MAJOR IMPACTS OF FLEET RENEWAL OVER AIRPORTS LOCATED IN THE MOST IMPORTANT REGION OF BRAZIL

Rafael Waltz Matera
Architect

Roberta de Roode Torres
M.Sc. student in Transportation Engineering
Federal University of Rio de Janeiro, Brazil

Respicio A. Espirito Santo Jr., D.Sc.
Associate Professor
Federal University of Rio de Janeiro, Brazil

The present article discusses and analyses the major impacts of the Brazilian carriers fleet renewal regarding Brazilian airport infrastructure in the most important region of the country, the Southeast (SE). A brief historical overview of the country's airline fleet will be presented, demonstrating the need for its renewal (in fact, Brazilian carriers started a major fleet renewal program in the last five years), while analyzing the periods in which a new breed of aircraft was put into service by the major carriers operating in the SE region. The trend of operating the classic regional jets plus the forthcoming entry into service of the "large regional jets" (LRJ, 70-115 seaters) in several point-to-point routes are presented along with the country's carriers' reality of operating these former aircraft in several high-capacity and medium-range routes.

The article will focus on the ability of four of the major Southeast's airports to cope with the fleet modernization, mainly due to the fact that the region studied is the most socioeconomic developed, by far, with the largest demand for air transportation, thus making the impacts much more perceptible for the communities and the airport management involved. With the emergence of these impacts, several new projects and investments are being discussed and pushed forward, despite budgetary constrains being a reality in almost every Brazilian city, even in the SE region.

In view of this, the paper presents how the general planning could be carried out in order to adapt the airports' infrastructures in function of the proposed (and in some cases, necessary) fleet renewal. Ultimately, we will present the present picture and two future scenarios in order to determine the level of service in the existent passenger terminal facilities in the wake of the possible operation of several new aircraft.

Keywords:
Airline fleet planning, Airport planning, Regional development, Regional Jets.

Authors' contacts:
rafaelmatera@bol.com.br, bel.iac@bol.com.br and respicio@momentus.com.br, respicio@pet.coppe.ufrj.br

1. INTRODUCTION

During the 80's and more especially in the late part of the decade, the world began realizing that a new political, economical, social and cultural order was coming to stay. In Latin America it was no different. In Brazil the government began abandoning the regime of indexation of the economy and price regulation. Regarding air transport issues, in November of 1991, seeking to establish a clear set of policies tuned with the liberalization trends being pushed forward by the federal government under then-elected president Fernando Collor de Mello, the Department of Civil Aviation (DAC) lead the organization, implementation and discussions of the V CONAC, the 5th National Conference of Commercial Aviation. Culminating with the liberalization policy (called *flexibilização* in Portuguese, a quasi-total deregulation), in mid 2001 the DAC along the Ministry of Finance published a Ministry Act issuing the full freedom of fares for the domestic market.

In March 2003, Brazil had four major carriers, totaling 251 aircraft in operation: TAM with 103, VARIG with 100, VASP with 26 and GOL with 22 (the later as of April, 2003). The market-share expressed in available-seat kilometers (ASK) for the domestic market in March of 2003 was of 36.43% for VARIG, 31.11% for TAM, 17.64% for Gol, 13.49% for VASP, and near 1,5% for all the other 10-or-so scheduled-service regional airlines.

Since the mid 90s, all Brazilian regional carriers face structural economical problems, mainly because these small regionals cannot reach the most important and lucrative markets between major cities. The city-pairs flown by these regional players do not generate enough traffic to catapult them into a new group of would-be "medium carriers". Thus, nowadays, Brazil has its majors and the small regional players; there are no "medium" size carriers operating in the country. The market-share distribution aforementioned is a clear confirmation of this fact.

2. THE BRAZILIAN DOMESTIC FLEET

With the present division of majors and small regionals, the Brazilian fleet can also be simply divided into three groups:

(1) Medium/large wide-body aircraft operating international routes (VARIG's MD-11s, 777s and 767s, plus TAM's A330s);
(2) medium capacity aircraft for domestic routes (737s in VARIG's, VASP's and Gol's fleets, plus TAM's A320/319 and Fokker F100s), and
(3) a few regional jets (RJs) combined with the assorted turboprop aircraft flown by the regionals.

Due to its importance, this paper will primarily focus on the single-aisle, narrow-body aircraft flown domestically by the major carriers (group 2). This group represents nowadays 66% of the entire Brazilian airline fleet (see Table 1).

Table 1 – Brazilian Airlines' Fleet Evolution (1990-2002) – Only Scheduled Carriers' Fleets Appropriated

Aircraft / Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
A300-B2/B4	4	3	4	3	3	3	3	3	3	3	3	3	3
A310	–	–	–	–	–	–	–	1	2	2	–	–	–
A319	–	–	–	–	–	–	–	–	–	–	12	6	13
A320	–	–	–	–	–	–	–	–	–	–	6	21	31
A330	–	–	–	–	–	–	–	–	–	2	5	7	9
707-320C	4	3	2	2	2	2	–	–	–	–	–	–	–
727-100/100C	15	14	5	5	5	5	9	9	9	9	7	5	4
727-200/200C	–	–	–	–	–	–	2	4	6	6	2	6	4
737-200	39	43	36	34	36	38	43	38	40	35	35	35	32
737-300	36	54	39	39	38	35	33	40	47	49	46	55	41
737-400	3	7	4	4	4	5	5	6	7	4	1	5	4
737-500	–	–	–	4	4	7	10	14	17	17	19	20	18
737-700	–	–	–	–	–	–	–	–	–	5	5	16	25
737-800	–	–	–	–	–	–	–	–	–	–	–	2	6
747-200/300	8	9	9	11	8	8	6	5	5	5	–	–	–
747-400	–	–	–	–	–	1	1	–	–	–	–	–	–
767-200/300	13	15	16	18	18	19	19	23	23	18	17	17	12
777-200	–	–	–	–	–	–	–	–	–	–	–	–	2
ERJ-145	–	–	–	–	–	–	–	6	11	11	20	18	15
DC-8F	–	3	3	–	–	–	–	–	–	–	–	–	–
DC-10-30/-30F	12	15	12	10	10	10	10	10	10	3	2	3	3
MD-11	–	2	6	9	10	10	16	18	20	21	13	16	14
Fokker F100	2	4	9	14	17	20	28	30	39	39	39	50	48
ATR-42	–	–	–	1	1	3	3	7	10	10	11	14	14
Cessna Caravans	–	–	13	21	27	37	46	45	45	46	45	10	7
EMB-110	45	41	37	31	29	29	44	38	34	34	15	13	8
EMB-120	8	12	12	16	17	22	23	30	27	27	31	29	18
DH Dash-8	–	3	5	5	4	3	–	4	4	2	–	–	–
Fokker F27	19	12	12	8	9	8	8	6	6	6	2	3	3
Fairchild FA22	6	5	5	4	4	3	3	3	3	3	–	–	–
Fokker F50	–	–	2	6	6	16	19	19	15	15	17	10	–
Lockheed Electra II	14	14	12	1	–	–	–	–	–	–	–	–	–
Total Jets	**136**	**173**	**145**	**153**	**155**	**163**	**185**	**207**	**239**	**229**	**232**	**285**	**284**
Total Trbprops	**92**	**87**	**98**	**93**	**97**	**121**	**146**	**152**	**144**	**143**	**121**	**79**	**50**
Total	**228**	**260**	**243**	**246**	**252**	**284**	**331**	**359**	**383**	**372**	**353**	**364**	**334**

Notes: Cessna Caravans includes Grand Caravans — Trbprops = turboprops — EMB-110 = Bandeirante, EMB-120 = Brasília

Source: Department of Civil Aviation Statistical Yearbooks.

