IS PLANNING COMPATIBLE LAND USE AROUND LARGE AIRPORTS SUFFICIENT TO AVOID URBAN CONFLICTS? EVIDENCE FROM LARGE AIRPORTS IN NORTH AMERICA AND LATIN AMERICA

Luiz Henrique Werneck de Oliveira
Ph.D. Student – Territory Planning and Management – Federal University ABC (UFABC)
R. Prof. Oswaldo Teixeira, 183 – 05617-020 – São Paulo – SP, Brazil
Phones: +55-11-98193-3691 / 55-11-99507-3503.
E-mail: luizwerneck64@gmail.com

ABSTRACT

Conflicts between airports and their neighbors are inevitable as aviation grows exponentially and urban development increases, including around airports. Intuitively, providing compatible land use zoning in the vicinities of airports would ease such conflict. This paper shows and discusses evidence regarding the land use compatibility neighboring large airports in North America and Latin America. A radial centered model was applied to 66 large airports classifying 16 land use typologies on 16 "*isoareas*" of 3.14 km^2 each. Evidence shows that airports with more compatible land use in their immediate neighborhoods may be as conflict-prone as airports with less compatible land uses.

Keywords: Airports, Cities, Conflicts, Urban Planning, Land Use Compatibility.

1. INTRODUCTION

The conflict between airports and their neighboring areas (and the cities they serve) is inevitable. It opposes users to non-users and demands adjusting distinct objectives, creating new challenges for urban planners. Airports are different from other types of urban equipment that generate opposition from their neighbors as they are capital-intensive infrastructure assets which cause negative impacts (the so-called externalities, such as noise, pollution, safety, congestion on road accesses etc.) that far transcend their boundaries.

Aviation grows exponentially and faster than urban population, which also grows and tends to keep growing in the coming decades, but at a slower pace. Thus, the conflicts between airports and cities tend to intensify.

Intuition leads to an expectation that proper planning vicinities of airport sites, inducing land uses compatible with airport activities, could minimize or even suppress the conflicts. Optimum results would be relief from night-time curfews, unrestricted use of runways and flight paths, and diminishing pressure to close existing urban airports.

However, this article presents evidence that shows otherwise. A survey of 16 different typologies and categories of land-use in 4 km radially centered circles cut into sections of equivalent areas ("*isoareas*" of 3.14 km^2 each) was applied to 66 large airports (with throughput of 10 million passengers per year in 2016) in North America and Latin America. The results show that some airports with more compatible land-use surroundings (parking lots, light industries, warehouses and logistic centers) may be as conflicting as airport surrounded by high density residential areas. Some are subject to restrictions such as night time curfews, night flights quota and ban of noisier aircrafts, limiting their environmental capacity. Nevertheless, this does not necessarily relief pressures for closure or further restrictions.

The article shows a brief literature review addressing the airport versus communities' issue, analyzing airports' impacts and externalities. This is followed by a description of the methodology, the results obtained, their discussion, and conclusions.

2. AIRPORTS AS IMPACT-CAUSING INFRASTRUCTURE ASSETS

Airports are urban and metropolitan infrastructure assets that cause conflicts with their neighbors. While they must be located within a competitive distance to their markets, neighboring land uses may be compatible (or not) with airports' activities. Light industries, warehouses, and parking lots are compatible; hospitals, schools and houses are not.

Intuition leads to the belief that proper land use planning and zoning should minimize or suppress such conflict; however, getting to grips with the problems of how airports impact the communities they serve goes beyond what can be achieved by zoning restrictions.

While earlier airports were developed in urban fringes, they attracted urban growth, and had their neighborhoods encroached by urban development. London-Croydon was one of the first airports to become cramped by its neighborhood, and was closed in 1952 after only 24 years of operation of its first-of-a-kind passengers' terminal. Others, like São Paulo-Congonhas, built in 1936, was surrounded by urban development 30 years later (Beiguelman, 1996). The advent of passenger jet aircrafts in the 1950's boosted the conflict, requiring longer runways, thus making airport sites larger and eventually affecting urban seamlessness.

As capital-intensive infrastructure assets, airports cause economic, environmental and social impacts that far transcend their physical boundaries. Their positive impacts (economic benefits to their users) are diffuse (Button and Taylor, 2000) and inevitably clash with their negative impacts (such as aeronautic noise, urban segmentation, traffic congestion, air, water and soil pollution, loss of natural habitats, loss of property values in their surroundings etc.). By being considered as externalities, these negative impacts are not always fully accounted for (Schipper *et al*., 2001).

Aviation is a growth industry. Figure 1 shows the exponential trend of growth of aviation production (passengers x kilometers) from 1965 to 2015. It is remarkable that, from 2014 to 2015, aviation growth equaled the total production of 1970, while from 2003 to 2015 the total production doubled. Overall, aviation

production in 2015 is 25-fold larger than that of 1965.

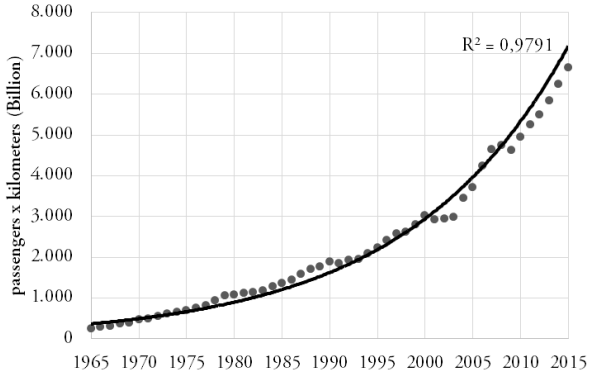


Figure 1: Exponential Trend of Aviation Growth, 1965-2015 (adapted from Airbus, 2016)

As part of aviation industry, airports must develop additional capacity to handle increasing numbers of aircraft movements to accommodate more passengers and cargo. Thereby they become "metastable" (stable in their instability), feeding back the conflict (Fuller and Harley, 2004). Avid for capacity growth, some cities have replaced their original airports with larger, farther ones, in urban-rural transition areas where sufficient land was available (Szurovy, 2003). Some airports remained cramped by urban development, eventually gathered by newer airports, hence creating urban airport systems, such as Chicago's Midway and O'Hare Airports (De Neufville and Odoni, 2003).

