africa. However there is still a big demand for turboprops in Europe as well even though this market is obviously dominated by jets. On the other hand jet airliners are most required in both North and Latin America and Middle East.

#### **4.1.2 Price comparison of regional aircraft**

There are some examples of airliners which were already mentioned above and here are their prices. The turboprop airliner of new generation Bombardier Q400 costs nowadays approximately \$ 27 million US, ATR 42-600 is available for \$ 15 million US and his bigger brother from ATR family carrying 70 passengers is \$ 19 million US. To compare price of jets there are two examples: Bombardier CRJ-700 is about \$ 24 million US and 50-seat Embraer ERJ-145 is being sold for \$ 21 million US.

Other popular regional airliners made in Europe in the category with more than 30 seats are for example these turboprops: Fokker 50 with 58 seats made by Dutch aircraft manufacturer Fokker, current price of this aircraft is around \$ 7 million US, 52-seat Antonov An-140 made by Ukrainian Antonov ASTC with initial price \$ 9 – 11 million US.

### **4.2 Business Aircraft**

Business aircraft is a specific group of regional aircraft, which is specified to operate in short-haul flights as well. Besides, turboprop airliners and jets are used in business flights as well. They are called business turboprop aircraft and business jets (bizjets). These aircraft are normally of smaller sizes and they are usually designed for transporting up to 19 passengers. An interior of some of business airliners may be produced in different varieties such as with equipment for classic short-haul air transport of passengers or with VIP furnishings.

#### **4.2.1 European business aviation**

The business turboprops and jets are very common in Europe but jet airliners still have a leading position in this field. According to Flightglobal Business aviation special report 2008 (the latest freely available) the most dominant business aviation markets in Europe are Germany, UK and France with over 300 active business airliners per country. And at the same time, Germany has the largest jet business fleet with 352 active airliners. On the other hand France is the market with largest turboprop business fleet in Europe with 195 active aircraft and simultaneously France is the only country in Europe which has larger turboprop presence than jets. France has about 195 TPs and 127 jets. Talking about percentage, Portugal has the leading business jet presence (more than 95 %), closely followed by Russia (95%) and Austria (90 %).

Here are two tables which show active business jet and turboprop market share in Europe by aircraft manufacturer.

Table 1 Jet manufacturers in Europe

Jet manufacturers	
Cessna	833
Bombardier	429
Dassault	400
Hawker Beechcraft	275
Gulfstream	109
Embraer	46
Boeing	28
Airbus	22
Other	163
<b>Total</b>	<b>2 305</b>

Source: Data collected from Flight Insight 2008

Table 2 TP manufacturers in Europe

Turboprop manufacturers	
Hawker Beechcraft	412
Pilatus	81
Socata	77
Piaggio	56
Piper	30
Cessna	23
Other	101
<b>Total</b>	<b>780</b>

Source: Data collected from Flight Insight 2008

As it is obvious from Table 1, Cessna is the leading jet aircraft manufacturer sold in Europe with 833 active aircraft. Interesting point is that Boeing and Airbus have both only about 1 % of business jet market, which means that those manufacturers are focusing mainly on large wide-body jets for long-haul flights. In case of turboprop airliners, represented in Table 2, Hawker Beechcraft is the dominant business aircraft manufacturer being sold in Europe with 412 active airliners.

Figure 7 and Figure 8 show percentual market share of jet and turboprop aircraft manufacturers being sold in Europe. The obvious leader in jet market is Cessna with 36 % and in turboprop market it is Hawker Beechcraft with 53 %. Both companies Cessna and Hawker Beechcraft are American manufacturers. That is an interesting point that the biggest aircraft market such as Europe is dominated by American manufacturers even though there are European manufacturers on similar technical level. To point out this fact, two tables with top 10 active jet and turboprop models in Europe are included.

Figure 8 TP market share by manufacturer

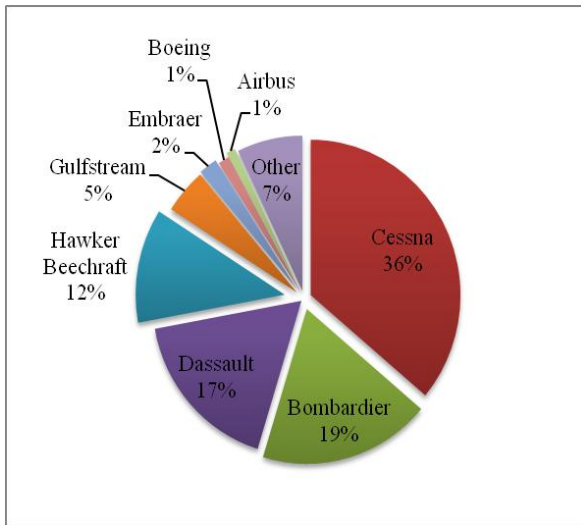
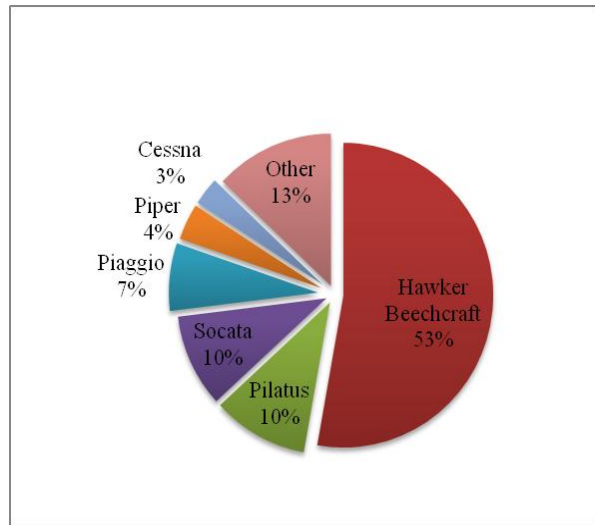