2.1. The necessity of fleet-renewal: TAM and VASP

The majority of the aircraft in group 2 are either very old (25+ years in operation) or relatively old (+13 years in operation). Although the age of an aircraft does not directly represent a safety concern, it certainly point towards several disadvantages in the airlines' daily operations, such as a higher fuel consumption, higher rate and cost of maintenance, higher level of noise and gas emissions, lower level of service to passengers (noise, outdated interiors, etc.), plus the smaller number of passengers carried.

This put, any process of fleet renewal of a given airline must constitute a relevant part of the financial projections of the company, in fact being a part within the vital long-range strategic planning done by any carrier. However, in the wake of some particular situations, airlines are practically forced to incur in a fleet renewal or a fleet "replacement" process (not necessarily renewal, but can be combined with). The latter can be exemplified by what has happened with TAM and its Fokker F100s in 2002/2003.

The Dutch-built F100 was acquired in the beginning of the 90s (see Table 1) and was extremely important for TAM's history, not only because it marked the introduction of the jet age in the airline, but that it introduced the jet service in the Rio–São Paulo air bridge (Ponte-aérea/shuttle Rio–São Paulo). This move by TAM forced VARIG, VASP and Transbrasil (then operating as a pool, with VARIG Lockheed Electra turboprop aircraft) not only to discard the Electras from the route, but also to review their strategic position as a pool, which would soon terminate.

Entering service in various major and medium-size cities, the F100 proved to be the workhorse of the airline. Pictured everywhere in TAM's ads and aviation magazines in Brazil, the F100 was associated directly with the airline's new image of modernity. Unfortunately the crash of an aircraft departing from downtown São Paulo/Congonhas (SBSP/CGH) airport in an early morning flight of the Rio–São Paulo air bridge in October 1996, caused the death of all passengers and crew onboard plus several people on the ground. The cause of the crash was determined as beginning in a major malfunction of the starboard engine thrust reverser control devices, prompting it to deploy during the critical take-off run at Congonhas, then worsened by the crew's inability to interpret the on-board computer reactions to minimize the problem. The crew's fight with the on-board computer reactions was a the decisive cause of the crash. The image of the airline was scratched not only due to the horrible accident itself, but also due to the particular flight, which was routinely used by important businessmen, government officials and politicians travelling from São Paulo to Rio.

The following year, when TAM began overcoming the accident in São Paulo, a passenger died when she was literally blown away of another F100 during a flight from São José dos Campos to São Paulo, when a depressurization of the passenger cabin occurred following the detonation of a home-made bomb by a nearby-seated passenger (as reported). Even being a non-aeronautical cause, the accident reactivated the negative public view of the aircraft. At the time these two accident occurred,

TAM stated that it would only return the fleet of F100s if the leasing contracts were not renewed satisfactorily. However, for the unfortunate of the carrier, five year later, in August 2002, on the very same day, two F100 were involved in two emergency landings: one in the Campinas/Viracopos International Airport (SBKP/VKP) and another in a countryside location, both in the state of São Paulo. With the public (mainly business passengers) shifting mostly to VARIG and Gol flights when knowing that a F100 was the assigned aircraft for any given route, TAM decided to anticipate the aircraft replacement. In fact, this replacement was only planned to begin in 2005, but as the serious accidents unfolded and prompted a major negative reaction of the flying public, the company was forced to rethink its strategy. In 2002 the airline decided to return 21 F100 aircraft, out a total of 50.

An airline whose particular situation practically demands an urgent fleet renewal is VASP. The company was once synonymous of new technology when in it brought to Brazil the first Boeing 737-200 Advanced to operate in South America, in 1969, and in 1986 the first 737-300 (then a new model of the 737 family). Regarding the 737-200s, some aircraft are approaching their useful life when analyzed by the number of cycles. Presently, VASP's fleet is composed by three old-version A300s, four 737-300s (mainly operated in the Rio–São Paulo air bridge) and twenty of those veteran 737-200s. Not only due to the nearing end of their operational and economic lives, VASP's 737-200s are noisy Stage 2 aircraft, which should be phased out completely by 2010, as recommended by ICAO.

Complementarily, the airline is aware that the operational limit of the mentioned aircraft will be around the year 2005, since the necessary investments to adapt the aircraft to environmental demands of neighboring airport communities, plus the necessary structural maintenance will turn the operations economically unviable. In reality, the problems associated with the Boeing 737-200s do not affect only VASP, but also VARIG, the other operator in the country.

A major solution for this complex almost-entire-fleet-renewal problem for VASP may come in the form of capturing investments to lease or even acquire brand new models from the Embraer 170/175/190/195 family beginning in 2004 or early 2005 at the latest. This alternative will be briefly explored in a forthcoming section.

2.2. A New Breed of Medium-capacity Single-aisle aircraft

According to analyses conducted by Boeing (2002), the Latin-American market should account for 2100 of the 24.000 jets that the market should acquire in the next 20 years, in a package worth some US$107 billion. This confirms current Brazilian airlines' situation, where almost 65% of the aircraft operating in scheduled passenger transport in the country are in the 100–150 seat range, with an average age of 20 years (DAC, 2002).

In the aircraft market renewal, Airbus Industries announced in 1981 that it would develop an aircraft for short/medium routes, with a 150-seat capacity. After the official launch of the A320 program, in

1984, the first prototype of the aircraft flew in February of 1987, receiving aeronautical certification in February of 1988. The A320 came as a reference in technology, being the first commercial airplane to be completely operated by fly-by-wire, plus the side-stick in replacement of the usual central column stick. With the configuration, the A320 cockpit layout resembled more a F-16 fighter jet than a commercial aircraft. After reprogramming some of the software packages related to the fly-by-wire flight controls, Airbus experienced several successes from the A320 family. In fact, the opportunities of the basic design are such that the manufacturer has built an entire family of twin jets around it: the A321 (a slightly larger aircraft, with a 7-meter fuselage stretch capable of seating 185 passengers in a two-class configuration); the A319 (the slightly smaller derivative of the A320, with a 4-meter fuselage shortening and capable of seating 124 passengers in a two-class layout); and the A318, the smallest member of the family, with a 107-seat configuration in its common internal layout. Clearly, with the launch of the A318 program in the late 90s, the European manufacturer was aiming the "large regional jet" (LRJ) niche market, with aircraft to fill in the need to replace Fokker F100/F70s, 737-200s, and DC-9s/MD-80s worldwide.

Boeing's prompt response to the outgrowth of the A320 family was a far superior successor of the widely known and also greatly successful 737-300/-400/-500 series: the 737-NG (New Generation). The 737-NG can be treated almost as a new family, with its models –600/-700/-800/-900. This family have larger, more aerodynamic wings (25% more area) optimized for higher fuel efficiency, higher speed and higher cruising altitudes, plus more efficient and more powerful CFM56 engines. Moreover, the 737-NGs also have larger fuel capacity, averaging 30% more than the –300/-400/-500 series, paving the way for transcontinental flights and even making it a contender for the lower-end of the ETOPS certification.

