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NEW TRENDS IN COMMERCIAL AVIATION AND ATATÜRK AIRPORT

Cevdet AYGÜN[1]

ABSTRACT: *It is understood that as the density of airline traffic and the number of airline passengers continue to soar at this rate, capacities of current aircraft and airport will not suffice within the next decade. If not intervened, this situation will result in air traffic congestion in worldwide proportions. In order to prevent this congestion either faster aircraft able to conduct more frequent flights or aircraft with more passenger capacity should be put into service. In addition, new airports with adequate infrastructure should also be planned and constructed for future needs.*

KEYWORDS: *Future Aircraft, Airport Construction*

TİCARİ HAVACILIKTAKİ SON YÖNELİMLER VE ATATÜRK HAVAALANI

ÖZET: *Bu çalışmada havayolu yolcuları sayısının ve hava trafik yoğunluğunun bu tempoda artmaya devam etmesi halinde mevcut uçak tiplerinin ve havalimanlarının kapasitelerinin yakın bir gelecekte yetersiz kalacağının ortaya çıktığı belirtilmektedir. Halihazır durumun bu şekilde sürmesinin dünya çapında büyük bir hava trafik sıkışıklığının ortaya çıkmasıyla sonuçlanacağı açık olarak görülmektedir. Gelecekteki bu sıkışıklığı önlemek için ya daha kısa aralıklarla uçuş seferi gerçekleştirebilecek daha hızlı uçakların ya da daha yüksek yolcu kapasiteli uçakların hizmete sokulması gerekmektedir. Buna ilave olarak, gelecekteki ihtiyaçları karşılamak üzere yeterli altyapıya sahip yeni havalimanlarının planlamalara dahil edilerek inşa edilmesi de zorunlu olacaktır.*

ANAHTAR KELİMELER: *Geleceğin Uçakları, Havaalanı İnşaatı*

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[1] *Cevdet AYGUN, Istanbul Technical University, Faculty of Aeronautics and Astronautics, 80626 Maslak ISTANBUL*

I. INTRODUCTION

The need and interest in the travel via air are increasing on a daily basis. Within the coverage of R & D activities, aircraft designers and manufacturers are taking up the feasibility of subsonic and supersonic aircraft that can transport more passengers. In particular, runway length requirement, wing span (B1), maximum structural takeoff weight (m1), passenger number strongly affect design, construction and operation of airports. It is estimated that number of passengers who are transported via air increases at a rate of 5.4 % [1]. According to this situation, the number of passengers in the year 2011 will be 2.2 times greater than the number of passengers who are transported today. By 2011, in order to transport those passengers, 12000 new aircraft must be added to the number of aircraft available today. According to this result, beside increasing the number of aircraft, currently available airports, runways, air traffic control towers and other elements of air traffic should be developed, increased and adapted to the specification of new designs.

It is possible to categorize the new aircraft designs into three groups with respect to their speeds. The first group is subsonic aircraft which will have the cruise speed between Mach number 0.5 – 0.7 and they will be capable of transporting up to 1000 passengers. Second group is supersonic aircraft which will have cruise speed between Mach number 0.8 – 3.0 and these aircraft will be capable of transporting up to 300 passengers. Last group is contemplated to be hypersonic aircraft which can fly faster than Mach number 3.0 but they will be able to carry less passengers.

I.1 Subsonic Aircraft

Transportation capabilities of new aircraft which will cruise at subsonic speed are high and they present less problems with regard to change of available infrastructure and environmental conditions when compared to supersonic aircraft and hypersonic aircraft. For this reason, it is expected that they will be more widely used, i.e. future transportation will be made via subsonic aircraft to a large extent. Passenger capacities of new subsonic aircraft will gradually increase within the next 20 years and it will evolve with respect to capacity as 500, 600, 800 and 1000 persons per flight. Among the reasons for increasing the passenger capacity in a gradual way, there are the potential capabilities which can be realized within a certain schedule such as finding solutions to

technological problems, developing the available airports, constructing the more adequate new airports, etc.

Airbus family (VLA 600) of British Aerospace (BAe) will be able to transport 500 to 600 passengers in case of three classes of passengers. Maximum passenger capacity of this aircraft is contemplated to be 1000 persons for special cases. The length, wing span and fin height of this aircraft are 80 m, 76 m. and 24 m., respectively [1].

I.2 Supersonic Aircraft

As of today, the only available supersonic aircraft in service is Concorde. It is estimated that as the airports which are large and sufficiently far away from settlement areas are increased, aircraft like Concorde and similar aircraft which currently have limited routes will multiply and become more widespread.

