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POLISH AIR TRANSPORT AMONG STRUCTURAL CHANGES IN THE WORLD CIVIL AIRLINE FLEET

Summary. The predicted tripling of regional air carriage before the year 2027 sets extremely high requirements on future aircraft choice. The main competitors for a share of this market are Bombardier from Canada and Embraer from Brazil, followed by the French-Italian combination ATR. Having gone through a series of important changes since 1989, PLL LOT S.A. must also compete in this highly dynamic market. Its choices in equipment will have an important effect on its future market position.

POLSKI TRANSPORT LOTNICZY W WARUNKACH ZMIAN STRUKTURALNYCH ŚWIATOWEJ FLOTY LOTNICTWA CYWILNEGO

Streszczenie. Przewidywany, trzykrotny wzrost przewozów regionalnych do roku 2027, stawia wyjątkowo wysokie wymagania dotyczące wyboru floty. W tym segmencie przedsiębiorstwami konkurującymi o zdobycie udziałów w rynku są: kanadyjski Bombardier, brazylijski Embraer, a przede wszystkim francusko – włoskie konsorcjum ATR. Podążając za serią istotnych zmian, zapoczątkowanych w 1989 roku, PLL LOT S.A. również musi konkurować na bardzo dynamicznie zmieniającym się rynku. Jego wybór dotyczący taboru będzie miał istotny wpływ na przyszłą pozycję rynkową.

1. MARKET DEMANDS IN THE REGIONAL FLEET SEGMENT

The important scope of services by the fleet of regional air transport aircraft, requires understanding of it's current commercial use, and knowledge about the changes in the production and exploitation of aircraft in this market. The competition between aircraft for regional operations takes place in the shadow of the spectacular process of fighting for the market for big planes. Yet the predicted triple rise of carriage to the year 2027 sets extremely high requirements in fulfilling the needs in this market too. The number of jet aircraft taking aboard from 30 to 120 passengers will soon rise from 4,7 to 9,2 thousand. Mostly these will be planes with a capacity of over 90 seats. Table 1 [18] shows the data concerning the changes taking place in the market of production and use of regional airplanes.

Table 1

Production and orders of regional communication planes in years 2005 to 2007

Type of the plane	Number of seats	Annual production				Number of orders	
		2004	2005	2006	2007	2007	Remained for realisation
Jet airplanes							
Embraer ERJ-135	37	1	2	0	0	0	0
Embraer ERJ-145	50	87	46	12	7	1	46
Embraer 170	70	46	46	32	11	13	31
Embraer 175	78	0	17	11	34	30	70
Embraer 190	98	0	12	40	68	88	282
Embraer 195	108	0	0	3	10	14	47
Bombardier CRJ 100/200	50	75	35	1	0	0	0
Bombardier CRJ 440	40	33	12	0	0	0	0
Bombardier CRJ 700/705	70-75	52	64	13	6	33	32
Bombardier CRJ 900	86	15	14	50	56	69	84
Bombardier CRJ 1000	100	0	0	0	0	39	39
Domier 328 Jet	33	8	6	1	0	0	0
Total jet airplanes		317	251	163	192	287	631
Turboprop airplanes							
ATR 42	48	5	5	8	7	16	20
ATR 72	68	8	10	16	37	97	173
Bombardier Dash 8Q 200	37	1	1	1	3	4	5
Bombardier Dash 8Q 300	50	8	9	16	16	13	12
Bombardier Dash 8Q 400	74	10	18	31	47	80	90
Raytheon Beech 1900	19	1	0	0	0	0	0
Total turboprop airplanes		33	43	72	110	210	300

The figures point out that in this segment the leading role is played by jet aircraft made by Embraer and Bombardier, and turboprop planes built by ATR. These three manufacturers delivered 302 airplanes in 2007, which represents a growth in sales by 44%, compared to the previous year. One of the main factors causing this phenomenon was the expansion of low-cost air carriers who prefer using this particular type of aircraft. It significantly improved the financial situation of the Embraer company in particular. The main product of this Brazilian company is a family of E-Jets (70 to 122 seats). Their advantage is their unique quality to be used on routes with variations in air traffic density, the elimination of bigger planes from thin routes, and replacement of older types of planes which are not able to operate under low temperatures (-70--TUTAJ--C) or in hard weather conditions (these machines have an ETOPS75 certificate: 75 minutes of flight with engine malfunction). In passenger cabins it is possible to install TV screens in the back of the seats and electrical sockets for laptop users. In the Embraer's business class one rule is obligatory - "there's never enough comfort". In each plane this class is furnished with the most elegant chairs and sofas. A few years ago Embraer produced first in the world agricultural aircraft EMB-202A Ipanema, powered with biofuel (alcohol) made form sugar cane in the price of 1,3 real (1,70zl) when the price of gas reached 3,4 real (around 4,40zl).