Figure 7 Jet market share by manufacturer



Source: Data for Figure 7 and Figure 8 collected from Flight Insight 2008

Table 3 Top 10 active jets in Europe

Jets	number
Cessna Citation jet series incl. CJ1/CJ2	156
Bombardier 604	83
Citation Bravo	80
Citation XLS	75
Citation II	68
Dassault Falcon 900EX	65
Citation Excel	63
Hawker Beechcraft 800XP	61
Falcon 2000EX	56
Falcon 2000	51

Table 4 Top 10 active TPs in Europe

Turboprops	number
Hawker Beechcraft King Air 200/B200	189
Pilatus PC-12	81
Piaggio P180	41
King Air C90	39
King Air 350	37
Socata TBM700A	34
King Air C90B	31
Piper Meridan	30
Embraer EMB-121 Xingu	23
King Air C90A	21

Source: Data for Table 3 and Table 4 adapted from Flight Insight 2008

#### 4.2.2 Price comparison of business aircraft

Theoretical rule says that turboprop airliners are cheaper than jets. There is a proof which shows that this rule is truthful. In the Tables 3 and 4 there are top ten active jet and turboprop models in Europe. For example number one jet models are two models of Cessna Citation (CJ1 and CJ2). Both these models are 5-seat airliners and the price is between \$ 4.70 – 6.40 million US. The leader of turboprops is Hawker Beechcraft King Air

B200 which can carry up to 13 passengers and it is available for circa \$ 5.5 million US. This example shows that the prices are almost the same but the turboprop airplane is bigger and it can carry up to 8 passengers more than the jets. Here are some other examples of jets. Cessna Citation XLS with capacity of 8 passengers is sold for \$ 11.80 million US. Hawker 850 XP with 8 seats as well is available for \$ 13.7 million. Other examples of turboprop airliners are for example Pilatus PC-12, which is number two on the European business turboprop market, with capacity of 9 seats is available for \$ 3.3 million. Piaggio P180 Avanti II, the fastest turboprop airliner in the world is able to carry up to 9 passengers and it is available for \$ 5.7 million. Beechcraft King Air C90 with capacity of 12 seats costs about \$ 3 million and King Air 350, the newest King Air model with capacity of 11 seats is sold for \$ 6.1 million.

## **5 HISTORY OF CZECH AVIATION INDUSTRY**

### **5.1 General overview**

#### **5.1.1 1920 - 1948**

Origins of the Czech aviation industry are dated back to 1920s. Czech aviation industry was developing very well and its situation at that time was on the comparable level to other economically advanced countries. Czechoslovakia caught up with other countries and imported aviation technology was replaced by technology made in Czechoslovakia.

Czechoslovakian aviation industry in the period between World Wars was driven mainly by government contracts. The area of military aviation was supported by Ministry of Defence and the civil aviation was supported by Ministry of Public Works. Czechoslovakian aviation industry had a great standard and it influenced development in aviation sector. Aerospace Research and Test Establishment, which was founded in 1922, contributed significantly to this achievement.

The vast majority of multi-engine transport aircraft and bomber aircraft were made in the territory of our country and some of them were manufactured here by license production, such as some categories of aircraft engines. At this period the export was not very common and all the contracts stayed within our country.

During the Second World War and in the period of German occupation of Czech countries, the Czech aircraft industry stayed paradoxically on a very good level. Moreover it even increased its capacity and from a technical point of view it reached higher standards. Czech orientation for domestic production, especially of military contracts, stayed the same after the war. There was just one exception and that was increasing export of light-sport aircraft. (ALV – Czech Republic 2008, 5)

#### **5.1.2 1949 – 1989**

After 1948 and during the Cold War we got a license for soviet military and transport airliners. This brought an access to fresh and modern aircraft technologies such as military jet technology (airframes and engines) and it helped to our own development in this area. On the other hand, the division of competences suppressed for example promising development of helicopters. However, the fact that we were subordinated to soviet policy we lost contact with valuable global development of aviation material, technology and avionics.