Formerly, British Aerospace had worked on a supersonic aircraft called Advanced Supersonic Transport (AST 2). Currently, British Aerospace, Aerospatiale and Deutsche Luftraumfahrt have come together to start work on an aircraft project which is very similar to former AST 2 within the framework of the European Supersonic Research Programme -ESRP. It is also known that Boeing has endeavored to develop an aircraft called High Speed Civil Transport-HSCT. In addition, there is an aircraft called US Supersonic Transport - SST which was cancelled by US Congress later, since it is said to aggravate the greenhouse effect. It is expected that new supersonic aircraft will become widespread after the year 2005.

I.3 Hypersonic Aircraft

One of the design objectives in designing these aircraft was to make them capable of cruising at an altitude of 30 000 to 40 000 m which correspond to stratosphere. As it is well known, meteorological phenomenon which is quite usual in troposphere, does not take place in stratosphere.

Hypersonic aircraft is classified somewhere between outer space vehicles (satellites) and usual aircraft. Propulsion system in Space Shuttle is in the form of rocket engine. In hypersonic aircraft, gas turbines, ramjets and in particular a combination of them will be used as in the case of some experimental aircraft. During the subsonic flight of the system, gas turbine will serve as a propulsion motor. During the supersonic or hypersonic flights of the aircraft, there will be no need for a compressor stage as well as a turbine stage to drive it, since the shock wave which come about at the air inlet duct

carries out the function of a compressor. In these sorts of flight, propulsion motor will be transformed into a ramjet completely by-passing the gas turbine engine. For these aircraft to take off from the airport, to fly through the subsonic, supersonic and hypersonic speed regimes and to ascend to the stratosphere, half an hour or 45 minutes at most will be required.

In the stratosphere, there is no air motion and air friction is extremely low because air is very rare at this altitude. As a result, the power requirement for propulsion in stratosphere decreases significantly. This situation also decreases fuel consumption. In addition to these facts, cruise speeds in stratosphere are expected to be 15 to 20 times higher than speed of sound or somewhere between 18 000 to 23 000 km/h.

In this manner, it will be possible to reduce the air travel time between İstanbul & New York to 2 hours. It is expected that hypersonic aircraft will become widespread after the year 2020. Some experimental aircraft has been already flight-tested. However, there will be a delay of 20 to 25 years before any commercial aircraft are flight-tested. The reason of this delay is that R & D activities concerning to surmount technological limits on an economic basis are currently continuing.

II. THE EFFECT OF PASSENGER TRAFFIC AND NEW AIRCRAFT ON ATATÜRK AIRPORT

Projection of passenger numbers of air traffic in the world and in İstanbul is presented in Figure 1 which facilitate comparison of the different rates of increase of airline passenger traffic on a year by year basis in a bar-scale sense. Notice that scale on this axis is accepted as 10 million pax for the world and 1 million pax for İstanbul [1,4]. Same data is also given Table 1 in order to provide information in the form of absolute numbers on a yearly basis. The base value for the world is taken as 1200 million passengers which was the case in 1992 [1] and the base value for Istanbul is chosen as the number of passengers in 1995 [4]. The rate of increase for the world is taken as 5.4 % and for İstanbul, it is varied as 3 %, 4 %, 5.4 %, 7 % and 8 % respectively [1].

As it is seen from the Table 1, the passenger traffic in İstanbul Atatürk Airport becomes 70 million for an increase of 8 % and 40 million for an increase of 5.4 % in 2018, after 19 years from now on. Notice that numbers are in million passengers and those with asterisks are not projected but real numbers [1,4]. It can be estimated that the projected

passenger numbers even with the highest increase of 8 % per year will become smaller than the real numbers in the future as this was already the case in İstanbul between the years 1994 and 1995.

Several measures must be taken in order for Atatürk airport to sustain the passenger load estimated for the long term. Otherwise, the restricting factors within İstanbul Atatürk Airport will certainly affect this traffic in a negative sense. It is possible to partially meet the passenger load within the short term by accomplishing the following tasks:

-To construct a new runway with a minimum length of 3500 m.

-To transfer the military facilities to civilian use.

-To modernize the available terminals and to expedite the new infrastructure investment.

-To employ the technology and methods to save time and to provide swiftness in procedures for holding, storing, loading and unloading cargo and managing passengers

-To connect the Airport to Yenikapı Subway Station, Bakırköy Sea Buses Terminal, etc.