On the regional transportation market the Canadian Bombardier is strengthening it's position. Sales of Bombardier planes in 2007 accounted for 238 machines (141 jet planes and 97 turboprop aircraft). The biggest of Bombardier's achievements is the program for construction and selling of a 100-seat model of its CRJ100, characterized by a reinforced undercarriage and modified wings. It was created in 2007. The general assumption of the constructors of both jet propelled and turbo propelled machines is extending the fuselage. After the emergence of the CL600 (20 m) to the moment of production of the 90 seats CRJ900 (36,4 m), the design was lengthened by 16,4 m. These adaptations also incorporate improvements in comfort, which is closely connected with an increase of space as such. A quality offensive is also announced by the newest decision of constructing CSeries family plane, including four type of planes (with between 110 and 130 seats) that have a take-off weight from 55 to 60 tones and maximum range reaching from 3300 km to 5500 km. Planes with such

characteristics offer optimum flexibility for regional market demands. An advantage of these machines is that they have a modern construction made of aluminum-lithium alloy and composites, combined with digital avionics and fly-by-wire steering with joysticks instead of steering-wheels. The expected date of coming in exploitation of the first planes is year 2013.

The position of the third biggest producer on the world market for regional aircraft is the French-Italian ATR (Avions de Transport Regional). ATR's share in the market stands at around 15% and might go up more than 23%. In its development strategy, the producer concentrated its efforts on quality improvement. The new versions of the ATR-42 (48 seats) and the ATR-72 (68 seats) will have modern, integrated digital avionics with liquid crystal displays inside the cockpit. Improvement in power plant will include using the latest Pratt & Whitney Canada PW127M turboprop engines, that are reliable in high temperatures and high altitudes. The systematical improvement of the quality features in ATR aircraft made that this producer increased sales twofold in 2007 compared to the year before.

The evaluation of the regional market points to undisputed primacy of western aircraft producers in this field. In the east, the programs for the construction of regional planes differ. The most advanced aircraft is the Russian Suchoi Superjet 100. Apart from that, a limited number of modern An-148 aircraft are produced in Ukraine for the needs of the Commonwealth of Independent States(CIS). Chinese producers, however, show better efficiency. The AVIC ARJ-21 jet, available on the market from the end of 2007, is designed to carry 90 passengers over a distance of 3700 km. The plane, for which already over 100 orders have been placed – it is estimated, that its production run can reach up to 900 units – is supposed to provide the producer acquisition of 60% of the regional Chinese market, mostly on the basis of low prices and high on-board comfort. The preferences of users of regional aircraft are more or less similar on every continent, which is illustrated by data in Table 2. (Own study on the basis of [18], [19])

In the world trends we can see a decrease in demand for planes with jet propulsion, which results from market saturation, and an increase in demand for turboprop machines, which are characterized by lower prices and 20 to 30% smaller fuel consumption. Nevertheless, the popularity of operating jet planes is not diminishing, due to their higher speed, which enables shortening of flight time.

2. FORECASTS

The evaluation of the present situation and the position of air transport in the nearest time is on the whole quite well defined. On the other hand, long-term forecasts regarding determinants and ways of air transport development are much more difficult. Global markets analysts agree that civil aviation will develop at a much faster rate than other kinds of economic activity. However there is some disagreement about how this will come about, and about the kinds of aircraft and equipment that will be in use.

The greatest uncertainty in a future evaluation is diagnosing the rate and scale of fuel price increases, and they comprise the main part of costs. A further problem is how the financial situation of companies will influence technical and technological levels of producers, airports and also the quality and size of equipment bought by users. The most useful in planning are projections prepared by the biggest aircraft producers, Boeing and Airbus, and the International Aviation Organization ICAO. Boeings forecasts concern regular and charter transports and the number of operational airplanes having over 90 seats. These forecasts are concerning the next twenty years and they are gathered in the document called Current Market Outlook - CMO. In its Global Market Forecast Airbus presents the regular and charter market projections and the demand on airplanes having above 100 seats. Analysts of ICAO published their forecasts in the document Civ. 313 Outlook for Air Transport to the Year 2025. This included cumulative statistics in domain of regular and charter traffic for the 189 members of ICAO, covering commercial airplanes having the takeoff weight above 9 tons. Table 3 (own study on the basis of [7], [9], [20]) gathers aerial producer and the International Aviation Organization forecasts, which shows a correspondence of these projections.