And airports became businesses: until the 1960's they were part of State bureaucracy, but from the 1980's onwards they became profitable assets (Doganis, 1992). Capacity expansion became crucial as commercial strategies triggered non-aviation revenue streams (Ashford and Moore, 1999). Airports also became architectural landmarks with strategic importance of intangible value (Gordon, 2004).

Flying became a common means of transportation, and there are millions of people living in one city and flying to work elsewhere. Whole urban communities gravitate around airports (Glaeser, 2011). Connectivity became so important that a new term – aeromobility – has been conceived (Urry, 2009).

Kasarda and Lindsay (2011) call for future cities centered in airports' activities, but neither airports are magnets for money nor are such airport-oriented types of urban arrangements free from criticism (Freestone and Baker, 2011), as there are many factors affecting success or failure of airport development. Tackling neighborhood conflicts though is no longer just "one more problem"; rather, it evolved from "management distraction to a business imperative" (Werneck de Oliveira, 2006).

Airports connect local and global scales (Cidell, 2004; Cwerner, 2009). The failure of welfare-state from the 1970's onwards challenged centralized power of national states (Jessop, 2000) and triggered the importance of city-regions (Purcell, 2007) and world cities (Friedmann and Wolff, 1982). Global cities started competing on one hand, while on the other they partner and cooperate with globalized capital – using their airports as a key tool.

Airports thus became the new crossroads of scale connection – a role that until 18th century belonged to ports, and then partially shifted to railroads during the 19th century and to highways in the 20th century. This new 21st century is the age of aviation and world-class airports as local-global scale connection.

Airports also slowly shifted from national gateways into hub-and-spoke networks that are functionally more interdependent than the network of the cities they serve (De Neufville and Odoni, 2003). For example, Memphis, Tennessee, Anchorage, Alaska, and Louisville, Kentucky are not large North-American cities by means of their population, but their airports rank systematically within the ten busiest air freight hubs in the world. In a symbiotic manner, as airlines gathered forming world agreements (such as *Star-Alliance*, *One World* and *SkyTeam*), airports also formed groups either by "corporatization" or by privatization (Oum *et al*., 2006). This established new performance indicators and changed the governance paradigms to deal with their externalities, now practiced in name of capitalist accumulation rather than by the State on behalf of the people (Gillen, 2011).

Publications on civil aviation externalities remain frequent. There are, however, clear indications that technological development is no longer capable of mitigating aircraft noise much further (Wolfe *et al*., 2017; Kuznetsov, 2003).

Paradigm changes such as code-share deals, airport slot allocation mechanisms (Forsyth, 2007) and use of larger aircraft in

denser routes (Berster *et al*., 2015) gained importance but are unable to prevent that increasing demand for air travel imply in further airport capacity, thus increasing the conflicts.

As per noise – the most perceivable of aviation negativities – airports employ noise contours representing day-night theoretical averages, leaving actual peaks out (Cidell, 2008; Andre, 2004). Noisier aircraft such as early jetliners were phased out or banned, but newer, quieter aircraft are also much more efficient, allowing substantial increase of flights. Indeed, the noise peaks monitored next to airports diminished with time, but the frequency of lesser peaks have not (GAO, 2001).

Graham and Marvin (2001) highlight differentiated, preferential and exclusive access by affluent minorities to the benefits of modern life – as long as they can afford it. Airports tend to magnify such inequalities, as they materialize the key difference between richer and poorer: the former are their frequent users, while the latter are disadvantaged, vulnerable to the externalities. In poorer countries, such logic is even more perverse, as the airport is an exception amid multiple access shortcomings to adequate infrastructure elements. "One person's infrastructure is another's difficulty: urban infrastructure networks [are] *'congealed social interests'*" (Graham and Marvin, 2001, p. 11).

Hence, conflicts between airports and cities naturally intensify (Ayres, 2001), bringing new challenges to urban planners. Over the past decades, planning and zoning instruments changed from the binomial *control and command* character to something more complex, socially built, involving multiple actors (Fainstein and Campbell, 2012), now called "stakeholders" – literally those who hold a stake to protect their interests.

However, planning literature has no handbook of how each city should deal with its airport – not even in terms of land use zoning. Although *Collaborative Planning* (Healey, 2003) is mentioned by somewhat successful Australian planners (Baker and Freestone, 2012), Australian experience in managing such conflict is not trouble-free (Freestone and Baker, 2010).

Even as the incorporation of airports in urban planning is a long call to planners (Ryerson, 2016), the evidence of conflicting trends is by no means new: in 1967 a former president of IATA already considered aircraft noise as a key element to be considered in airport planning (Hammarskjöld, 1967), while even during aviation infancy (before World War II) some authors were worried about how to deal with such conflicting land use planning issues (Rau Jr., 1930; Albers, 1940).

The belief that the problem can be tackled by urban planners alone is naïve and dangerous: when airports are replaced by larger, farther and newer ones, they postpone or transfer the conflict. On the other hand, airports have killed cities, as Los Angeles International (LAX) did with Surfridge and part of Westchester (Erie, 2004; Gordon, 2004; Kasarda and Lindsay, 2011), and as Paris-Charles De Gaulle did with Goussainville Viex-Pays, where dozens of houses were bought out and walled up by the airport (Houdry and Houdry, 2000) as the urban landscape around its heritage-protected 14th century medieval church could not be modified by bringing the houses down.