As a simplification, one could assume that the –600 model is the natural replacement for the 737-500s and other similar aircraft, while the –700 would replace the –300, the –800 would be a natural substitute for the –400, while the –900 would fit into a "new" market for the family, almost coming as close to a "short 757".

In Brazil, airlines operate with the two manufacturers: TAM operates A319 and A320, respectively 13 and 24 aircraft, while VARIG currently operates 2 Boeing 737-800s and 5 –700s (as January, 2003). Exploring the Southwest-led fleet commonality for low-cost/low-fare carriers, Gol operates an all-Boeing fleet comprising 22 737-NG aircraft (eighteen –700s and four –800s).

2.3. The Regional Jets

The Regional Jet (RJ) phenomenon began in the U.S. as a follow-on to the successes from the turboprops used by the regional and commuter carriers code-sharing with or subcontracted by the majors and nationals. In the beginning used simply as feeder and to link secondary and tertiary cities to the main hubs dominated by the majors, first the turboprops and then the RJs are now under the spotlight with its present darling role of hub bypassing. As mentioned above, the RJs success was

directly derived from the turboprops' own success, being the former much more praised by the flying public for its speed, comfort and sense of safety and modernity. In fact, the RJs were designed to be an efficient yet affordable (in terms of operations) replacement for the turboprops.

Motivated by the success of RJs in the 30–60 seat range and foreseeing a necessity for airplanes to fill the gap between these aircraft and the 737-600/-700 or the A320/319 family, the four main aircraft manufacturers have heavily invested in the "larger regional jet" (LRJ) concept. This entirely new family of aircraft will be in the 70-120-seat range, with an extremely positive market ahead (see forecasts on Table 3). The first attempt came from Bombardier with an outgrowth of its successful CJ700 (a 64-seater), turning it into the CJ900 (90-seater), as already in service with the Mesa Air Group (as of May, 2003).

Table 2 – Regional Jet Order Book by the Two Largest Manufacturers (as of December/2002)

Manufacturer/Aircraft	Delivered	Backlog	Firm orders	Options	Total
Bombardier	775	423	—	—	1198
CRJ100	226	0	—	—	226
CRJ200	463	206	—	—	669
CRJ440	18	57	—	—	75
CRJ700	68	130	—	—	198
CRJ900	0	30	—	—	30
Embraer	623		374	560	1557
ERJ135/140/145/145XR	623	—	256	352	1231
Embraer 170/175/190/195	0	—	118	208	326

Notes: Data as Dec. 31, 2002 – Embraer data does not reflect impact of the Swiss International order renegotiation – Table column key exactly as appears in source – Data does not contemplate an order for 100 170/190s placed by LetBlue in June, 2003.

Source: Bombardier Aerospace and Embraer, via Air Transport World, May/2003.

Table 3 – Regional Jet Deliveries Forecast

Seats per aircraft	2003-2012	2013-2022	2003-2022
30 – 60	1745	1765	3510
61 – 90	1175	1415	2590
91 – 120	1090	1420	2510
Totals	**4010**	**4600**	**8610**

Source: Embraer, via Air Transport World, May/2003.

In the race for the most efficient and most appropriate model to fill the gap cited above, Embraer will probably take a very comfortable position as it is, by now, the sole of the four major

manufacturers (other being Boeing, Airbus and Bombardier) that have developed a totally new design and not an outgrowth of a smaller version (as Bombardier) or, on the contrary, a shortened version of a larger aircraft (such as Boeing with its 737-600 and Airbus with its A318). The Brazilian manufacturer new family is the Embraer 170/175/190/195 (in the 70, 76, 90, 96-108 seat range respectively).

It is important to point that both Boeing and Airbus, with shortened versions of the "not-really-designed-nor-developed-for-regional-jet-service" 737-NGs, Boeing 717 (formerly McDonnell-Douglas MD-85) and A318s, are direct competitors to Embraer's 190/195 models (or vice-versa, as the latter aircraft are still to be produced). It is also important to complement that only the Embraer jets were specifically developed and designed from the drawing boards to be a "large regional jet", this being one of its main advantages over the much heavier competitors' models. However, when bringing to light the relevancy of fleet commonality, an airline may prefer ordering the Airbus A318 or the Boeing 737-600 instead of the Embraer 190/195 simply because it already has other members of the European or the North-American family in the fleet. This is exactly what TAM is considering: the airline has manifested interest in acquiring A318s to replace Fokker F100s. On the other hand, JetBlue, an all-Airbus low-cost/low-fare operator in the U.S., ordered 100 Embraer 170/190 in early June, in a contract worth around US$3 billion.

Complementarily, when considering a major fleet renewal, Embraer with its totally new family of 170/175/190/195s could end up composing the entire fleet of a given small or midsize carrier. VASP's current fleet of veteran 737-200s in their 110-or-so seat configuration is a particular potential candidate for a complete modernization with the new Embraer twin jets. Considering VASP's average load-factor of 50-55%, replacing the old 737s with, for example, a mix of Embraer 170s and 190s would be an extremely interesting solution. In the particular case of VASP, the problem is not with any possible delivery delays of the acquired aircraft (being from any manufacturer); it is the critical financial situation of the carrier that currently blocks any short-range fleet modernization.

Interestingly, several Brazilian aviation professionals say that the new Embraer family is extremely well suited for what they call "first-world operations". The aircraft's embarked avionics and flight characteristics are a pilot's dream, not to mention its airfield performance and reliability in mid-temperatures and cold weather. On the other hand, airlines operating in less-developed or developing countries and without much access to capital, see the new family as extremely costly (US$20+ million the smallest 170) and point that the aircraft would have multiple restrictions if operated in very hot weather and short runways, exactly the cases of almost every non-capital airport in Brazil and in several other developing and less-developed countries. In fact, these aviation professionals argue why Embraer has not yet designed the 170/175/190/195–"Lite" versions, these being a kind of "no-frills" aircraft models of the new family. Time remains to be seen if either Embraer or any other major manufacturer will come any closer to this approach regarding its LRJs.

Table 4 – Profit Improvement – Narrowbody *versus* RJ

Per segment	737-200	50-seat RJ	% change
Revenue (US$)	5,846.23	4,458.90	–24
Expenses (US$)	7,434.88	3,738.00	–50
Operational Income (US$)	(1,588.65)	720.90	n.m.
Margin	–27%	16%	—
Revenue ASM (US$ cents)	0.092	0.167	82
Cost per ASM (US$ cents)	0.117	0.14	20
Yield (US$ cents)	0.144	0.194	35
RPMs (x 1000)	40,669	22,962	–44
ASMs (x 1000)	63,546	26,700	–58
Load factor (%)	64	86	22 pts.
Passengers	76	43	–33

Source: An unidentified U.S.-based major airline, via Air Transport World, May/2003.

3. THE SOUTHEASTERN AIRPORTS FOCUSED

There are approximately 746 public aerodromes registered in Brazil (ROTAER, 2002). The Department of Civil Aviation (DAC), the Brazilian Federal Airport Authority (INFRAERO), states, cities and a few private consortiums are responsible for the management of these public airports. According to Institute of Civil Aviation (IAC) data, 74,456,117 passengers passed through all the 65 airports managed by INFRAERO, being 9,352,856 from international flights and 64,423,933 flying domestically. To demonstrate its importance throughout the system, INFRAERO's airports are responsible for 95% of the total volume of passengers indicated above.