Table 2

The number of the most popular regional planes in particular parts of the world

	Type of aircraft	Users by region											
		North and South America			Europe and CIS			Asia and Middle East			Africa		
		2006	2007	change	2006	2007	change	2006	2007	change	2006	2007	change
1	ATR 42	106	105	-1	125	131	+6	50	55	+5	31	31	0
2	ATR 72	72	70	0	126	133	+7	87	101	+14	14	16	+2
3	Bombardier CRJ 100/200	748	767	+17	144	136	-8	40	40	0	6	13	+7
4	Bombardier CRJ 700	224	229	+5	33	34	+1	3	3	0	0	0	0
5	Bombardier Dash 8/Q	308	308	0	175	175	0	116	155	+39	31	35	+4
6	De Havilland Twin Otter	157	145	-12	30	31	+1	103	105	+2	60	54	-6
7	Embraer EMB-110	115	93	-22	4	3	-1	33	23	-10	8	6	-2
8	Embraer EMB-120 Brasilia	140	128	-12	39	30	-9	17	22	+5	12	29	+17
9	Embraer 135/140/145	680	687	+7	141	135	-6	20	24	+4	7	8	+1
10	Embraer 170/175/190/195	124	175	+51	28	45	+17	15	27	+12	0	5	+5
11	Fairchild Metro/Merlin	246	246	0	50	50	0	73	63	-10	8	7	+1
12	Fokker F27	38	30	-8	40	38	-2	46	42	-4	40	37	-3
13	Fokker 50	15	15	0	85	86	+1	50	52	+2	20	20	0
14	Fokker 100	57	59	+2	112	110	-2	58	58	0	3	3	0
15	LET L-410	93	83	-10	132	130	-2	20	19	-1	68	66	-2
16	Raytheon Beech 1900C/D	284	289	+5	38	36	-2	60	47	-13	0	0	+3
17	SAAB 340	230	211	19	58	64	+4	64	68	+4	8	7	-1
18	Antonov An-24	23	23	0	328	323	-5	68	67	-1	29	25	-4
19	Antonov An-26	35	35	0	184	169	-25	19	20	+1	29	26	-3
20	Jakovlev Jak-40	16	16	0	357	347	-10	17	18	+1	20	19	-1
21	Jakovlev Jak-42	7	7	0	120	123	+3	0	2	+2	3	1	-2

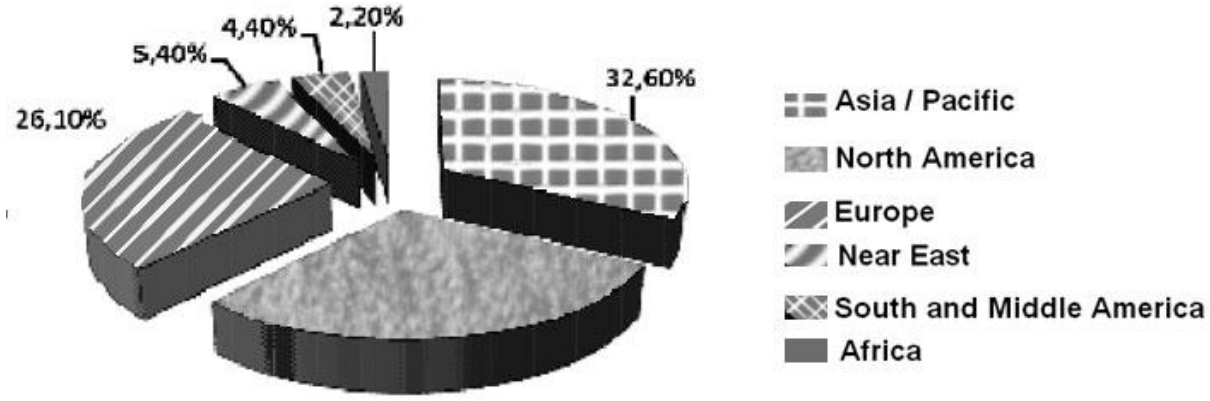
These projections are based on presumption, that the number of flights in the next twenty years will increase from 24,9 million to 50,5 million and that the average number of seats in each airplane will grow from 181 to 215, fulfilling an important criterion of increasing seat capacity. Very important information for producers is the volume of passenger and cargo transport in different regions of the world in terms of the necessity to include client expectations in future short-range aircraft. Detailed statistics regarding this problem are presented on Figure 1 (Own study on the basis of [20]).