While (for the time-being) there are examples of successfully suppressing the conflict – such as Hong Kong's Chek Lap Kok replacement of legendary Kai Tak Airport, and Oslo's Gardermoen replacing the ill-fated Fornebu airport, both in 1998 – emblematic conflict cases still remain. Tokyo-Narita development was wildly violent at times (Bowen, 1975), while the effort to build a new airport for Mexico City (Mastny, 2002) come and go in ebb-like moves. Conflicts such as the development of additional runway capacity in England's southeast remain uncertain, possibly reviving the conflicting path faced by BAA during the enquiries of London Heathrow's Terminal 5 (Egan and Wilson, 2002). In Los Angeles' Metropolitan Area, El Toro airport development has been prevented by ingenuous strategies by citizens against it (Erie, 2004). Last but not least, Berlin remains without a world-class airport as Berlin-Brandenburg's "*schadenfreude*" continues: after the functional issues are resolved, noise insulation of thousands of houses will have to be addressed (Delius, 2017).

Assuming these conflicting trends will not continue seems unwise. As Knut Hammarskjöld put it, back in 1967: "these problems cannot be ignored in the hope that they will go away".

3. METHODS

Based on the author's database with information from some 900-plus large airports, a sample was selected with 66 North-American and Latin American airports with passengers' throughput larger than 10 million per year in any year of the past two decades.

Each airport's neighborhood was mapped in Google Maps® (2017). Mosaics of screen images were selected, cropped and pasted with MS PaintShop® into MS PowerPoint® files. The airports' sites boundaries were drawn, defined upon visibly assumed physical limits. A radial centered sectoring model was pasted atop such images, centered in the middle of the airport site or, if adequate, at coinciding point of geographical reference (latitude and longitude coordinates).

Figure 2 shows the radial centered model with its North-South and an East-West lines passing through the center. The inner circle (0 to 2 km radius) was split into 4 sectors at 90° lines, while the outer ring (2 to 4 km radius) was split into 12 sectors at every 30° lines, thus resulting 16 area sectors ("*isoareas*") of 3.14 km^2 each, totaling 50.24 km^2 for the survey. Sectors were named as C1-S"i" ("i" = 01 to 04) or C2-S"j" ("j" = 01 to 12), numbered clock-wise from the North line from the radius center.

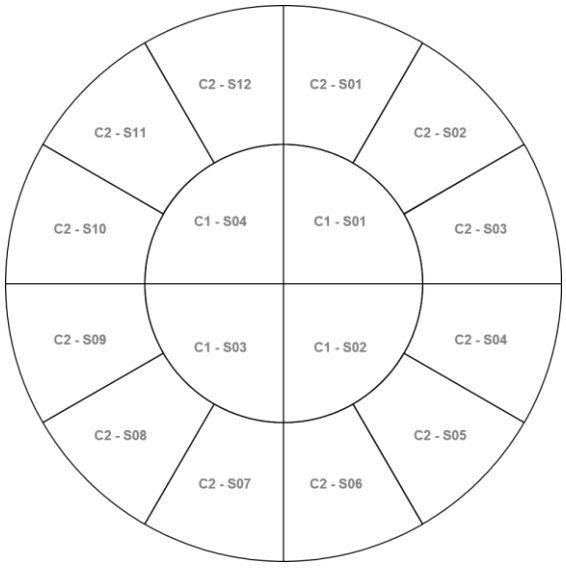


Figure 2: Radial Centric Model with 16 "*isoareas*" of 3.14km^2 each

Figure 3 shows an example of such radial centered model overlaid to São Paulo-Congonhas Airport, São Paulo, Brazil.



Figure 3: Radial Centered Model applied to São Paulo Congonhas (CGH/SBSP) Airport, Brazil

Four main land-use typologies were defined depending on the territorial land use: (a) airport sites (coded "A"); (b) masses of water (coded "W"); (c) rural areas (coded "R"); and (d) urban areas (coded "U"). These typologies were subdivided into more specific categories of land use, as shown on Table 1. An MS Excel® spreadsheet was prepared for each sector or "*isoarea*" C"n"-S"i". A summing spreadsheet in the same file was prepared for the inner circle, a second for the outer ring and a third summing these two. Each line of the spreadsheet corresponded to one airport of the sample.

The interpretation of land use typologies and categories was visual. The 16 categories of land uses were identified in terms of percentage of the each "*isoarea*", ranging from 2.5% to 100%. There was no formal metrics for the definition of polygons, as no Geographical Information System (GIS) tools were employed at this moment. To improve visual definitions, the "zoom" tool of Google Maps® was used, and to allow understanding construction types, the "street view" tool was also often employed.

The survey and classification of land use in the 16 categories was thus developed for the 66 airports for the inner circle (C1, 0-2 km) and the first ring (C2, 2-4 km).

Table 1: List of Types and Categories of Land Uses Surveyed

Typology		Category	
Code	**Description**	**Code**	**Description**
A	Airport Site	A1	Airport Site (airport under analysis)
		A2	Other Airport Site (non-adjacent to airport under analysis)
W	Mass of Water	W1	Ocean, Sea or Bay
		W2	River or estuary
		W3	Natural Lake or Artificial Reservoir
		W4	Unoccupied Island (on sea, estuary, lake, mangrove, sand beds etc.)
R	Rural Area	R1	Forests, Wooded Terrain, Bushes (darker green)
		R2	Fields and Pastures (light green)
		R3	Agricultural and Crop Areas (visible plantations, yellow or brown shades)
		R4	Naked land, exposed soil, deserts, empty rural areas (yellow or grey - if urban)
U	Urban Area	U1	High density areas, multi-story buildings - with adjacent parking lots
		U2	Medium density areas, 2-3 stories maximum, attached houses in small or medium sized lots, including condominium with limited wooded areas
		U3	Sparsely occupied residential areas, fully detached houses in big lots with trees (American suburbs or Latin America Villas)
		U4	Large roofs (shopping centers, hospitals schools), warehouses (industrial or logistics), parking lots (including car rental yards)
		U5	Urban Parks, golf courses, large gardens, urban woods, cemeteries, urban river wetlands fully inserted within urban areas
		U6	Urban infrastructure: roads, highways, ramps, road interchanges (including grassed areas within ramps), railways and rail yards, water and wastewater treatment plants, landfills, recycling facilities, thermal power plants, port terminals (containers, tank farms etc.) and oil refineries