Our country was allowed to supply just other countries of Soviet bloc. Nevertheless, this huge market brought extraordinary selling opportunities in areas we were allowed to specialize i.e. (military jet trainers, small regional airliners, light-sport aircraft, agricultural airplanes and gliders). Czechoslovakian aircraft industry ranked among the top global manufacturers in these fields. Czechoslovakia took an offered opportunity as the best from all the soviet countries at that time, which shows its potential and quality. More than 3600 MIG fighter aircraft, 6000 of military jet trainers and more than 1000 regional airliners were built. In contrast to interwar period, Czechoslovakian aircraft industry started to be oriented for export at that time. (ALV – Czech Republic 2008, 5)

### **5.1.3 1989 – 1999**

After 1989 the Czechoslovakian aircraft industry suddenly lost the markets for export. Mainly because the markets we used to export to were based on political relationship. Moreover, our industry was not able to succeed on new markets. It was caused by bad economic policy in first half of 1990s. The industry lost all the government support even for government contracts such as combat aircraft L-159. Furthermore, almost finished turboprop regional aircraft Let L-610, the biggest transport aircraft which have been ever developed in the Czech Republic, lost all support which altogether with the loss of the Russian market meant unavoidable end of this project. Army contracts were focused mainly on army projects and military versions of traffic airliners were minor. On the other hand, even the support, in forms of different grants offered by the government to convert military production into traffic airliners, was not used by many companies. In anticipation of privatization, the Czech aircraft industry was decentralized and remained to its own destiny. This completely opposite trend than the one carried out in other western economically advanced countries had just a negative impact on the industry. (ALV – Czech Republic 2008, 6)

In the second half of 1990s the government became interested in the aircraft industry again. However, an uncritical reliance on foreign investors led to disadvantageous contracts for Czech manufacturers. These contracts did not provide expected financial background and they unfortunately contributed to the collapse of traditional domestic manufacturers. Moreover, the worldwide demand for traditional Czech aircraft products rapidly declined because of the market saturation. In the case of military jet trainers the demand declined from political reasons and in the case of small turboprop regional airliners the demand



decreased because of the economic and technical status of those airliners. (ALV – Czech Republic 2008, 6)

## 5.2 AVIA

The Avia company was founded in 1919 and it focused its manufacture on airliners and aircraft engines. In pre-war period, particularly before the World War II, the company was mainly connected with manufacturing transport and military aircraft, and they were known especially for the most famous Czechoslovak single engine biplane fighter at that time AVIA B-534. In 1955 AVIA started licensed manufacturing of propeller aircraft Iljušin Il-14. It was Soviet twin-engine regional airliner used for commercial, military and cargo reasons. This aircraft was primary built to replace Douglas DC-3. The pieces of Iljušin Il-14 made in Czechoslovakia were known as Avia Av-14. Av-14 was the biggest aircraft which have ever been made in Czechoslovakia. This airliner was made in many different variants, at the beginning it was made as Av-14 for 18 passengers, Av-14-14 for 24 passengers. Then there were Av-14-32 for 32 passengers and Av-14-40 for up to 40 passengers. (AVIA, a. s. 2008)

In the post-war period, in 1996 AVIA also entered an automotive industry and it started developing and producing trucks, buses and light automobiles. Since 1961 the aircraft program was gradually diminishing and it was limited to manufacture of aircraft engines and propellers. The engines were produced just until 1988 and the propellers have been still being made. (AVIA, a. s. 2008)

## 5.3 Aero

Aero – the aircraft factory was founded in 1919 in Prague. This company was focused on production of airplanes, aircraft parts and aircraft repairs. The first prototype of their own was Aero A-1. This plane was primarily designed for pilot training and it was built in 1919. In 1920, Aero made their first civil transport airliner A-10 which was able to carry up to five passengers. However, this aircraft started to fly regularly after 1923 and it was usually flying a route Prague – Bratislava. In 1921, Aero started manufacturing more powerful training aircraft such as bomber and training biplanes A-11 and A-12. Military pilots started to break records and became famous for winning races in Aero airliners. In 1925, Aero started licensed manufacturing of British civil transport airliner De Havilland DH-50 designed for four passengers and Aero made altogether seven of these airplanes. Before

and during the Second World War, Aero made different kinds of military aircraft and bombers. (Aero Vodochody 2008)

Shortly after WWII in 1947, Aero made a civil twin piston-engine business aircraft Aero Ae-45. It was designed to carry up to 4 passengers and the maximum flight range of the Ae-45 was 1000 kilometers. These airliners served mostly as “air taxis” and fifty of them were used by Czechoslovakian Airlines. The Ae-45 was a great success of Czechoslovakian aircraft industry because it was very modern and timeless airplane which was very famous not only in Czechoslovakia, but also in the whole world. Aero made about 590 of these airliners and most of them were exported.