Table 3

Long-term forecast of the global air transport market for years 2005-2025

Source	Passengers				Cargo				The fleet in total		
	Total		Volume of transport performance		Total		Volume of transport performance				
	billion		Trillions of passenger-km		Billions of tonnes		Billions of tkm		2005	2025	remarks
	2005	2025	2005	2025	2005	2025	2005	2025			
Boeing	2,1	5,25	3,7	10	37,7	143	143	560	17 330	36 000	above 90 seats
ICAO	2	4,5	3,7	9,2	37,7	145	142	510	22 133	44 300	takeoff weight above 9 tonnes

In passenger transport



In cargo transport

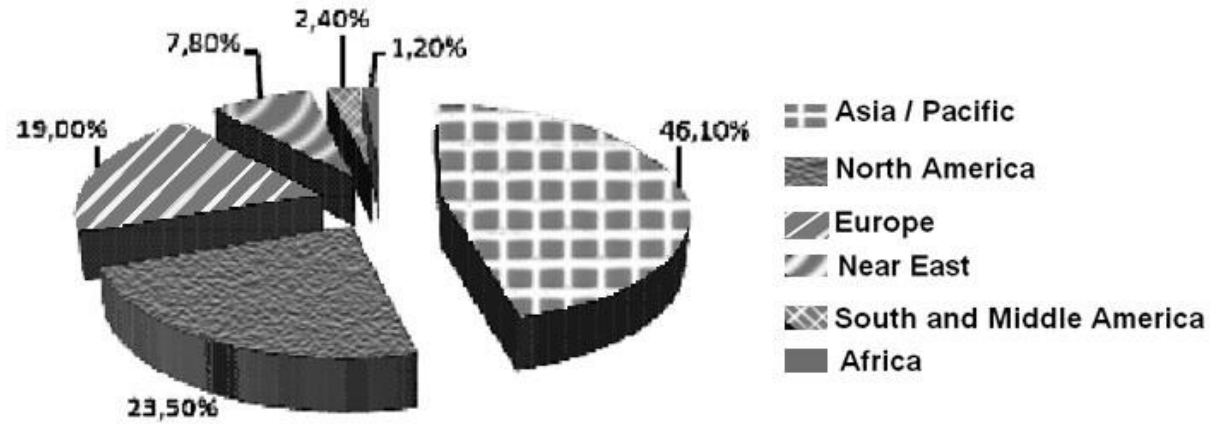


Fig. 1. Forecasts of the air transport performance volume in 2025 in particular regions of the world
Rys. 1. Prognozy wielkości przewozów lotniczych w poszczególnych regionach świata w 2025 roku

Projections indicate that in 2025 North America will have the greatest share in passenger transport, followed by Asia and the Pacific, and Europe. In the domain of cargo transport Asia and the Pacific will be ahead of North America and Europe. In this case the opinions of the analysts of Boeing and Airbus coincide. They also agree about the predictable number of airplanes that will be bought in the future. Differences appear, however, in the evaluation of capacity usage (Airbus predicts a higher expansion of airplanes having above 400 seats). According to CMO authors projections of cargo transport, some 10% of the world carriage will be done by about 400 cargo airplanes in 2025 (64% in wide-body aircraft, half of them with a carrying capacity above 80 tons). In comparison with 2007 the transport performance of goods will triple and the inventory of the fleet will double. About 25% will constitute of a typical cargo aircraft, and 75% of modified passenger-cargo aircraft. The evaluation of statistics presented in Table 4 (own study on the basis of [7], [9]) concerning the deliveries of commercial aircraft, gives a comprehensive view of projected changes in the civil aviation to 2026.