As all images were interpreted and land uses in the two rings were classified, the totals for each "*isoarea*" and concentric circle/ring (C1 and C2) were summed in typologies "A", "W", "R" and "U", with additional subtotals for categories "U1", "U2" and "U3" (less compatible with airport activities) and "U4", U5" and "U6" (more compatible with airport activities).

Each of these sums, as well as the passengers' throughputs of all the 66 airports were then organized ("ranked") from 1 to 66 for patronage (2016 and 2015 data) and for typologies "A", "W", "R" and "U". The latter was also ranked for its 6 categories, and for the sums of the subtotals above stated in the target columns of the spreadsheet.

4. RESULTS

The criterion of selecting North- and Latin-American airports with more than 10 million passengers per year (MPax/y) resulted in 66 airports – 49 in North America and 17 in Latin America. Patronage data may vary depending on the source; for the United States, data from the Bureau of Transport Statistics was used (BTS, 2017); other countries' data are from airport authorities' and airports' websites). Two Latin American airports very close to the threshold (Rio de Janeiro Santos-Dumont and Panama City-Tocumen) and two which are no longer over 10 MPax/y (Belo Horizonte-Confins and Campinas-Viracopos) were included. Caracas-Maiquetia had no data for 2016, but was also included. On the same token, in North America, the sample included three airports which are no longer major hubs (Cincinnati-Northern Kentucky, Cleveland-Hopkins, and Pittsburgh), which used to process more passengers in the past than they currently do. All other airports of the sample processed more than the 10 MPax/y thresholds in 2016.

Table 2 shows the summed percentages of land uses for all 66 airports for each of the 16 "*isoareas*" for typologies/categories "A", "W", "R" and "U4", "U5" and "U6" (more compatible with airport activities) and of the categories "U1", "U2" and "U3" (less compatible with airport activities).

Table 3 summarizes the rankings of the all results obtained, ordered by the sum of categories potentially less compatible with airport activities ("U1" + "U2" + "U3").

Table 2: Percentage of the sums of the "*isoareas*" by Typology/Category with Potentially More ("A", "W", "R", "U4", "U5", "U6") and Less ("U1", "U2", "U3") Compatible Land Uses up to 4 km radius from Airport Site Center