In 1953, Aero moved from Prague to Vodochody and they built new facilities for manufacturing military jet aircraft there. In the same year they started the production. Aero Vodochody began a large-scale series licensed production of MiG-15 aircraft and other types derived from it. The supersonic aircraft MiG-19 and MiG-21 were produced by Aero Vodochody during 1960s and 1970s. With some experience of manufacturing jet aircraft, in 1959 Aero started producing L-29 Delfin and ten years later the L-39 Albatros occurred. Those aircraft were both very well known jet trainers. Aero sold more than 3500 pieces of L-29 Delfin during 1960s and 1970s. They also supplied around 2900 pieces of L-39 Albatros from 1971 to 1999. (Aero Vodochody 2008)

In 1990s Aero Vodochody began a civil aviation program called L-270. Aero Vodochody found a foreign investor, a Taiwan company Aerospace Industrial Development Corporation (AIDC), who was supposed to help financing of this project. They both together created a company Ibis Aerospace. The L-270 was renamed to *Aero Ae-270 Ibis* and it was run by Ibis Aerospace. Ae-270 Ibis is a single-engine turboprop civil utility aircraft, powered by Pratt & Whitney engine. It was built to carry up to eight (9 with just 1 pilot) passengers. The Ae-270 was primary designed to replace Antonov An-2 which was the most widespread utility airliner in Soviet Bloc. The Ae-270 project was well aimed into the group of single-engine regional and utility aircraft for up to nine passengers, a very popular segment nowadays. The most typical airliners in this category are for example: Cessna Carava, Pilatus PC-12, Daher Socata TBM, Piper and others. The first flight of Ae-270 Ibis was in 2000 and it was officially introduced to public in 2003. However, Aero Vodochody made just six pieces of this airliner because in 2007 AIDC left this common project even though the Ae-270 Ibis got the European certificate from EASA in 2005 and American certificate from FAA in 2006. Aero Vodochody was looking for

some other investors but they were unsuccessful and the project Ae-270 Ibis was officially closed. (MAGAZÍN LETIŠTĚ České republiky 2010)

Nowadays, Aero Vodochody, a. s. is a joint-stock company subscribed in Companies Register in Prague, in January 1991. Till the end of 2006, Aero Vodochody was owned by Czech Consolidation agency and since 2007 the owner and a sole shareholder of the company has been a private equity group Penta. At present, Aero Vodochody co-operates with international aerospace manufacturers such as Sikorsky Aircraft Corporation, Alenia Aeronautica, Sonaca, Saab and others. (Aero Vodochody 2008)

#### **5.4 LET Kunovice (Aircraft Industries)**

This company was established in 1936, when AVIA Aircraft Manufacturing Works of Letňany (Prague) decided to open a new branch in Uherské Hradiště – Kunovice. A capacity of production was planned to be at least the same as the Prague works. However, the political events, which resulted in the Munich dictate, marred the big plans and the Kunovice company was used only for AVIA aircraft repairs. Till the Second World War they used to repair mostly biplane fighter aircraft AVIA BH-33 and B-534. After occupation by Nazi Army in 1939 and during WWII the Kunovice works were used by the German Luftwaffe for the repairs of Junkers W-34, a single-engine passenger and transport aircraft, and Arado Ar-96b single-engine trainer aircraft. After the War the company was nationalized, and all the types of aircraft flying in Czechoslovakia at that time, such as Aeronca C-2, propeller fighter aircraft Avia S-199, and big twin engine Aero C-3 aircraft, used to be repaired there. (Krumbach 1987, 227)

In the period from 1950 to 1953 the construction of new manufactory began. Since 1952 the new manufactory was responsible for the complete construction of trainer aircraft Yakovlev Yak-11. They made total of 707 of these aircraft and during the construction most of the employees gained first experience in aircraft production. After this success, the modernization of Aero Ae-45 followed in Kunovice. This work resulted in 228 pieces of new types of airliners called Aero 45 Super and another 142 pieces of Ae-145. The airliners such as Ae-45S/145 made the Kunovice aircraft company very popular all over the world and they also contributed to formation of Czechoslovakian air-taxi.

After some experience with manufacturing of Aero airliners, in 1955 the Kunovice company, called LET at that time, decided to develop a same category airliner of their own. The result was L-200 Morava; a twin-engine touring/utility/regional airliner with capacity

of four passengers, which first flew in 1957. Many of these airliners were exported. During the production period from 1957 – 1964 Let Kunovice has made in total 360 of the L-200 Morava airliners. (Krumbach 1987, 227)

LET Kunovice was also manufacturing gliders and light sport airplanes, namely Zlín Z-22 Junák, Z-24 Galánka, LF-109 Pionýr, Z-425 Šohaj 3 and VSM-40 Démant. The most popular glider made in LET Kunovice was L-13 Blaník, which was very famous not just here in Czechoslovakia, but worldwide. Until 1982 they made 2 648 gliders and many of them were exported into the whole world. In the time between 1963 and 1973 LET was making military jet trainers L-29 Delfín on the license basis for Aero. Since 1961 the aircraft manufactory of Kunovice was producing also specific agriculture airplane Z-37 Čmelák. Until 1984, when the production of this aircraft finished, LET Kunovice made 713 pieces of this type of aircraft. (Krumbach 1987, 227)