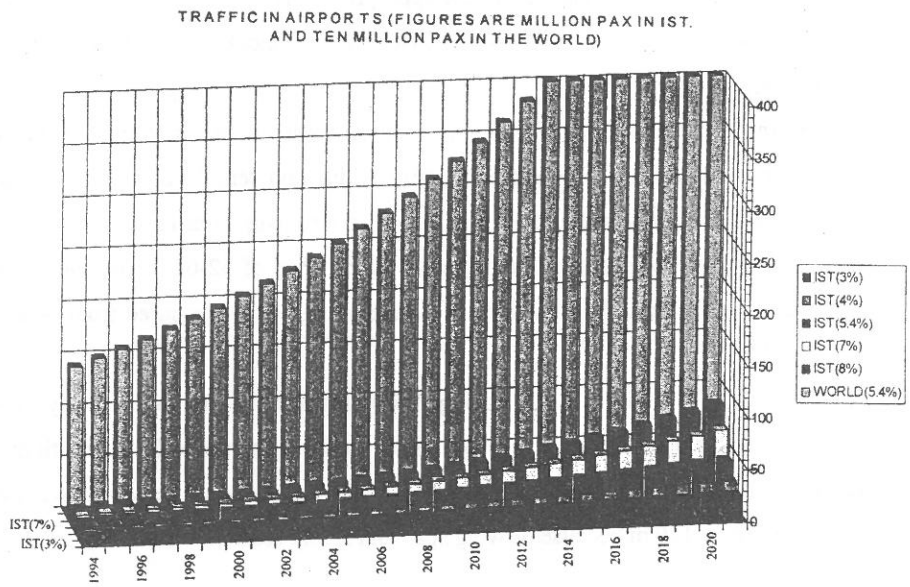

Figure 1. Estimates of airline passenger traffic in the world and in İstanbul.

As it is understood from Greater City Municipality of İstanbul; works for connecting Atatürk Airport with subway will be started soon. Other solutions will also affect the parking problem of airport in a positive sense.

Efforts related to other airports that will absorb passenger load in the medium and long terms can be summarized as:

- To make Kurtköy Airport with a 3500 m runway ready within the medium term.
- To expropriate two large and plain pieces of land far away from the settlement areas as future airports within the long term. One of these pieces of land should be located in the vicinity of Adapazarı and the other in Trakya.
- To start plans of constructing the airports with runways of at least 3500 meters long.
- To connect these airports via fast train or subway.

As a result of economic interests, competition between companies or nations, technological developments, increasing safety and comfort or various needs, continuous innovations in the constructions, dimensions and operations of aircraft come into existence. These innovations require the appropriate change of all types of man power, infrastructure, hardware, software and services which should develop in parallel with aircraft technology.

In general, the trend in the direction of increasing aircraft capacity requires the enlargement of aircraft dimensions, runway width and length as well as passenger transit areas. Currently, the aircraft which require a runway of at least 1800 m or more (code number=4, code letter=E) must have a wing span of 52-62 m (excluding 62 m) and a main wheel track distance of 9-14 m (excluding 14 m) measured from outer limit to outer limit.

As it can be seen from Table 2, Boeing 747-400 is able to land at a runway of 45 m wide. Notice that runway distance is defined at the sea level, under ISA conditions, on a no wind day. The important issue herein is that the distance between taxiway and runway must be 150 m because of wing span and safety reasons.

Table 1.Estimates of passenger number in airline traffic in İstanbul and in the world