Country	City	Airport	MPax/year		Sum of Airport Site ("A")	Sum of Water Masses ("W")	Sum of Rural Areas ("R")	Sum of Urban Areas "U4" + "U5" + "U6"	Sum of Urban Areas "U1" + "U2" + "U3"
			2016	2015					
Argentina	Buenos Aires	Aeroparque Jorge Newberry	11.66	11.05	5.63	44.27	0.00	30.63	19.48
		Ezeiza - Ministro Pistarani	9.80	9.13	33.75	0.00	49.06	8.85	8.33
Brazil	Brasília	Juscelino Kubitchek	17.95	19.33	43.44	0.31	19.90	16.46	19.90
	Belo Horizonte	Confins - Pres. Tancredo Neves	9.63	10.99	21.98	0.42	60.83	1.46	15.31
	Campinas	Viracopos	9.32	10.12	23.85	0.31	43.65	11.98	20.21
	Rio de Janeiro	Galeão - Antonio Carlos Jobim	16.00	15.39	27.60	37.81	10.21	9.17	15.21
		Santos Dumont	9.05	9,52	4.69	59.06	0.00	10.52	25.73
	São Paulo	Congonhas	20,73	19.28	6.88	0.00	0.00	10.21	82.92
		Guarulhos - Gov. A. F. Montoro	36.60	38.99	37.08	0.00	10.63	15.31	36.98
Chile	Santiago	Com. Arturo Merino Benitez	19.19	17.23	34.38	0.42	47.50	15.94	1.77
Colombia	Bogotá	El Dorado	31.04	29.96	31.35	1.56	16.77	15.42	34.90
Mexico	Cancun	Cancun	21.42	19.60	32.60	0.73	60.42	3.54	2.71
	Guadalajara	Dom Miguel Hidalgo Castilla	11.36	10.04	23.85	0.31	43.85	5.31	26.67
	México	Benito Juarez	41.41	39.30	25.21	0.94	1.77	16.15	55.94
Panama	Panamá	Tocumen	9.69	9.09	20.94	0.00	41.56	4.17	33.33
Peru	Lima	Jorge Chavez	19.32	17.56	17.60	1.77	22.08	16.56	41.98
Venezuela	Caracas	Maiquetia - Simon Bolivar	N.A.	20.94	14.48	27.50	35.10	5.83	17.08
Canada	Calgary	Calgary	15.68	15.48	50.83	0.94	14.06	22.50	11.67
	Montreal	Pierre Elliot Trudeau	16.62	15.51	39.58	4.48	0.42	44.48	11.04
	Toronto	Pearson	44.33	41.04	50.21	0.00	0.73	45.83	3.23
	Vancouver	Vancouver	22.29	20.49	45.73	20.63	5.94	13.65	14.06
United States	Atlanta	Hartsfield-Jackson	100.99	98.73	53.02	0.10	3.44	28.33	15.10
	Austin	Bergstrom	12.14	11.54	48.02	0.83	26.77	16.88	7.50
	Baltimore	Baltimore-Washington Int'l	24.51	23.25	39.38	0.00	6.77	29.38	24.48
	Boston	Logan	35.42	32.70	26.35	39.90	0.00	14.06	19.69
	Charlotte	Charlotte-Douglas	42.95	43.86	50.73	0.42	22.60	20.94	5.31
	Chicago	Midway	22.09	21.64	10.94	0.63	0.42	33.23	54.79
		O'Hare	74.98	72.65	73.85	0.21	2.08	17.60	6.25
	Cincinnati	Northern Kentucky	6.49	<10.00	54.90	1.98	22.71	16.04	4.38
	Cleveland	Hopkins	8.01	<10.00	24.27	0.10	18.75	31.56	25.31
	Dallas	Dallas-Fort Worth	62.57	63.23	87.81	0.00	3.96	8.02	0.21
		Love Field	15.07	14.06	22.71	4.48	3.85	29.58	39.38
	Denver	Denver	56.46	52.48	83.23	0.00	15.00	1.77	0.00
	Detroit	Detroit - Wayne County	33.66	32.51	60.52	1.15	21.25	10.63	6.46
	Ft Lauderdale	Hollywood	28.48	26.14	27.92	4.79	3.65	35.94	27.71
	Honolulu	Honolulu	19.16	18.96	50.83	17.60	0.00	19.17	12.40
	Houston	George Bush Intercontinental	40.04	41.25	69.06	0.52	20.83	6.46	3.13
		William P. Hobby	12.56	11.87	26.25	0.73	13.44	27.92	31.67
	Kansas City	Kansas City	10.71	10.24	50.83	0.00	43.75	4.90	0.52
	Las Vegas	McCarran	44.78	43.27	38.44	0.00	5.73	31.04	24.79
	Los Angeles	LAX	79.08	72.77	35.83	5.73	4.38	28.54	25.52
	Miami	Miami	40.77	41.14	39.58	3.75	0.10	23.13	33.44
	Minneapolis	Minneapolis-St. Paul	36.13	35.32	39.27	10.21	13.02	19.27	18.23
	Nashville	Nashville	12.63	11.39	46.46	0.00	23.33	9.58	20.63
	New Orleans	Louis Armstrong	11.03	10.62	22.92	6.88	14.38	23.96	31.88
	New York	John F. Kennedy	58.57	55.99	52.92	20.52	4.79	7.81	13.96
		La Guardia	29.42	25.59	11.88	30.83	0.73	22.40	34.17
	Newark	Liberty	39.55	37.31	33.96	4.27	1.04	45.42	15.31
	Oakland	Metropolitan Oakland	11.83	11.00	36.77	30.83	0.00	22.81	9.58
	Orlando	Orlando	40.62	36.68	70.31	2.50	12.29	12.08	2.81
	Philadelphia	Philadelphia	29.06	30.19	40.00	15.94	14.69	23.13	6.25
	Phoenix	Sky Harbor	41.78	42.69	30.94	0.00	5.10	46.88	17.08
	Pittsburgh	Pittsburgh	7.83	<10.00	37.29	0.10	35.42	11.04	16.15
	Portland	Portland	18.33	16.69	35.94	27.19	1.04	18.23	17.60
	Raleigh; Durham	Raleigh-Durham	10.71	9.88	29.69	3.33	44.79	16.04	6.15
	Sacramento	Sacramento	10.12	9.82	33.65	3.75	59.06	3.33	0.21
	Salt Lake City	Salt Lake City	22.36	21.23	59.48	0.94	19.69	13.23	6.67
	Saint Louis	Lambert	13.53	12.33	31.56	0.00	1.98	33.75	32.71
	San Diego	San Diego - Lindberg Field	20.63	19.95	13.85	23.44	2.19	35.63	24.90
	S. Francisco	San Francisco	51.56	48.60	32.71	34.48	0.10	14.79	17.92
	San Jose	Norman Y. Mineta	10.66	9.65	15.63	0.00	2.19	51.67	30.52
	Santa Ana	John Wayne	10.50	10.18	9.69	1.04	3.65	55.94	29.69
	Seattle	Sea-Tac	43.78	40.34	28.13	1.77	0.73	28.54	40.83
	Tampa	Tampa	18.27	18.23	37.60	8.13	0.83	31.98	21.46
	Washington	Dulles	21.22	20.83	62.08	0.00	10.73	20.73	6.46
		National - Ronald Reagan	22.74	22.46	11.88	28.44	0.10	27.50	32.08

Table 3: Ranking of the Results by Passengers' Throughput and Predominant Typology/Category of Surrounding Land Use (Ordered by the Potentially Less Compatible with Airport Activities – "U1" + "U2" + "U3")