An airliner *LET L-410* first flew on 16 April 1969. The L-410 is a twin engine turboprop regional transport aircraft designed for carrying 19 passengers. Firstly this airliner was powered by two Pratt & Whitney PT6A-27 engines with three-bladed propellers Hamilton Standard. In total they made 31 pieces of L-410 powered Pratt & Whitney power plants. In 1973 the new model of this airliner, called L-410M, was introduced. This model was already powered by Czechoslovakian engines Walter M-601A with AVIA V-508 propellers. This type of airliner was gradually adapted to wishes of Soviet customers which were mainly focused on need to operate these airliners on small airports. That is why another model was created, L-410 UVP. The capacity of this airliner dropped to 15 seats. For the L-410 UVP they used Walter M-601B engines, 46 kW more powerful. Until 1990 LET sold more than 500 of L-410 UVP airliners and the most important customer was USSR.

In the beginning of 1980s LET Kunovice started developing more economic version of L-410. They increased the number of seats, gross weight and the range. They also reduced a noise in the cabin by using more-bladed propellers. Basically, this new type was based on the L-410 UVP but it was equipped with the new five-bladed propellers and at the end of the wing new teardrop shape fuel tanks were added. The new type called L-420 with capacity up to 19 passengers was introduced at the Holešov Airshow in 1984. Later, they changed the name to L-410 UVP-E. This new model started to be manufactured in the second half of 1984. It was powered by two Walter M-601E engines with V-510 propellers. Until 1990 LET made more than 300 pieces of L-410 UVP-E.

In 1976 Soviet company Aeroflot demanded LET for a regional airliner with higher capacity of seats than L-410 had, which would replace Soviet regional airliner Antonov An-24. After few years LET Kunovice came up with a prototype of a model called *LET L-610*. L-610 was regional twin-engine turboprop airliner designed for carrying maximum of 40 passengers. The basic concept was taken from successful L-410. The first prototype of L-610 more accurately L-610M first flew in December 2009. In total Let made six airliners called L-610M powered by two Walter M602 engines with Avia V518 five-bladed propellers. A serial production was supposed to start in 1990 but it did not because of the dissolution of Soviet Union.

Because of the loss of the Soviet market, LET tried to enter new western markets. They came up with a new modern version of L-610 called L-610G. This new type was powered by General Electric CT7-9D engines with Hamilton Standard HS 14 RF-23 four-bladed propellers. However, this modernized version was unfortunately not mass-produced either because of the financial problems in the company. Even American company Ayres Corporation, which entered into Let in 1998 and tried to sell L-610G's under the title Ayres 7000, could not prevent this model from its doom. In total let made just two pieces of this modernized version. (Srncová)

In September 2005 the company LET Kunovice was renamed to Aircraft Industries and new company under the trade name was formed. It was due its acquisition by the Czech private group PAMCO and new company under the trade name Aircraft Industries was formed. "In June 2008 the Russian industrial holding Ural Mining and Metallurgical Company (UGMK) acquired 51% of company shares." (LET, Aircraft Industries)

## **6 CURRENT SITUATION OF AVIATION INDUSTRY IN THE CZECH REPUBLIC**

The previous chapter brings us to current situation of Czech aviation industry. Nowadays, there are two companies in the Czech Republic which focus on manufacture of regional airliners, LET Aircraft industries and Evektor. In the past the Czechoslovakian aviation industry was very well known and popular in the world. Then the popularity declined and our aviation industry did not have many famous products. However, it seems that recently it has started getting better.

### **6.1 LET Aircraft Industries**

As stated earlier, LET Aircraft Industries is a company dealing with a manufacture of airliners and it is based in Kunovice. 51% of the LET Aircraft industries are owned by Russian company UGMK and 49% are owned by Czech company PAMCO INT. a. s. At present, they are focused mainly on developing and manufacturing regional turboprop airliner L-410. Since 1960s till present LET Kunovice has made more than 1100 pieces of L-410, and about 400 of them are still in service. As LET Aircraft Industries mentioned in their annual report, 2010 was the most successful year since foundation of the company. 2010 EBT (earnings before taxes) was CZK 214 million. (Aircraft Industries 2010, 12)

In 2011, Aircraft Industries became the Company of the year of Zlín region. The criteria for winning this award were: number of employees, benefits for the region and impact on the environment. Aircraft Industries won first place out of 245 competitors which is a great success. They also won in a special category called Responsible company. (Businessinfo.cz 2011)