The regional and geographical division of the country is defined by the Brazilian Institute of Geography and Statistics (IBGE), being Brazil presently divided into 5 regions: North, Northeast, Southeast, South and Center-West. Table 5 depicts the territorial distribution and the regions' differences regarding its social-economic power (and consequent political influence).

Table 5 – Geographical Regions of Brazil

Region	Relative area of Brazil (%)	Aerodromes	Gross Internal Product (in US$ millions)	Population
Center-west (CO)	18.87	99	20,700	11,636,728
North (N)	45.25	129	14,289	12,900,704
Northeast (NE)	18.25	171	42,121	47,741,711
South (S)	6.77	133	56,670	25,107,616
Southeast (SE)	10.86	214	187,156	72,412,411
Total	**100**	**746**	**321,390**	**169,799,170**

Sources: ROTAER (April, 2002) and IBGE (via www.ibge.gov.br)

3.1. The choice of the Southeast Region of Brazil – The Importance of Four Airports

Major historical settlements founded by the Portuguese (including turning Rio de Janeiro the country's capital until the 60s, leaving Salvador behind), combined with prosperous mining, agricultural and cultural activities during the 18th and 19th centuries, and more recently the heavy industrialization, were the main reasons for the Southeast to become the most populated and richer region of Brazil. As can be seen in Table 5, population distribution in Brazil is not proportional to the geographical size of each region. This combined resulted in a socioeconomic inequality of the country through a mega-development of the Southeast in contrast with the North, Center-West and Northeast regions. Airport implementation and infrastructure development would not be contrary to this reality: out from the total of 64,423,933 passengers flying domestically, nearly 32% used either one of the four major airports located in the downtown areas of the four capitals of the Southeast region (São Paulo, Rio de Janeiro, Belo Horizonte and Vitória).

3.1.1 Congonhas (downtown) Airport – City of São Paulo, state of São Paulo (SP)

Congonhas (CGH/SBSP) is the second largest airport in passenger volume. It can be said that Congonhas functions almost as a hub for both TAM and Gol, concentrating and distributing traffic originating from of cities of several Brazilian states. Nowadays it is processing approximately 29,000 passengers a day, traveling through 52 different destinations dispersed throughout the country. However, the airport is operated under a series of air side capacity restrictions, while also having serious surface access limitations. This is the direct consequence of the airport being engulfed by the largest and most important city in the country. Back when it was opened to the first flight, in the 30s, Congonhas was no where near the city, its neighbors being far apart farms with its crops and cows. Nowadays, its privileged city-center location is hated by the surrounding communities and beloved by the airlines and thousands of businessmen, politicians and government officials that have to fly routinely to São Paulo.

Congonhas Infrastructure Summary:

- Runways: 17L/35R (1,940 x 49 m) and 17R/35L (1,435 x 49 m), not capable of simultaneous operations.
- Apron area: ~130,000 m^2 — Parking Positions for 26 Aircraft.
- Passenger Terminal operational area: 13,102m^2.

3.1.2 Santos Dumont (downtown) Airport – City of Rio de Janeiro, state of Rio de Janeiro (RJ)

Rio de Janeiro/Santos Dumont airport (SDU/SBRJ) is the fifth busiest airport in Brazil in terms of passengers. The main connection to/from SDU is to São Paulo/Congonhas through the Rio–São Paulo shuttle (*ponte-aérea*), the main route in the country. The other most important links to/from SDU are to Belo Horizonte/Pampulha (PLU/SBBH) also in the SE region and to Brasília (BSB/SBBR), the country's capital.

In the beginning of the 90's the airport experienced a major modernization of its operations: the introduction of jet service by TAM (Fokker F100s) and by the VARIG/VASP/Transbrasil pool right after (737-300s). Before these aircraft entered service, the Ponte-aérea had been operating the Lockheed Electra II turboprops (in VARIG colors) for 18 years. In just a few months, fourteen Electras were replaced by ten 737-300s, combining a substantial increase in capacity (from the 90 seats in the Electra to the 132 seats in the 737s) with a slight reduction in flight time (the flight became 7-10 minutes faster, in average).

Santos Dumont Infrastructure Summary:

- Runways: 02R/20L (1,323 x 42 m) and 02L/20R (1,260 x 30 m), not capable of simultaneous operations.
- Apron area: ~65,000 m^2 — Parking Positions for 15 Aircraft.
- Passenger Terminal operating area: 4,952 m^2.

3.1.3 Pampulha (downtown) Airport – City of Belo Horizonte, state of Minas Gerais (MG)

The airport began its activities as a technical stop in the flights of the Military Airmail, in 1933, in the then-called "Linha do São Francisco" ("San Francisco Route", named after the river São Francisco that extends from the Northeast region all the way through the state of Minas Gerais) linking Rio de Janeiro (then capital of Brazil) to Fortaleza. In 1937 this technical stop in Belo Horizonte was transformed into a routinely-flown link to Rio de Janeiro, at the time operating the twin-engine Lockheed 10E Electra I, with a two-men crew and the capacity for six passengers.

Beginning in the early 70s, already under INFRAERO management, Pampulha airport (PLU/SBBH) grew steadily with the development of air transport in the country and particularly in the Southeaster region. Soon, the already community-engulfed airport could not satisfactory support the increasing demand and the need for new services, mainly international flights. In view of this, the Ministry of Aeronautics (through INFRAERO) decided to finance and buitd a new airport, to be located far away from growing Belo Horizonte. The Confins/Tancredo Neves International Airport (CNF/SBCF) was opened in January 1984, being considered at the time one of the most modern facilities in Brazil. A few months after opening, the new international airport registered about 75% of the movement of aircrafts and 95% of the passengers in the Belo Horizonte area.

For the desperation of the surrounding communities and for INFRAERO itself, Pampulha started to regain one flight after the other, starting from 1986 with the creation of the direct flights among the downtowns of the cities, linking the downtown airports of Rio, São Paulo, Belo Horizonte and Brasilia (the then-called VDCs or "Vôos Diretos ao Centro", standing for "Direct Flight to the Center"). The picture got even worse with the multiplication of jet services during the 90s, where Pampulha completely outpaced Confins in passenger and aircraft served. This reflected the consequences of the majority of businessmen, politicians and government officials traveling to/from Belo Horizonte preferring to fly to/from downtown Pampulha than to/from distant Confins

International. Today, the later airport is even called a "white elephant", being one of the most underused sites in the country, despite being a top-level international facility.

Pampulha Infrastructure Summary:
- Runway: 13/31 (2,540 x 45 m).
- Apron area: 36,456 m^2 — Parking Positions for 8 Aircraft.
- Passenger Terminal operational area: 4,500 m^2.

3.1.4 Vitória International Airport – City of Vitória , state of Espírito Santo (ES)

According to INFRAERO data, there are presently 74 aircraft daily in the airport, with eight airlines operating almost a million passengers per year. The number of passengers transported in January of 2002 was the largest of the airport's history to date: 104,781 passengers, a number 20% higher if compared with January 2001.