YEAR	WORLD (5.4%)	İSTANBUL (8%)	İSTANBUL (7%)	İSTANBUL (5.4%)	İSTANBUL (4%)	İSTANBUL (3%)
1994	1333.33	*10.11	*10.11	*10.11	*10.11	*10.11
1995	1405.33	*11.93	*11.93	*11.93	*11.93	*11.93
1996	1481.22	12.88	12.76	12.57	12.40	12.28
1997	1561.21	13.91	13.65	13.25	12.90	12.65
1998	1645.51	15.02	14.61	13.96	13.41	13.03
1999	1734.37	16.22	15.63	14.72	13.95	13.42
2000	1828.03	17.52	16.73	15.51	14.51	13.82
2001	1926.74	18.92	17.90	16.35	15.09	14.24
2002	2030.78	20.44	19.15	17.23	15.69	14.67
2003	2140.45	22.07	20.49	18.16	16.32	15.11
2004	2256.03	23.84	21.92	19.14	16.97	15.56
2005	2377.85	25.75	23.46	20.18	17.65	16.03
2006	2506.26	27.81	25.10	21.27	18.36	16.51
2007	2641.60	30.03	26.86	22.42	19.09	17.00
2008	2784.24	32.43	28.74	23.63	19.86	17.51
2009	2934.59	35.03	30.75	24.90	20.65	18.04
2010	3093.06	37.83	32.90	26.25	21.48	18.58
2011	3260.09	40.85	35.20	27.66	22.34	19.14
2012	3436.13	44.12	37.67	29.16	23.23	19.71
2013	3621.68	47.65	40.31	30.73	24.16	20.30
2014	3817.25	51.47	43.13	32.39	25.12	20.91
2015	4023.38	55.58	46.15	34.14	26.13	21.54
2016	4240.65	60.03	49.38	35.98	27.17	22.18
2017	4469.64	64.83	52.83	37.93	28.26	22.85
2018	4711.00	70.02	56.53	39.98	29.39	23.54
2019	4965.40	75.62	60.49	42.13	30.57	24.24
2020	5233.53	81.67	64.72	44.41	31.79	24.97
2021	5516.14	88.20	69.25	46.81	33.06	25.72

As a result, it is possible to use İstanbul Atatürk Airport in a most efficient and effective way by improving human resources quality, infrastructure, hardware, software and services. In addition, it is essential that Kurtköy Airport must be put into service as a medium term solution. In the long term, two areas which is as close to İstanbul as 100 to

Table 2.Characteristics of available aircraft [2, 3]

B1 = wing span, L1 = length, L2 = wheel base, B2 = wheel track, m1 = maximum takeoff weight, m2 = maximum landing weight, m3 = operational empty weight, m4 = zero fuel weight, TF = turbofan engine, TJ = turbojet engine

Manufacturer	Type	B1 (m)	L1 (m)	L2 (m)	B2 (m)	m1 (kg)	m2 (kg)	m3 (kg)	m4 (kg)	Engine type	Min. number of pax.	Max. Number of pax.	Runway distance (m)
Airbus Ind.	A-300-600	44.83	53.5	18.62	9.6	165003	138003	89446	130002	2 TF	247	375	2316
Airbus Ind.	A-310-300	43.89	46.7	15.21	9.6	150001	123003	77040	113001	2 TF	200	280	2031
Airbus Ind.	A-320-200	33.91	37.6	12.62	7.59	72000	61000	38180	57000	2 TF	138	179	1716
Airbus Ind.	A-340-200	60.3	59.4	19.18	5.11	253517	180986	122790	168966	4 TF	262	375	2316
Boeing	B-727-200	32.92	46.7	19.28	5.72	83825	68040	46164	62597	3TF	145	189	2621
Boeing	B-737-200	28.35	30.5	11.38	5.23	45360	43092	27171	38556	2 TF	97	136	1707
Boeing	B-737-300	28.88	33.4	12.45	5.23	56473	51710	31480	47628	2 TF	128	149	1920
Boeing	B-737-400	28.88	36.5	14.27	5.23	62824	54886	33190	51257	2 TF	146	189	2225
Boeing	B-737-500	28.88	31	11.07	5.23	52391	49896	31312	46494	2 TF	108	149	1554
Boeing	B-747-100	59.64	70.7	25.6	11	322056	255830	162389	238820	4TF	452	480	2896
Boeing	B-747-200B	59.64	70.7	25.6	11	351540	255830	172890	238820	4TF	452	480	3719
Boeing	B-747-300	59.64	70.7	25.6	11	322056	255830	177040	243356	4TF	565	608	2347
Boeing	B-747-400	64.92	70.7	25.6	11	362880	260366	179690	242676	4TF	400	660	2682
Boeing	B-747SP	59.64	56.3	20.52	11	285768	204120	147719	185976	4TF	297	331	2134
Boeing	B-757-200	38.05	47.3	18.29	7.32	99792	89818	58233	83462	2 TF	186	239	1768
Boeing	B-767-200	47.57	48.5	19.69	9.3	142884	123379	80128	113400	2 TF	216	255	1829
Boeing	B-767-300	47.57	54.9	22.76	9.3	156492	136080	84541	126101	2 TF	261	290	2438
Boeing	B-777-200	60.93	63.7	25.88	11	242676	201852	135876	190512	2 TF	305	375	2652
McDonnell-Douglas	DC-8-73	45.24	57.1	23.62	6.35	161028	117028	75524	104782	4TF	196	269	3048
McDonnell-Douglas	DC-9-32	29.06	36.4	16.21	4.98	54886	49896	25941	44680	2 TF	115	115	1686
McDonnell-Douglas	DC-9-51	28.45	40.7	18.57	4.88	54886	49896	29337	44680	2 TF	139	139	2164
McDonnell-Douglas	MD-81	32.87	45.1	22.07	5.08	63504	58061	35330	53525	2 TF	155	172	2110
McDonnell-Douglas	MD-87	32.87	39.8	19.18	5.08	67813	58968	33966	50803	2 TF	130	139	1920
McDonnell-Douglas	MD-90-30	32.87	46.5	23.52	5.08	70762	64411	39276	58061	2 TF	158	172	2073
McDonnell-Douglas	DC-10-10	47.04	55.6	22.07	10.7	195048	164884	108942	151956	3TF	270	399	2743
McDonnell-Douglas	DC-10-30	50.39	55.6	22.07	10.7	259459	182801	121201	166925	3TF	255	380	2832
McDonnell-Douglas	DC-10-40	50.39	55.6	22.07	10.7	251748	182801	122569	166925	3TF	255	399	4420
McDonnell-Douglas	MD-11	51.97	61.4	24.61	10.7	273294	195048	129660	181440	3TF	323	410	2987
Lockheed	L-1011-500	50.09	50.1	18.8	11	231336	166925	111313	153317	3TF	246	330	2804
British Aerospace	BAe111-500	28.5	32.6	12.62	4.34	54000	49500	30056	39499	2 TF	86	104	2103
Fokker	F-28-4000	25.07	29.6	10.34	5.05	33113	31525	17645	28123	2 TF	85	85	1585
Aerospatiale/BAC	Concorde	25.55	62.6	18.19	7.72	185069	111132	79380	90720	4TF	108	128	3444
Russia	Ilyushine-62	43.21	53.1	24.51	6.81	165002	105008	71451	94598	4TF	168	186	3301
Russia	Tupolev-154M	37.57	47.9	18.92	11.5	100001	80000	55301	74000	3TF	162	180	2499