Country	City	Airport	MPax/year		Ranking (airports ordered from 1 to 66)													Compatibility	
					MPax/y		Typologies/Categories											Less	More
			2016	2015	2015	2016	A	W	R	U	U1	U2	U3	U4	U5	U6		U1+U2+U3	U4+U5+U6
Brazil	São Paulo	Congonhas	20.73	19.28	36	33	64	66	66	1	1	3	19	58	30	29		1	52
Mexico	México	Benito Juarez	41.41	39.30	15	13	48	36	49	5	21	1	48	49	11	37		2	37
USA	Chicago	Midway	22.09	21.64	28	30	62	40	57	2	28	2	49	10	42	4		3	10
Peru	Lima	Jorge Chavez	19.32	17.56	39	35	56	30	17	15	4	6	52	26	48	34		4	35
USA	Seattle	Sea-Tac	43.78	40.34	14	10	43	29	54	6	29	11	5	28	2	33		5	18
USA	Dallas	Love Field	15.07	14.06	45	44	53	22	41	7	26	8	12	8	40	26		6	15
Brazil	São Paulo	Guarulhos - Gov. A. F. Montoro	36.60	38.99	16	18	29	60	32	25	8	5	51	29	43	56		7	42
Colombia	Bogotá	El Dorado	31.04	29.96	23	22	40	31	23	26	7	9	53	41	16	60		8	41
USA	New York	La Guardia	29.42	25.59	25	23	60	6	53	17	6	10	54	23	26	17		9	27
USA	Miami	Miami	40.77	41.14	12	14	22	24	60	18	17	21	6	18	27	24		10	23
Panama	Panamá	Tocumen	9.69	9.09	63	59	55	64	10	30	39	4	50	60	62	58		11	62
USA	Saint Louis	Lambert	13.53	12.33	46	45	39	62	48	8	30	15	15	13	3	22		12	9
USA	Washington	National - Ronald Reagan	22.74	22.46	27	27	61	8	59	13	9	31	4	21	6	15		13	21
USA	New Orleans	Louis Armstrong	11.03	10.62	53	52	52	18	26	19	34	7	43	14	51	18		14	22
USA	Houston	William P. Hobby	12.56	11.87	47	47	47	39	28	14	32	14	17	7	50	49		15	20
USA	San Jose	Norman Y. Mineta	10.66	9.65	60	55	57	65	46	4	11	17	18	2	36	13		16	2
USA	Santa Ana	John Wayne	10.50	10.18	55	56	63	33	42	3	12	18	20	1	28	8		17	1
USA	Ft Lauderdale	Hollywood	28.48	26.14	24	25	44	20	43	10	22	20	16	17	25	2		18	7
Mexico	Guadalajara	Dom Miguel Hidalgo Castilla	11.36	10.04	57	51	51	47	7	40	16	12	55	54	57	65		19	60
Brazil	Rio de Janeiro	Santos Dumont	9.05	9.52	61	62	66	1	61	33	2	38	41	59	24	38		20	51
USA	Los Angeles	LAX	79.08	72.77	2	2	32	19	39	22	36	13	56	19	31	3		21	17
USA	Cleveland	Hopkins	8.01	<10.00	64	63	49	51	22	16	33	62	1	9	20	40		22	12
USA	San Diego	San Diego - Lindberg Field	20.63	19.95	33	34	59	11	45	12	14	19	25	11	23	5		23	8
USA	Las Vegas	McCarran	44.78	43.27	9	8	26	59	36	20	5	26	23	6	39	30		24	13
USA	Baltimore	Baltimore-Washington Int'l	24.51	23.25	26	26	24	58	34	23	23	16	42	15	14	20		25	16
USA	Tampa	Tampa	18.27	18.23	38	39	27	17	52	24	37	33	13	12	7	27		26	11
USA	Nashville	Nashville	12.63	11.39	49	46	18	57	14	42	45	51	2	43	56	51		27	53
Brazil	Campinas	Viracopos	9.32	10.12	56	61	50	46	9	39	43	22	28	33	53	57		28	48
Brazil	Brasília	Juscelino Kubitchek	17.95	19.33	35	40	20	45	20	32	18	54	3	57	4	25		29	36
USA	Boston	Logan	35.42	32.70	20	20	46	3	63	36	10	23	57	55	34	10		30	44
Argentina	Buenos Aires	Aeroparque Jorge Newberry	11.66	11.05	50	50	65	2	62	27	3	44	38	64	1	7		31	14
USA	Minneapolis	Minneapolis-St. Paul	36.13	35.32	19	19	25	16	29	31	40	35	14	44	9	19		32	30
USA	S. Francisco	San Francisco	51.56	48.60	7	7	37	5	58	37	24	28	26	35	33	46		33	43
USA	Portland	Portland	18.33	16.69	41	38	31	10	50	34	41	42	8	32	22	45		34	32
Venezuela	Caracas	Maiquetia - Simon Bolivar	N.A.	20.94	30	66	58	9	12	51	13	25	59	63	55	16		35	59
USA	Phoenix	Sky Harbor	41.78	42.69	10	12	41	63	37	9	27	27	33	3	15	31		36	3
USA	Pittsburgh	Pittsburgh	7.83	<10.00	65	64	28	50	11	46	25	47	7	40	61	39		37	49
USA	Newark	Liberty	39.55	37.31	17	17	34	23	51	11	31	29	39	20	32	1		38	5
Brazil	Belo Horizonte	Confins - Pres. Tancredo Neves	9.63	10.99	52	60	54	44	1	59	59	48	9	65	60	61		39	66
Brazil	Rio de Janeiro	Galeão - Antonio Carlos Jobim	16.00	15.39	44	42	45	4	33	48	50	24	58	42	59	55		40	54
USA	Atlanta	Hartsfield-Jackson	100.99	98.73	1	1	10	49	44	29	38	32	31	16	29	11		41	19
Canada	Vancouver	Vancouver	22.29	20.49	32	29	19	12	35	44	47	52	10	50	21	44		42	45
USA	New York	John F. Kennedy	58.57	55.99	5	5	11	13	38	53	20	30	60	53	44	50		43	57
USA	Honolulu	Honolulu	19.16	18.96	37	37	12	14	65	41	44	34	37	36	18	21		44	31
Canada	Calgary	Calgary	15.68	15.48	43	43	13	35	27	35	15	37	36	30	10	36		45	26
Canada	Montreal	Pierre Elliot Trudeau	16.62	15.51	42	41	23	21	56	21	35	63	11	4	19	23		46	6
USA	Oakland	Metropolitan Oakland	11.83	11.00	51	49	30	7	64	38	42	36	45	22	17	43		47	25
Argentina	Buenos Aires	Ezeiza - Ministro Pistarani	9.80	9.13	62	58	35	61	4	57	57	39	40	48	49	48		48	55
USA	Austin	Bergstrom	12.14	11.54	48	48	17	37	13	49	51	43	32	47	37	9		49	34
USA	Salt Lake City	Salt Lake City	22.36	21.23	29	28	8	34	21	55	55	50	21	38	46	32		50	46
USA	Washington	Dulles	21.22	20.83	31	32	6	54	31	45	48	53	22	37	8	28		51	29
USA	Detroit	Detroit - Wayne County	33.66	32.51	21	21	7	32	18	58	58	46	29	39	58	47		52	50
USA	Philadelphia	Philadelphia	29.06	30.19	22	24	21	15	25	43	46	40	61	45	13	6		53	24
USA	Chicago	O'Hare	74.98	72.65	3	3	3	48	47	50	52	41	62	27	52	14		54	33
USA	Raleigh; Durham	Raleigh-Durham	10.71	9.88	58	54	42	26	6	52	53	45	34	34	38	35		55	38
USA	Charlotte	Charlotte-Douglas	42.95	43.86	8	11	15	42	16	47	49	55	27	31	12	41		56	28
USA	Cincinnati	Northern Kentucky	6.49	<10.00	66	65	9	28	15	54	54	59	24	24	47	52		57	39
Canada	Toronto	Pearson	44.33	41.04	13	9	16	56	55	28	19	61	30	5	5	12		58	4
USA	Houston	George Bush Intercontinental	40.04	41.25	11	16	5	41	19	61	61	58	35	51	64	63		59	58
USA	Orlando	Orlando	40.62	36.68	18	15	4	27	30	60	60	49	63	46	35	53		60	47
Mexico	Cancun	Cancun	21.42	19.60	34	31	38	38	2	63	63	56	44	61	63	59		61	63
Chile	Santiago	Com. Arturo Merino Benitez	19.19	17.23	40	36	33	43	5	56	56	57	64	25	45	54		62	40
USA	Kansas City	Kansas City	10.71	10.24	54	53	14	55	8	64	64	60	65	56	65	62		63	61
USA	Dallas	Dallas-Fort Worth	62.57	63.23	4	4	1	52	40	62	62	64	46	52	54	42		64	56
USA	Sacramento	Sacramento	10.12	9.82	59	57	36	25	3	65	65	65	47	66	41	64		65	64
USA	Denver	Denver	56.46	52.48	6	6	2	53	24	66	66	66	66	62	66	66		66	65