Vitória International (VIX/SBVT) registers one of the highest rates of growth in the country, with 12% per year, well above the national average of 8%. With the recent discovering of a great number of highly potential oil fields near the coast of the state of Espírito Santo, the opportunities for an even higher growth of the state's economy may push forward a major modernization of the airport. In fact, INFRAERO has already a draft project to review the airport master plan, where a second runway would be added along a new passenger terminal building and new cargo facilities.

Vitória International Infrastructure Summary:
- Runway: 05/23 (1,750 x 45 m).
- Apron area: 24,360 m^2 — Parking Positions for 6 Aircraft.
- Passenger Terminal operational area: 3,294 m^2.

3.2. Major Links to/from the Four Airports

In Brazil, the number of frequencies and the schedule of each given flight are defined for DAC, by the scheduled airlines, under bulletins called *Hotran* (for "Horário de Transporte", or Schedule of Transports). The capacity of any given flight (or route, when all *Hotrans* of that route are summed up) vary according to the number of frequencies, the size and configuration of the aircraft used by the airline(s) and specified in the *Hotran* document.

According to the manufacturers (Boeing, 2002), airlines (should) acquire airplanes to fly specific routes in view of their market and demand forecast studies. Therefore, Tables 6 through 9 will present the destinations flown by the scheduled airlines in their routes to/from each of the four depicted airports, pointing the percentage of each equipment type used in a given airport for a week.

Table 6 – Destinations to/from Congonhas Airport (CGH), in 2002

City/Destination	No. of flights per week	737-200	737-300	737-500	737-700	737-800	A319	A320	F100	ERJ145	ATR 42
Araraquara	18										18
Araçatuba	12								12		
Araxá	6									6	
Belém	28	7				7		7	7		
Belo Horizonte	196		11	67	33			73	2	10	
Brasília	223	14	15	32	41	7		88	26		
Bauru	18								18		
Campo Grande	53		7	6	13		13	7	7		
Criciúma	16								16		
Corumbá	7								7		
Curitiba	232		7	49	33			114	29		
Caxias do Sul	41			17					24		
Cuiabá	52		7	6	13		6	14	6		
Pres. Prudente	23										23
Manaus	21				7			14			
Florianópolis	65		14	11	7	14		6	13		
Fortaleza	41				20		7	14			
Rio de Janeiro (GIG)	80				22	14		21	23		
Goiânia	72	7			38			7	20		
Ilhéus	34			14				20			
Santana do Paraíso	10									10	
Imperatriz	6								6		
Juiz de Fora	19										19
João Pessoa	7							7			
Joinville	47			31					16		
Campinas	13						7		6		
Londrina	51							19	7	25	
Marabá	7								7		
Marília	23										23
Maceió	1		1								
Macapá	21	7				7		7			
Navegante	55			29	7			12	7		
Santo Ângelo	6									6	
Natal	7		7								
Porto Alegre	185		7	54	26	7		48	31	12	
Passo Fundo	6									6	
Porto Seguro	14			7				6	1		
Recife	42		7		14	7		14			
Rio de Janeiro (SDU)	593		286	6	75		202			24	
Ribeirão Preto	65							20	16	29	
São Luis	6								6		
São José do Rio Preto	28							14	7		7
Salvador	115		1	23	28	14	35	7	7		
Comandatuba	2						1	1			
Uberlândia	69								39	30	
Uberaba	29									11	18
Varginha	12										12
Vitória	61		7	13	12			6	23		
Canoas	6										6
Chapada Diamantina	2			2							
Mucuri	3										3
Ji-Paraná	6								6		
Total flights (per week)	2755	35	377	367	389	77	271	546	395	169	129
Equipment market share (%)	100%	1%	14%	13%	14%	3%	10%	20%	14%	6%	5%

Source: SGTC – Sistema de Gerenciamento de Torres de Controle (April 2002)

Table 7 – Destinations to/from Santos Dumont Airport (SDU), in 2002

City/Destination	No. of flights per week	737-200	737-300	737-500	737-700	737-800	A319	A320	F100	ERJ145	ATR 42
Belém	14				7		7				
Pampulha	136		7	56	19				52	2	
Brasília	136		7	6	61		46		10	6	
Campo Grande	5		5								
Curitiba	45		7		27					11	
Cuiabá	5		5								
Florianópolis	2		2								
Campinas	63		7		34				11	11	
Maringá	6				6						
Macapá	7						7				
Porto Alegre	15		2	6						7	
Petrolina	6									6	
Recife	7				7						
Ribeirão Preto	5								5		
São José dos Campos	13			6						7	
São Paulo	588		286	6	74		202			20	
Uberlândia	6									6	
Vitória	96		7	30	20				25	14	
Total flights (per week)	1155	—	335	110	255	—	262	—	103	90	—
Equipment market share (%)	100%	—	28%	10%	22%	—	23%	—	9%	8%	—

Source: SGTC – Sistema de Gerenciamento de Torres de Controle (April 2002)

Table 8 – Destinations to/from Pampulha Airport (PLU), in 2002

City/Destination	No. of flights per week	737-200	737-300	737-500	737-700	737-800	A319	A320	F100	ERJ145	ATR 42
Brasília	84	7		25	12			14	16	5	5
Curitiba	13								13		
Fortaleza	7				7						
São Paulo (GRU)	5										5
Gov. Valadares	15										15
Santana do Paraíso	30									10	20
Campinas	39				14				13	12	
Montes Claros	16									6	10
Natal	7	7									
Poços de Caldas	5										5
Palmas	5									5	
Porto Seguro	7								7		
Recife	14	7			7						
Rio de Janeiro (SDU)	136		7	55	19				53	2	
São Paulo (CGH)	200		12	61	41			75	1	10	
Salvador	27	7		7					7	6	
Uberlândia	16								11		5
Vitória	84	7			13				12	47	5
Araguaiana	5									5	
Total flights (per week)	715	35	19	148	113	—	—	89	133	108	70
Equipment market share (%)	100%	5%	3%	20%	16%	—	—	12%	19%	15%	10%

Source: SGTC – Sistema de Gerenciamento de Torres de Controle (April 2002)

Table 9 – Destinations to/from Vitória International Airport (VIX), in 2002

City/Destination	No. of flights per week	737-200	737-300	737-500	737-700	737-800	A319	A320	F100	ERJ145	ATR 42
Belo Horizonte	84	7			13				12	47	5
Brasília	27	7			7				13		
Boundaries	5	5									
Criciúma	5								5		
Curitiba	7				7						
Fortaleza	7								7		
Rio of Janeiro (GIG)	28	7							11		10
São Paulo (GRU)	18	7							11		
Gov. Valadares	5										5
Joinville	5								5		
Campinas	18				7				11		
Maringá	6				6						
Montes Claros	6									6	
Maceió	7	7									
Porto Seguro	1								1		
Recife	7	7									
Rio de Janeiro (SDU)	96			29	27				25	15	
Ribeirão Preto	5	5									
São Paulo (CGH)	69		14	13	13			6	23		
Salvador	24	14							4	6	
Petrolina	7								7		
Total flights (per week)	437	66	14	42	80	—	—	6	135	74	20
Equipment market share (%)	100%	15%	3%	10%	18%	—	—	1%	31%	17%	5%

Source: SGTC – Sistema de Gerenciamento de Torres de Controle (April 2002)