#### **6.1.1 LET L-410 UVP-E20**

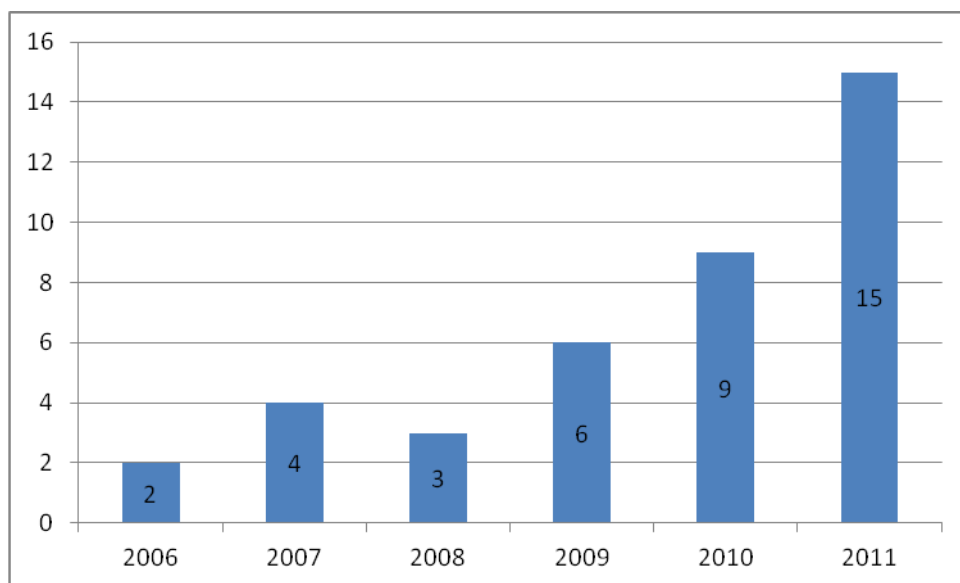
The official name of the most recent and the newest version of L-410 airliner is L-410 UVP-E20/L-420. This model is powered by GE Aviation M601F engines with five-bladed Avia V-510 propellers. This version is designed to carry up to 19 passengers. Maximum speed of this airliner is more than 350 kilometers per hour and the range is about 1400 kilometers. As the company claims on their website they value the airliner for these qualities: “the lowest operating and maintenance costs in its category, unsurpassed durability and proven reliability in extreme conditions and superb hot and high performance (from -40°C to +50°C), reliable operation from short unpaved runways and in

extreme weather, high versatility and passenger comfort and excellent safety record” (LET, Aircraft Industries). Approximate price of this airliner is about € 4 million (approx. CZK 100 million).

### 6.1.2 Export

The production of new L-410s is gradually increasing every year. Most of the L-410 airliners are exported all over the world. The following figure shows the production since 2006. In 2007 the company delivered 4 new airliners of which 2 of them went to Brazil and 2 of them to South Korea. In 2008 they supplied just 3 L-410s which were delivered to Brazil and Africa. However in 2009 they produced 6 airliners, four of them were sent to Russia and two of them to Equatorial Guinea. Furthermore, in 2010 the number of produced airliners climbed again. They sold 9 airliners to Russia, Brazil, French Guiana, Slovakia and Bulgaria. The production plan for 2011 was 15 airliners. (Aircraft Industries 2010, 15)

Figure 9 Number of produced airliners sorted by the year



Source: Data for Figure 9 collected from Aircraft Industries 2010

In December 2011 LET Aircraft industries got a permission by The Ministry of Civil Aviation of the Government of India to supply their airliners to India and neighboring states. The Asian market has always been a big challenge for LET Aircraft Industries, and now by getting this certificate this huge market is opened for them. Now they can supply

countries such as India, Bhutan, the Republic of the Union of Myanmar, Sri Lanka, Nepal or Maldives. (Finance.cz 2012)

On March 15, 2012, LET Aircraft Industries already received first order for L-410s by two Indian carriers. Asian Aviation based in New Delhi has ordered three airliners, and Hyderabad-based Turbo Aviation, which is the second customer, has ordered one L-410. “Asia Aviation and Turbo Aviation are small carriers that operate scheduled and charter flights connecting the smaller towns in India. First deliveries to both companies will be in third quarter.” (Aviation Week 2012)

The L-410 airliners are mostly delivered to Russia, Eastern European countries, developing countries in Africa, South America and Asia and unfortunately competition is too high to deliver L-410 to western countries and the USA. It is caused by the fact that the technical condition of L-410s is not on the same level as the technical condition of airliners made by western manufacturers. That means that for now L-410 can hardly compete with them. To supply western countries and the USA, L-410 would need an extensive modernization.

An appropriate form of modernization would be the innovation which includes a glass cockpit. The glass cockpit is a very modern aviation technology which unifies avionics, typically into large LCD screens, that check and monitor terrain, weather and traffic. This technology is used for example in the new generation turboprop airliners made by ATR.