Table 4

Predictable volume of communication airplanes deliveries in 2007-2026

Region	Number of aircraft				Total	
	Regional (short-range)	Narrow-body aircraft	Wide-body aircraft		volume	Value in billions dollars
			Max. to 400 seats	above 400 seats		
Europe	450	4630	1360	230	6670	660
Asia/Pacific	630	4690	2530	500	8350	1020
North America	1880	5840	1330	90	9140	730
South America	140	1370	210	10	1730	120
Near East	70	380	600	110	1160	190
Africa	70	270	150	0	490	50
Countries of past USSR	460	470	110	20	1060	70
World in total	3 700	17 650	6 290	960	28 600	2840

At present intensive competition is taking place among the leading producers of aircraft and aviation equipment. Increasing carrying capacity, range, convenience of travel, and economic effectiveness of machines is paramount in this. Boeing has announced the start of a research project on a supersonic airplane, identified under its work name 20XX, or Sonic Cruiser. The presumptions of this project have been concentrated on obtaining a maximum range and flight speed of 0,95 Mach (1057 km/h) and on achieving a substantial reduction of aerodynamic drag during high speed flight. Boeing has also started a study into an airplane having about 800 seats without an isolated fuselage, a so-called blended wing body (delta shape).

Not to stay behind, Airbus has started research on a forward model identified as E2, which focuses on the assumption that supersonic transport aircraft with rotary wings will be built. Within the European Union a special group of scientists was also created to work on a project for a supersonic jet, called A2, flying at five times the speed of sound (Mach 5), i.e. two times faster than Concorde, which has been withdrawn from operation in 2003. This project takes into account strict requirements in the domain of ecology and seeks to use hydrogen fuel, which does not pollute the atmosphere.

3. STRUCTURAL CHANGES IN THE POLISH CIVIL AVIATION

The Polish civil aviation rests on one main pillar, which is LOT Polish Airlines, existing on the market since year 1929. The fleet of this company, which has the status of a national carrier, underwent changes dependent on political conditions to the moment of converting it to Joint Stock

Company in December 1992. This made that LOT found itself in an area of operation in which the market economy rules. Table 5 contains data showing the size of quantitative changes of the basic equipment after World War II.

Table 5

Civil Aircraft Register in the Polish civil aviation for years 1945 to 2008
(as of the 1st of the January of every year) [25]

Years	Type of equipment				
	Airplanes	Helicopters	Gliders and motor gliders	Balloons and airships	Total
1945	3	-	138	-	142
1950	211	-	751	-	624
1955	291	-	597	-	693
1960	506	3	858	4	1290
1965	564	13	790	5	1585
1970	500	13	758	4	1273
1975	624	27	958	2	1611
1980	782	134	958	5	1879
1985	864	149	922	7	1942
1990	936	203	987	38	2164
1992	912	232	971	47	2162
1994	933	228	949	53	2163
1996	918	214	929	67	2128
1998	845	164	919	83	2011
2000	922	161	897	96	2076
2002	970	165	904	101	2140
2004	1007	122	869	105	2103
2005	1064	124	879	116	2183
2006	1123	129	898	124	2274
2007	1151	126	913	137	2327
2008	1161	143	869	136	2309

At the beginning of the 1990s Soviet airplanes were dominant in Polish civil aviation. Internal connections were operated with the Antonov An-24 (44 seats) and Jakowlev Jak-40 (24 seats). International connections to capital cities of the CMEA (Council for Mutual Economic Assistance) countries were served by Tupolev Tu-134. For the service of the few routes to Western Europe and the Near East Tu-154 (140-166 seats) were used. Despite the difficulties resulting from political pressure, LOT held on to the operation of lines to Asia (Singapore, Delhi) and the United States (New York, Chicago, Detroit, Los Angeles), which were served also by Soviet airplanes, particularly the Ilyushin Il-62M (174 seats). The 1990s are also a time of overcoming the hegemony of Soviet equipment. Western producers offered planes with characteristics that were significantly ahead of Soviet aircraft. The main difference consisted in vital reduction of fuel consumption, decreasing the unit weight of passenger seats through the application of new materials, modern engines and more reliable avionics. Such features made for economic efficiency and increased the commercial attractiveness of these aircraft, which was important for the competitive position under market conditions of air services. In this period the obsolete and uneconomical An-24, Yak-40, Il-18 models were gradually withdrawn and partly replaced with more modern medium-range Tu-154 planes and with present-day western ATR-72 and ATR-42 models of French-Italian production, which started working for LOT in year 1991.

Similar replacements were also carried out in the long range segment. In the place of Tu-134 and Il-62M introduction of American Boeing started, whose arrival in exploitation was a breakthrough in Polish civil aviation. The years between 1990 and 1993 were a time of great changes in the Polish civil aviation fleet, in which conversion to a new generation of models of western, mostly American, aircraft was effected. The first Boeings 767-200ER were bought in 1989, augmented in 1991 by the B737-500 and in 1993 by the B737-400. As result of this, LOT became the first and only national carrier among the Eastern Bloc countries, which exclusively operated planes of western production. This process still continues and is characterized by the increase of modern machines, which is illustrated by data contained in Table 6 (Own study on the basis of [21, 24]).