4. THE IMPACT ON THE INFRASTRUCTURE

4.1 Options for Direct Aircraft Replacement

According with the links listed in the previous tables, there are ten different types of aircraft operating in the domestic scheduled market in the four Southeast airports depicted. Among these ten types, 50% can be labeled as "new aircraft" (less than 10 years of service), while the other remaining 50% can be treated for simplicity as "old aircraft" (10+ years of service). In view of this, after interviewing several government and airline officials, and academics involved in air transport issues, ideas of what possible future replacements could be managed by the Brazilian carriers and their current operational fleets emerged. These opinions are depicted on Table 10:

Table 10 – Possible Replacement for Several Aircraft in Use by Major Brazilian Carriers (2002)

Aircraft to be replaced (*)	Possible Replacement Aircraft (*)	Difference in seating capacity	Motivation and/or Justification
737-200 (95)	737-600 (110) * *	+ 15%	Aims in maintaining the overall dimensions (wingspan and length) in order to simplify airport planning (same aircraft planning group), while permitting the fleet modernization. Individual airlines should study fleet commonality and associated technical aspects in order to determine what type/family/manufacturer it would ultimately chose for the envisioned fleet modernization.
	A318 (107)	+ 13%	
	ERJ 190-100 (98)	+ 3%	
737-500 (110)	737-700 (126) * *	+ 14%	
	A319 (124)	+ 13%	
737-300 (128)	737-800 (162) * *	+ 26%	
	A320 (150)	+ 17%	
Fokker F100 (108)	A318 (107)	– 1%	TAM is the only operator of that aircraft (F100) in Brazil, and because of fleet standardization, it could most probably opt to transition to the smallest aircraft of the A320 family.
ATR-42 (48)	ERJ-145 (50)	+ 4%	Several routes now been operated by turboprops could transition to jets, given that the airports depicted herein are capable of operating the new aircraft. Being Embraer a Brazilian manufacturer and as its aircraft are already flying everywhere in the country, a natural choice would be replacing these turboprops with ERJs (financial and or other capital-related issues not addressed here).

Notes:

(*) Number of passengers with typical configuration, according to manufacturer's data.

(**) For simplification and comparative results, the aircraft with the largest capacity was chosen.

Source: Table elaborated by the authors, after consultations with Brazilian aviation experts..

4.2 The Apron

The apron dimensions are directly related to the dimensions of the aircraft that will be operated in that facility. In short, lengths, wingspans, wheel-bases and ground envelopes will determine the separation distances among the aircraft themselves, the turning and taxi tracks, plus the separation of the parked aircraft to the passenger and cargo terminals, just to mention a few examples.

For planning proposes, aircrafts are classified in groups by physical (dimensions) and operational characteristics. This classification distributes several aircraft inside a same group. For example, aircraft inside of a certain wingspan strip they are grouped in a single letter. The standards for aircraft group classification was set forth by ICAO and they were published in Annex 14, the official ICAO recommendation for Airport Planning (Standards for Configuration and Operations of Aerodromes).

This paper assumes, for simplification of the airport planning studies, that the future number, the position and the group of aircraft that operate in a given airport will not be different from the present day, only the types/variants/models of aircraft will be a matter of substitution (see Tables 10 and 11). Therefore the planning groups presently in use by the airport authority in Brazil to overlook the airport master plan will be maintained to make possible a better analysis regarding operation of the aircraft mentioned herein. In view of this, Table 11 presents possible new configurations of the four listed airport aprons as the operating airlines opt to invest in a fleet renewal process.

Table 11 – Aircraft on the Apron in 2001 and the new Configuration Proposed (%)

		737 200	737 300	737 500	737 600	737 700	737 800	A318	A319	A320	F100	ERJ 145	ATR 42
Santos Dumont (RJ)	2001	-	28	10	-	22	-	-	23	-	9	8	-
	Proposed	-	-	-	-	32	28	9	23	-	-	8	-
Vitória (ES)	2001	15	3	10	-	18	-	-	-	1	31	17	5
	Proposed	-	-	-	15	28	3	31	-	1	-	22	-
Pampulha (BH)	2001	5	3	20	-	16	-	-	-	12	19	15	10
	Proposed	-	-	-	5	36	3	19	-	12	-	25	-
Congonhas (SP)	2001	1	14	13	-	14	3	-	10	20	14	6	5
	Proposed	-	-	-	1	27	17	14	10	20	-	11	-

Source: Table elaborated by the authors based on the airports' master plan data.

The aircraft compatibility – because of being from the planning group – makes possible a smoother transition regarding the impacts on the apron. However in some cases, the operation of the new equipment can generate significant effects in the planning parameters, mainly in safety and security.

To reach more specific results of that impact on the apron, a meticulous analysis of the physical characteristics of the equipments (particular aircraft-type dimensions) is required.

4.3. Passenger Terminals

To make the capacity of a passenger terminal compatible with demand is one of the main roles of the airport management. The capacity of an airport should be able to grow in response to the most effective and flexible form of management. Unfortunately, airport expansion limitations are

enormous in several cases and very difficult to be implemented in its desired, original overall concept. Within this complex situation lies the necessity of planning far ahead, in the long-range mode (it is not uncommon to plan for 20-30 years, but yet very difficult to predict mainly the technological advances that could be incorporated in this period). One of these difficulties is the necessity of airlines renewing their fleets with modern, sometimes an "unthinkable" aircraft 15-20 years in the past (the Airbus A380 and the now-shelved Boeing Sonic Cruiser are examples of this kind of aircraft, just as the 747 and the Concorde were in the mid-to-late 60s).

As in other areas of the airport, the passenger terminal can be related to a level of service that it provides. According to IATA (International Air Transport Association), the level of service is considered as a limit of values or an evaluation of the ability of supplying the demand combining amount and quality of the services, for consequence respecting the desired (predicted/planned) comfort and convenience of the terminal for the passengers (present and future demands, as forecasted in appropriate studies for that matter). Therefore a great difficulty exists in establishing a quantifiable relationship between available space and level of service.

To allow a comparison in large-scale, between the several systems and sub-systems of an airport, while still reflecting the dynamic nature of passenger demand (seasonal peaks, for example), IATA established a measure of variation in the level of service of a passenger terminal, ranging from "A" to "F" (Table 12). IATA recommends level "C" as the minimum required to offer a satisfatory-to-good level of service, with of reasonable implementation/operation costs.

Table 12 – Levels of Service for Planning Purposes according to IATA (square meters per passenger)

Terminal Area / Level of Service	A	B	C	D	E	F
Check-in area	1.8	1.6	1.4	1.2	1.0	UNACCEPTABLE
Circulation area	2.7	2.3	1.9	1.5	1.0	
Departure gates/lounges	1.4	1.2	1.0	0.8	0.6	
Baggage claim areas (arrival)	2.0	1.8	1.6	1.4	1.2	
Primary Recommended Totals (m^2/pax)	7.9	6.9	5.9	4.9	3.8	

Legend (levels of service):

A = Excellent. Free flow and excellent comfort level

B = High. Flow stable, few delays and high comfort level.

C = Good. Stable flow, acceptable delays and good comfort level.

D = Appropriate. Flows unstable, small delays and appropriate comfort level.

E = Inadequate. Unstable flows, unacceptable delays and inadequate comfort level.

F = Unacceptable. Crossed flows, unacceptable delays and unacceptable comfort level.

Source: IATA, Airport Development Reference Manual.