### **6.1.3 Modernization of L-410: The MOSTA Project**

The MOSTA project should be the largest innovation of L-410 in last 40 years of its existence. It should improve mainly efficiency of the airliner and other features such as the performance in hot and alpine conditions by using new turboprop engines GE H8XX and new propellers AV-725. Luggage compartment will be enlarged. Another improvement should be the maximizing of range and cruising speed as well as extending of service life (at least 30 000 hours). The modernization will also improve economic and technical parameters of devices and aggregates. Other targets are: introduction modern system of maintenance, simplifying the construction (reducing the labor intensity of production), modernization of flight instruments (cockpit).

The MOSTA project is divided into 3 basic stages:

1. Analysis and designing
2. Construction of prototypes



### 3. Testing and documentation

The MOSTA project was launched on August 11, 2011, and it will take 4 years to be completed. Estimated project costs are CZK 460 million. Except Aircraft Industries, many other companies are involved in the project as well. Namely: Avia Propeller, Evektor, GE Aviation Czech, Jihlavan, Jihostroj, MESIT, SVÚM, Aero Vodochody, UNIS, VR Group, VUT Brno and VZLÚ (TECHNODAT 2011). The MOSTA project does not include the glass cockpit. If the MOSTA project is successful the glass cockpit should be another necessary step of modernization to enable L-410 to compete with airliners made by American and Western Europe manufacturers.

## 6.2 Evektor-Aerotechnik

Evektor–Aerotechnik is a world famous manufacturer based in Kunovice. During its 40-year long history it focuses on manufacture of light sport and very light airplanes. Evektor–Aerotechnik has already manufactured over 1000 airplanes and delivered them to flight schools, aero clubs and private pilots worldwide. Recently, they have started developing and manufacturing a new generation twin turboprop regional airliner EV-55 Outback. Evektor has been cooperating with other 19 companies such as Aero Vodochody, Technometra Radotín, Jihlavan and others on this project. Evektor claims that “the project is, since the very beginning, financially supported by the Ministry of Industry and Trade of the Czech Republic in form of a grant.” (Evektor Aerotechnik)

### 6.2.1 Evektor EV-55 Outback

As mentioned above, Evektor EV-55 Outback is a new generation twin turboprop regional utility airliner which was primarily built to replace utility piston aircraft. It is available in three variants: for 9 passengers, 14 passengers and cargo. The range of cargo version carrying about 1500 kg is approximately 750 km. The airliner is powered by Pratt & Whitney PT6A-21 engines with four-bladed AVIA AV-844 propellers. Maximum speed of this airliner is about 400 km/h. The company is proud of the airliner for these features:

- Low operating costs
- Low purchase price
- Spacious and flexible cabin offering variety of configurations, from 9 passenger interior to combi or all cargo, whatever customers prefer
- Speed for more productivity per flight hour
- Modern aerodynamic design, avionics and well-proven engines
- Twin engine turboprop reliability and safety for you and your passengers

- Excellent take-off and landing characteristics both in hot and high airport conditions
- High operating versatility - even float version expected (Evektor aerotechnik)

The development of this airliner took around six years and cost approximately CZK 1 Billion. Production of the first prototype of this aircraft began in 2007. The first flight of EV-55 Outback came true in March 2010 and military version called EV-55M first flew in June 2011. However, important information is that this airliner is not mass-produced yet, because at present it is waiting for all certifications. A certificate by European Aviation Safety Agency (EASA) costs about CZK 7 million per year. At present Evektor looks for an investor who would help to finance this certification. They are planning the serial production on 2014 and the assumed price for the Ev-55 Outback is \$ 2 million what is circa CZK 37 million. (Technik 2010)

Evektor EV-55 Outback should be a main competitor of Cessna Caravan and other airliners in the General Aviation category with up to 9 seats. Many of these aircraft which are in service now are older than 30 years, and they will need to be replaced. Evektor-Aerotechnik believes that EV-55 will be able to replace these airliners (ALV – Czech Republic 2008, 16). According to the manufacturer, the EV-55 Outback is intended for operators in South America, Africa, Asia but also Brazil, Russia, Australia and India.

## 7 OPPORTINUTIES FOR TOMAS BATA UNIVERSITY

### 7.1 CEBIA–Tech

CEBIA-Tech is a new ICT technology park focusing on information and communication technologies. Regarding the organizational structure it belongs under the Faculty of Applied informatics, TBU. The construction of CEBIA-Tech began in March 2011 and it is planned to be completely finished in June 2012. European Union provided a subsidy of CZK 174 Million to Tomas BATA University in Zlín for this regional research centre. CEBIA-Tech is a great way how to interconnect theory and practice. It also represents an opportunity for research and development in fields like applied informatics, security technologies and alternative energy sources.