5. DISCUSSION

The sample of large airports is comprised of 49 North American and 17 Latin American airports, yielding a 2.88:1 ratio. Of the top ten airports ranked with more compatible land use in their vicinities, 8 are in North America and only 2 are in Latin America (4:1 ratio). On the other hand, of the top 10 airports ranked with less compatible land use in their vicinities 5 are in North America and 5 in Latin America (1:1 ratio).

This leads to the thought that North American cities were more successful than Latin American ones to produce compatible land uses surrounding their airports, but it does not mean that this is sufficient to suppress the conflict between these airports and the cities they serve. On the contrary: within the sample, two airports – one at each continent – are subject to full night curfews (Santa Ana-John Wayne in the United States – processing 10.5 MPax/y – and São Paulo-Congonhas, in Brazil, processing 20.73 MPax/y in 2016). Many North American airports are also subject to other restrictions such as full ban or night curfew for older and noisier Stage 2 aircraft, which may still fly unrestrictedly in Latin America. Most North American airports have Noise Abatement Departure Procedures (NADP), which are rare in Latin America. Also, in terms of litigation, North American airports such as Los Angeles International are a well-known target, while law suits against Latin American airports are not well-documented (there is little or no information regarding pro-communities' settlements).

There are, however, cases in both continents of airports proposed by authorities and rejected by the affected communities and other stakeholders such as airlines, which often oppose such change as well (GAO, 1995) in a way that they failed to materialize.

The only case involving physical violence in the sample, though, is the attempt of developing a new airport for Mexico City in San Salvador Atenco in 2002 (Mastny, 2002). All other conflicts were settled either by arbitration (court sentences), mediation (facilitated agreements) or conciliation (natural agreement between parties, without the need of external help or ruling). Such settlements, however, are either weak or temporary; hence these conflicts resurface whenever additional capacity is needed.

The sampling criterion considering large airports those processing more than 10 MPax/y resulted in a well-sized number of North American airports (39), but reduced the Latin American to 17 airports. This criterion was made flexible; otherwise, the sample would be further unbalanced, comprising 36 airports from North America and only 12 in Latin America.

Should the threshold criterion be revised to include, for example, all airports processing more than 10% of the passengers' throughput of the busiest airport in each continent, the North American sample would remain large (36 airports), but the Latin American sample would increase from 17 to 30 airports, possibly enriching the survey.

Specific factors regarding the precision and reproducibility of the methodology are also discussed herein.

There is no precision to the definition of the limits of the airport sites, neither to their reference center. Visually choosing the center of the sites probably affected the results.

The visual classification of land uses into the 4 typologies is adequate, but into the 16 categories may have induced errors (apparently relatively small), which could be corrected using geo-referenced tools such as GIS software superposed to satellite images.

The different ages, quality and occurrence of clouds in the satellite images from Google Maps® may also marginally influence the results, especially in Latin American airports, where images had lower resolution.

Classifying urban areas into "U2" and "U3" involves practical difficulty and eventual subjectivity. The identification of areas with more vertical, multi-story buildings ("U1") also has subjectivities, as it is hard to identify the boundaries between high-rise buildings and less dense single- or double-story adjacent houses and condominiums, which may share gardened areas and parking lots.

In North American cities, there is often a well-defined concentration of high rise buildings ("U1") in the so-called "business districts", whereas in some Latin American cities (São Paulo, Rio de Janeiro and Buenos Aires) there is a trend of finding many high-rise residential buildings ("U1") in relatively small urban plots in the vicinities of their more urban, downtown airports.