Table 3. Characteristics of the future aircraft, [2, 1]

B1 = wing span, L1 = length, L2 = wheel base, B2 = wheel track, M1 = maximum takeoff weight, M2 = maximum landing weight, M3 = operational empty weight, M4 = zero fuel weight, TF = turbofan engine, TJ = turbojet engine

Manufacturer	Type	B1 (m)	L1 (m)	L2 (m)	B2 (m)	m1(kg)	m2 (kg)	m3 (kg)	m4 (kg)	Engine Type	Min. number of pax	Max. number of pax	Runway distance (m)
Boeing	B-747-400	64.92	70.7	25.6	11	362880	260366	179690	242676	4TF	400	660	2682
Boeing	B-777	60.93	63.7	25.88	11	242676	201852	135876	190512	2 TF	305	440	2652
Airbus Ind.	A-340-300	60.3	63.7		10.7	254400						440	
Boeing	B-747X	88.0	85.0 64.0 double		17.0	771000						600-800	
Mc Donalds	MD12	64.9	68.8									500	
Bae	Airbus Family	80.0	80.0									1000	
ICAO estimate	Future Aircraft	84.00	84.0		20	567000							

150 km. but around which no settlement is allowed must be introduced to serve as airports.

III. CONCLUSION

As it can be concluded from available and projected data, it becomes necessary to develop new categories of aircraft capable of flying in various flight regimes in order to meet growing demands. As being undertaken by many nations, design and development studies of such aircraft are already under the way in accordance with required specifications. Complementing this situation, new airports with larger capacities and adequate infrastructure will facilitate future air traffic. For the region of İstanbul, such a larger scale project is under the preparation phase.

REFERENCES

[1] C. David, "The Impact of New Aircraft Developments on the Design and Construction of Civil Airports", *Proc. Instn. Civ. Engrs. Transp.*, 111, pp.59-69, 1995.

[2] R. Horojeff, and F. X. Mckelvey, *Planning & Design of Airports*, fourth edition, McGraw-Hill Inc., 1994.

[3] Anonym, The fleet, *Aeroflot Inflight Magazine*, No.16, February-April 1996.

[4] K. Ünlü and F. Ocaklı, *Special Interview furnished with Documents on İstanbul Atatürk Airport*, DHMI-Deputy General Directors of Atatürk Airport, August 02, 1996.