In the present study, in order to develop a brief analysis of the passenger terminals' situation regarding a possible comprehensive fleet renewal by Brazilian major airlines, and its possible impacts in the four Southeast airports herein highlighted, three scenarios were elaborated based on Department of Civil Aviation official statistical data:

- **Scenario 1** – The load factor of the aircraft involved will be the average of 2001 (base year) and the fleet will continue the same (in other words: 2001 demand; 2001 fleet/capacity);
- **Scenario 2** – The load factor of the aircraft involved will be the average of 2001 (base year) and the fleet will be renewed (2001 demand; new fleet, as proposed)
- **Scenario 3** – The load factor of the aircraft involved will increase (targeted year in the future = 2006) and the fleet will be renewed, as proposed (new demand [increased]; new fleet).

(Note: According to DAC data, traffic in Brazil has grown 62.2% from 1997-2001; for simplicity, this growth was extrapolated to the 2001-2006 period in this study. This extrapolation, here depicted in Scenario 3, is more conservative than the original DAC data for its "most favorable" scenario).

The first step for the application of the proposed Scenarios will be the determination of the number of passengers that will be carried by the new proposed aircraft. These numbers were calculated based on the weekly use of each equipment (see Tables 6 to 9), thus generating more data. With the numbers of the possible future volumes of passengers, Scenarios 1 through 3 were generated for each of the four airports herein listed:

4.3.1 São Paulo/Congonhas Airport

Table 13-A – Weekly participation of aircraft and total of proportional passengers used per equipment – CONGONHAS
(Considering the apron in its full capacity of 26 aircraft)

Equipment	% Apron Today (Table 11)	Actual Pax	% Apron Proposed (Table 11)	Proposed Pax
737-200	1	25	—	—
737-300	14	466	—	—
737-500	13	372	—	—
737-600	—	—	1	29
737-700	14	459	27	885
737-800	3	126	17	716
A318	—	—	14	389
A319	10	322	10	322
A320	20	780	20	780
F100	14	393	—	—
ERJ-145	6	78	11	143
ATR-42	5	62	—	—
Total	100	3083	100	3264

Notes:

% Apron Today = Apron percent usage by an aircraft in a period of one week. (base = 2001).

% Apron Proposed = Proposed apron percent usage by an aircraft in a period of one week.

Actual Pax = A proportional number of passengers that now uses certain equipment for a weekly use (proportion between apron use and the full capacity of the aircraft).

Proposed Pax = A proportional number of passengers that will use certain equipment for a weekly use (proportion between apron use and the full capacity of the aircraft).

Table 13-B – Proposed Scenarios for Congonhas/CGH

	Scenario 1	Scenario 2	Scenario 3
Average load-factor (per equipment)	63.57% (*)	63.57%	100% (**)
Passengers carried	1960	2075	3264
Average no. of passengers per aircraft	75	80	126
Square meters per passenger	6.69	6.31	4.01
Level of service	C	C	F

Notes:

(*) Data obtained from the DAC Statistical Yearbook.

(**) Load-factor in base-year 2001 with the increment of 62.2% (increase of demand without considering increasing the number of frequencies).

Square meters per passenger = Actual passenger terminal operational area divided by total passengers calculated.

Level of service "F" denotes urgent need for passenger terminal expansion.

4.3.2 Santos Dumont Airport/Rio de Janeiro downtown

Table 14-A – Weekly participation of aircraft and total of proportional passengers used per equipment – SANTOS DUMONT (Considering the apron in its full capacity of 15 aircraft)

Equipment	% Apron Today (Table 11)	Actual Pax	% Apron Proposed (Table 11)	Proposed Pax
737-200	—	—	—	—
737-300	28	538	—	—
737-500	10	165	—	—
737-600	—	—	—	—
737-700	22	416	32	605
737-800	—	—	28	680
A318	—	—	9	144
A319	23	428	23	428
A320	—	—	—	—
F100	9	146	—	—
ERJ 145	8	60	8	60
ATR 42	—	—	—	—
Total	100	1752	100	1917

Notes: See Table 13-A.

Table 14-B – Proposed Scenarios for Santos Dumont/SDU

	Scenario 1	Scenario 2	Scenario 3
Average load-factor (per equipment)	57.14% (*)	57.14%	92.67% (**)
Passengers carried	1001	1096	1770
Average no. of passengers per aircraft	67	73	118
Square meters per passenger	4.95	4.52	2.79
Level of service	D	E	F

Notes:

(*) Data obtained from the DAC Statistical Yearbook.

(**) Load-factor in base-year 2001 with the increment of 62.2% (increase of demand without considering increasing the number of frequencies).

Square meters per passenger = Actual passenger terminal operational area divided by total passengers calculated.

Level of services "E" and "F" denotes urgent need for passenger terminal expansion.

4.3.3 Pampulha Airport/Belo Horizonte downtown

Table 15-A – Weekly participation of aircraft and total of proportional passengers used per equipment – PAMPULHA
(Considering the apron in its full capacity of 8 aircraft)

Equipment	% Apron Today (Table 11)	Actual Pax	% Apron Proposed (Table 11)	Proposed Pax
737-200	5	38	—	—
737-300	3	31	—	—
737-500	20	176	—	—
737-600	—	—	5	44
737-700	16	161	36	363
737-800	—	—	3	39
A318	—	—	19	163
A319	—	—	—	—
A320	12	144	12	144
F100	19	164	—	—
ERJ 145	15	60	25	100
ATR 42	10	38	—	—
Total	100	813	100	852

Notes: See Table 13-A.

Table 15-B – Proposed Scenarios for Pampulha/PLU

	Scenario 1	Scenario 2	Scenario 3
Average load-factor (per equipment)	45.72% (*)	45.72%	74.16% (**)
Passengers carried	371	390	632
Average no. of passengers per aircraft	46	49	79
Square meters per passenger	6.30	6.00	3.70
Level of service	C	C	F

Notes:

(*) Data obtained from the DAC Statistical Yearbook.

(**) Load-factor in base-year 2001 with the increment of 62.2% (increase of demand without considering increasing the number of frequencies).

Square meters per passenger = Actual passenger terminal operational area divided by total passengers calculated.

Level of services "E" and "F" denotes urgent need for passenger terminal expansion.

4.3.4 Vitória International Airport

Table 16-A – Weekly participation of aircraft and total of proportional passengers used per equipment – VITÓRIA
(Considering the apron in its full capacity of 6 aircraft)

Equipment	% Apron Today (Table 11)	Actual Pax	% Apron Proposed (Table 11)	Proposed Pax
737-200	15	86	—	—
737-300	3	23	—	—
737-500	10	66	—	—
737-600	—	—	15	99
737-700	18	136	28	212
737-800	—	—	3	29
A318	—	—	31	199
A319	—	—	—	—
A320	1	9	1	9
F100	31	201	—	—
ERJ 145	17	51	22	66
ATR 42	5	14	—	—
Total	100	586	100	614

Notes: See Table 13-A.

Table 16-B – Proposed Scenarios for Vitória/VIX

	Scenario 1	Scenario 2	Scenario 3
Average load-factor (per equipment)	47.54% (*)	47.54%	77.12% (**)
Passengers carried	279	292	473
Average no. of passengers per aircraft	46	49	79
Square meters per passenger	10.09	9.63	5.94
Level of service	A	A	C

Notes:

(*) Data obtained from the DAC Statistical Yearbook.