Table 6

PLL LOT Fleet (including EuroLOT) in years 2002 to 2008

Type of the plane	Range	Number of seats			2002	2003	2004	2005	2006	2007	2008
		Total	BC	EC							
Boeing 767 200 ER	12 600	202	12	190	2	2	2	2	2	-	-
Boeing 767-300 ER	11 700	243	18	225	3	3	3	5	5	7	7
Boeing 737-300	2352	145	-	145	2	2	-	-	-	-	-
Boeing 737-400	2860	147	48	99	7	7	3	3	2	2	2
Boeing 737-500	2150	108	36	72	10	7	6	6	6	6	6
Embraer 175	2450	82	-	82	-	-	-	-	6	4	6
Embraer 170	3000	70	-	70	-	16	10	10	10	10	10
Embraer ERJ-145	1500	48	-	48	14	14	13	11	9	9	9
ATR 72	1500	64	-	64	8	8	8	8	8	8	8
ATR 42	1500	48	-	48	5	5	5	5	6	5	6

An analysis of presented values indicates that the process of change is still ongoing. For example the share of the 48-seat Embraer ERJ-145 is decreasing and it is replaced by the latest model of Embraer-170 and the 82-seat Embraer-175. These aircraft represent unique technical and technological solutions, and also functions improving the comfort of travel. Their main advantage, however, is low fuel consumption per seat.

The exchange of the fleet under market conditions is a basic process. It gives the chance to increase both economic advantages and the demand attractiveness, gaining momentum in terms of tightening up the competition in area of usage, stimulating at the same time rivalry in the domain of production. The results if this process can be seen in the changing number of aircraft used and in the structure of using particular models. The present register of Polish airlines aircraft is presented in Table 7 (own study on the basis of [9, 10, 22, 23]).

In the last period there have been seen important changes in the LOT's fleet inventory. A regional corporation Eurolot (1997) separated from LOT took over the ATRs 42 and 72. A similar process took place when the dependent partnership Centralwings (2005) was created. This corporation took over 9 Boeings 737-400 for transport services in the low cost segment.

Table 7

Register of Polish airlines aircraft in 2007-2008 (as of the 1st January)

Type	PLL LOT EuroLOT Centralwings			Aeroclubs Flying schools			Ambulance planes Agriculture planes Private firms			Privately owned equipment			Total		
	2007	2008	change	2007	2008	change	2007	2008	change	2007	2008	change	2007	2008	change
Airplanes															
- Boeing 767	7	7		-	-	-	-	-	-				7	7	-
- Boeing 757	-	-	-	-	-	-	1	1	-				1	1	-
- Boeing 737	17	17	-	-	-	-	-	-	-				17	17	-
- Embraer 175	4	6	-	-	-	-	-	-	-				4	6	+2
- Embraer 170	10	10	+2	-	-	-	-	-	-				10	10	-
- Embraer 145	9	9	-	-	-	-	-	-	-				9	9	-
- ATR 72	8	8	-	-	-	-	-	-	-				8	8	-
- ATR 42	5	6	-	-	-	-	4	4	-				9	10	+1
- SAAB 340	-	-	+1	-	-	-	6	9	+3				6	9	+3
- Tupolev	-	-	-	-	-	-	7	5	-2				7	5	-2
- An 26	-	-	-	-	-	-	6	6	-				6	6	-
- Cessna	-	-	-	31	43	+12	84	118	+34	55	43	-12	170	204	+34
- An 2	-	-	-	55	52	-3	84	83	-1	12	13	+1	151	148	-3
- PZL-104-Wilga	-	-	-	77	67	-10	19	19	-	5	5	-	101	91	-10
- Other types	-	-	-	230	182	-48	262	293	+31	153	55	+2	645	630	-15
Total number of aircraft	60	63	+3	393	344	-49	473	538	+65	225	216	-9	1151	1161	+10
Helicopters				1	-	-1	117	133	+16	8	10	+2	126	143	+17
Motorgliders				6	6	-	5	5	-	22	21	-1	33	32	-1
Gliders				736	684	-52	34	29	-5	110	124	+14	880	837	-43
Balloons				29	26	-3	62	63	+1	45	46	+1	136	135	-1
Airships				-	-	-	-	-	-	1	1	-	1	1	-
Total	60	63	+3	1165	1060	-105	691	768	+77	411	418	+7	2327	2309	-18

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