Specialization of CEBIA-Tech:

- grid computing and application of artificial intelligence
- intelligent manufacturing systems
- intelligent buildings
- embedded systems
- development of mobile data and telecommunication networks for emergency services
- development of system for the detection and analysis of hazardous substances using THz frequency
- electronic systems protection from external and internal electromagnetic field interference
- alternative energy sources – biofuels (FAI 2012)

### 7.2 Evekto: The ARTEMIS Project

Tomas Bata University has been successfully cooperating with Evekto for few years and they also took a part in one Evekto's important project concerning aviation. The project is called ARTEMIS which is an acronym of Analytical Research of threats in ElectroMagnetically Integrated Systems. ARTEMIS is a system which deals with protection of avionics from electromagnetic interference caused by external factors. Three companies, namely Evekto, Hit and Mecas-ESI, and two universities including Tomas Bata University and VUT Brno have been working together on this project. Ministry of

Industry and Trade of the Czech Republic has financially supported this project (Evektor). Further information about the ARTEMIS Project is classified.

### **7.3 Possible cooperation of Evektor–Aerotechnik and Aircraft Industries**

As mentioned earlier, both Evektor and Aircraft Industries are companies based in Kunovice and they both deal with production of turboprop airliners. Recently, Evektor has been developing new generation turboprop airliner EV-55 Outback equipped by very modern technologies, including glass cockpit. However this airliner is not mass-produced yet because now they are waiting for certifications. Moreover, they need to find some business partner who would help them to finance these certifications as they are very costly.

Aircraft Industries has been producing the L-410 UVP-E20 turboprop airliner for more than 40 years. So far, they have made more than 1000 pieces of this airliner. Nevertheless, the technical condition of L-410 is not sufficient to compete on markets in developed countries. The modernization of L-410 is now in progress, but this innovation includes mostly just modernization of airframe. However, there is a big need for further modernization of avionics as well.

As I found out from my previous research Evektor-Aerotechnik has very good technical background, and background for science and innovation but they lack funds to certificate EV-55 and adequate conditions for manufacture of mentioned airliner. On the other hand, Aircraft Industries has 40 year long experience with manufacturing of L-410 and they have great conditions for production, but as was said the technological side of the airliner is not sufficient for developed markets.

My suggestion is to fuse these companies. Due to this fusion they could share their advantages and get rid of each others' disadvantages. As one company focused on manufacturing regional airliners, they could produce two types of turboprop airliners in two different seat segments. Together they would be able to finance certifications of EV-55, and they would manage to modernize L-410. Also, they would not have a problem to produce both EV-55 and L-410. Moreover, it would open the huge Russian market for Evektor EV-55 because L-410 is very popular there. This fusion would create one very strong producer of regional airliners.

Having such a strong aircraft manufacturer in the Zlín region would be a great opportunity for TBU along with CEBIA-Tech. Establishing cooperation with regional companies is one of the main targets of CEBIA-Tech, therefore, if Evektor and Aircraft Industries fused together, TBU and especially CEBIA-Tech should focus on establishing cooperation with this potential merged company.

## CONCLUSION

The research resulted in recommendation for Evektor and Aircraft Industries to fuse together. As one company they would have bigger chance to succeed on the market with airliners EV-55 Outback and L-410 which they make. Moreover, they could share the technological background and facilities for research and development of Evektor and longtime production experience interconnected with knowledge of Russian market of Aircraft Industries.

Evektor and Aircraft Industries are both companies based in Kunovice which deal with production of regional turboprop airplanes. The turboprop airliners experience a huge comeback in regional air transport at present. This type of aircraft almost disappeared from the market in the second half of 20th century due to the popularity of turbojets. However lately, the turboprops have started to be very popular again among regional air carriers because of their efficiency for short-haul flights.

It is very likely that the popularity of turboprop airplanes is going to grow in direct proportion with growing prices of crude oil and petrol. At this moment, the market share of turboprop airliners in Europe is about 30 % but with passing years this number will probably raise. The current trend among regional airlines is to swap jet airliners for turboprop aircraft to keep the costs of aviation fuel down and thus they do not have to make their flight tickets more expensive.

The increasing utilization of regional turboprop airliners is just a general prediction and I believe in it, but is it going to come true? We will know the answer in few years. However, I wonder what the future of Evektor and Aircraft Industries is. Is it possible that these two aircraft manufacturers fuse into one company or will Evektor certify the EV-55 Outback and Aircraft Industries succeed in modernization of L-410 separately? Only time will bring some answers and then we can compare the reality with this prediction.

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**LIST OF TABLES**

Table 1 Jet manufacturers in Europe .....	28
Table 2 TP manufacturers in Europe .....	28
Table 3 Top 10 active jets in Europe .....	29
Table 4 Top 10 active TPs in Europe.....	29

**LIST OF FIGURES**

Figure 1 A basic structure of an airline.....	17
Figure 2 Distribution of the total market for small aircraft by technology.....	20
Figure 3 Total market for turboprop engines.....	22
Figure 4 Comparison of fuel-efficiency in the regional market.....	24
Figure 5 Regional aircraft deliveries by manufacturer.....	26
Figure 6 Regional aircraft deliveries by category.....	26
Figure 8 TP market share by manufacturer.....	29
Figure 7 Jet market share by manufacturer.....	29
Figure 9 Number of produced airliners sorted by the year.....	39