(**) Load-factor in base-year 2001 with the increment of 62.2% (increase of demand without considering increasing the number of frequencies).

Square meters per passenger = Actual passenger terminal operational area divided by total passengers calculated.

5. CONCLUSIONS

Any study involving fleet renewal is already a complex task. This paper has presented, in a simplified approach, some of the possible impacts of a comprehensive fleet renewal conducted by scheduled carriers operating in the Southeastern states over the current infrastructure of four of the major airports in the region (São Paulo/Congonhas, Rio de Janeiro/Santos Dumont, Belo Horizonte/Pampulha and Vitória). As the great majority of the aircraft operated in these airports are medium-sized twin-jets, the study opted to focus primarily these aircraft and their possible replacements.

For this, the study identified the existence of ten different types of aircraft operating in the scheduled domestic market from the four depicted airports. For simplicity, these aircraft were herein separated into two distinct groups: an "old" group with 737-200s, 737-300/-400/-500s, Fokker F100s and ATR-42s; and a "new" group comprising 737-NGs (-700/-800), A319, A320 and Embraer ERJ-145.

The simple fleet renewal pictured in this paper was guided by the principles of fleet commonality, the maintaining of approximately the same overall dimensions, and a possible fleet modernization (in the case of the turboprops). Due to the diversity of the physical and operational characteristics of the aircraft involved, only the relationships among the replaced and replacement aircraft, the apron and the passenger terminal were listed. In fact, due to the maintaining of the overall dimensions (replacement aircraft in the same airport design/planning group of the replaced aircraft), the possible impacts of the fleet renewal proposed over the apron were practically discarded in the present study. However, it must be pointed out that a detailed study should be carried out in order to evaluate existing ramp equipment configuration and compatibility in relation to the proposed replacement aircraft.

In order to permit a broad comparison among the four airports, the level of service indexes recommended by IATA were used to evaluate possible future capacity constrains and passenger comfort levels in the respective passenger terminals. For this, three scenarios were built for each airport, based on the last official data (2001) for passenger volumes. These scenarios give a brief overview of what could happen with the level of service in the four airports' passenger terminals if a +60% increase in demand is confirmed, a comprehensive fleet renewal is carried out, but no terminal expansions are planned. These possible impacts can be summarized:

- São Paulo/Congonhas (CGH/SBSP) is operating on the level of service lower limit (IATA level "C"), and it will maintain the same level with a fleet renewal, despite a small reduction in the relation of square meters/passenger (as shown in Scenario 2). However for a mid-term scenario (Scenario 3), Congonhas' terminal would become unacceptable, as it would reach IATA's level of service "F".
- Rio de Janeiro/Santos Dumont Airport (SDU/SBRJ) is already operating below the desired minimum ("C") as it obtained a level "D" for the present demand. With a major fleet renewal it would get even worse, falling to level "E" (shown in Scenario 2). For the mid-term future (Scenario3), Santos Dumont's passenger terminal would match Congonhas as well, being unacceptable in IATA's indexes (would rock bottom at level "F").
- Belo Horizonte/Pampulha Airport (PLU/SBBH) has also shown that it has already reached its operational limit (level "C" in the present passenger demand data). This level will be maintained with a major fleet renewal, but, as Congonhas, with a small reduction in the square meters/passenger relation (as pointed by Scenario 2). However, just as Congonhas and Santos Dumont, Pampulha will also reach level "F" if the forecasted increase in demand materializes complementarily with the major fleet renewal (Scenario 3).
- Vitória Airport (VIX/SBVT) is a totally different case from the other three airports. It is presently operating under the highest level of service ("A"), and will continue with the introduction of the proposed replacement fleet (as depicted in Scenario 2). Interestingly, if compared with the other airports, Vitória will maintain a level "C" for its passenger terminal even in the event of maximizing demand in the mid-term (Scenario 3).

It is important to observe that the majority of equipment located in an airport or in use by an airport is dimensioned proportionally to the 5, 10 or 20-year forecasted volume of passengers that are processed by the facility. Thus, if capacity and/or level of service problems already do exist in a given passenger terminal, it will certainly impact negatively in several other facilities in the airport site. This put, the present study has demonstrated the relevancy of considering fleet renewal options as an important variable for present and future airport planning in Brazil.

References and Bibliography

AIRBUS INDUSTRY. *Global Market Forecast 2000-2019*. Toulouse, France. 2000.

ARNOULT, S. Flying a Bit Under the Weather. *Air Transport World*, March/2003 – vol. 40, no. 5, pp.38-42, Penton Media Inc. Co. USA. 2003.

AVIAÇÃO EM REVISTA, *Edição 666 – Ano 65*. Aviação em Revista Editora Ltda. Brasil. 2003.

BOEING. *The 2002 Current Market Outlook, Boeing Commercial Airplanes*. Seattle, USA. 2002.

COMANDO DA AERONÁUTICA. Departamento de Aviação Civil – DAC. Instituto de Aviação Civil – IAC. *Movimento Operacional da Rede de Aeroportos da INFRAERO 1979-2001*. Rio de Janeiro, Brasil. 2001.

COMANDO DA AERONÁUTICA. Departamento de Aviação Civil – DAC. *Subdepartamento de Planejamento. Anuário do Transporte Aéreo 2001 – Dados Estatísticos*. Rio de Janeiro, Brasil. 2001.

CUBAS JR., M. *Introdução das Aeronaves de Fuselagem Larga no Aeroporto Santos Dumont – Estudo de Caso*. Rio de Janeiro, Brasil. 2002.

DA SILVA, A. *Aeroportos e Desenvolvimento*, Incaer, Rio de Janeiro, Brasil. 1991.

GAZETA MERCANTIL. *Panorama Setorial do Transporte Aéreo*. Brasil. 1998

IATA. *Airport Development Reference Manual – 8th Edition*. International Air Transport Association. Montreal, Canadá. 1995.

IBGE. *Brasil em Números*. Instituto Brasileiro de Geografia e Estatística. Brasília, Brasil. 2002

ICAO. *Aerodrome design and operations. (Annex 14) – Vol.1*. International Civil Aviation Organization. Montreal, Canadá. 1990.

MALAGUTTI, A. O. *Evolução da Aviação Civil no Brasil*. Consultoria Legislativa, Câmara dos Deputados. Brasília, Brasil. 2001.

MINISTÉRIO DA AERONÁUTICA, Departamento de Aviação Civil – DAC. *Código Brasileiro de Aeronáutica*. Brasília, Brasil. 1986.

PÊGO FILHO, B., *Setor Aéreo e as Empresas Brasileiras: Situação Atual e Perspectivas – Boletim de Conjuntura n°. 59* – IPEA, Brasil. 2002.

TORRES, R. R. *Airport Performance – Desempenho de Aeronaves*. Rio de Janeiro, Brasil. 2002.

Authors' address:

UNIVERSIDADE FEDERAL DO RIO DE JANEIRO
Att.: Prof. Respicio A. Espirito Santo Jr.
Ilha do Fundão, Centro de Tecnologia, Bloco D – sala D209
Departamento de Engenharia de Transportes, DET/EP-UFRJ
Rio de Janeiro, RJ 21945-970
Brasil

respicio@momentus.com.br

respicio@pet.coppe.ufrj.br