The inclusion of hospitals and schools in the "U4" category and of sanitary landfills and recycling facilities in "U6" may mistakenly result in classifying these land uses as "more compatible" while they should be otherwise classified in new, specific "less compatible" categories in future surveys. The same can be said to adding another urban category for empty plots (here considered as "R4", causing confusion between rural and urban areas with small influence in the results). Urban empty plots have uncertain future in terms of compatibility with airport activities, as they may be converted to high-rise buildings. As these subcategories are not so numerically common, this has apparently affected the results rather marginally.

These comments indicate that although promising, the methodology can be improved by revising the classification categories in urban areas. Also, its precision can be further increased using GIS tools in the future.

On the other hand, residential categories such as "U1", "U2", and "U3" are not always less compatible with airport activities when considered in a radial-centered model such as the one herein employed. They tend to be a lot less compatible if they are aligned with the airports' runways and or take-off and approach flight paths. However, when sideways to (and sufficiently apart from) airports' runways, this relative proximity may not be a fully negative factor; on the contrary, they may be important feeding markets for airports, supplying them with passengers and/or workers. Nevertheless, residential areas even when farther than 4 km from busy runways may be highly impacted by airport operations, should they be aligned to the runways or under busier flight paths.

Also, residents near large airports fear negative impacts of airports other than aircraft noise, such as safety. Although the number of aircraft accidents impacting man-made structures outside airports is very low, future surveys locating them could enrich the analysis of airports' impacts in their vicinities.

The radial-centered model with a 4-km radius is probably not sufficient to represent the conflict in terms of land use and zoning. It was chosen as a first-step approach to further research and it must be improved to reach more conclusive findings. This calls for using sectoring other than the radial centered, considering the alignment of the runways.

Using noise contours-oriented areas may not be the best alternative, as they are not available or do not use the same methodology in all airports of the sample. Furthermore, their indication of compatibility is criticized by some experts (Cidell, 2008; Andre, 2004).

As air operations close to airports are somewhat linear, runway-aligned, rather than radial, a modified radial model could be applied. Instead of North-oriented, it could be phased at a 45º angle of the dominant runway alignment, thus creating two sets of quarter-circles' "bow-tie" shapes – one set aligned with the runway direction and the other phased out from it (dis-aligned, sideways).

The question arising from such further methodological step would be if the two non-consecutive circle quarters' ("bow-tie") aligned with the runway have land uses that are more compatible with airport activities than the dis-aligned additional "bow-tie" area, literally sideways to the runway alignment.

Another enhancement would be expanding the radius from 4 km to 10 km.

However, its application on airports with multiple runway alignments could be difficult, resulting in double counting of many of the "*isoareas*", leaving little or no neighboring compatibility area in the cases of airports with perpendicular crossing runways.

The origins of the conflicts between areas with less compatible uses and the airports' activities also deserves more specific research.

In this sense, it is worth noting that North American airports such as Los Angeles International (LAX) are among those with most severe litigation cases with their neighbors (Kasarda and Lindsay, 2011). Nearby, Santa Ana-John Wayne is practically

the only large airport in the United States subject to night time curfew, and Los Angeles Metropolitan Area experienced a legal battle involving the rejection of a new airport in 2002, when the development of El Toro as a new alternative airport to LAX lost the ballot elections which decided the area be otherwise dedicated to a large park (Erie, 2004).

If such complex litigation cases are not common in Latin America (where politics, governance and democracy act differently from North America), one should bear in mind that, even during hardline military ruling, São Paulo (Brazil) rejected a new proposed airport in 1976, changing the original site selection from Caucaia to that of current São Paulo-Guarulhos airport, opened in 1985 (GRU Airport, 2017).

These cases in Los Angeles and in São Paulo indicate that groups' affiliation happens without monolithic interests and must be better understood (Simmel, 1955). The diversity of interests at stake makes the identities of the groups harder to define (Coser, 1956). Improbable grouping dynamics and somewhat loose associations generates outcomes that are harder to predict than in bi-polar, classic conflicts with well-defined and clear interests (Dahrendorf, 1959).

Further research on the patterns and origins of conflicts may also shed a light to better understanding their complexity, allowing a potentially more harmonious relationship between airports' neighbors, city planners and airport authorities, evolving from conflicting "*Not In My Back-Yard*" (NIMBY) attitudes (Dear, 1992) to more sound, lasting, and mutually respectful "post-NIMBY" relationships (Suau-Sanchez *et al*., 2011).

6. CONCLUSIONS

However intuitive this may be, having more compatible neighborhoods does not prevent conflicts between airports and cities. Evidence from selected large North American and Latin American airports shows that inducing more compatible land uses within a 4-km radius around these airports does not avoid conflicts. Land use zoning around airports alone is not sufficient to prevent or suppress the conflict between airports and their neighborhoods. Further research on the nature of conflicts is justifiable. Adopting methodological improvements such as considering airports' runway alignment and expanding the analytical radius from 4 km to 10 km is advisable to improve the findings to help outline a better co-existence between large airports and the cities they serve.

7. REFERENCES

AIRBUS (2016). *Global Market forecast*: mapping demand 2016-2035. Blagnac Cedex: Airbus S.A.S.

ALBERS, J. M. (1940). "Progress in County zoning: Marathon County, Wisconsin". *The Journal of Land and Public Utility Economics*, 16: 4, 393-402.

ANDRE, R. (2004). *Take back the skies*: protecting communities in the path of aviation expansion. Bloomington (IN): i-Universe.

ASHFORD, N.J. and MOORE, C.A. (1999). *Airport finance*. 2ª ed. Woodhouse Eaves (Leicestershire): The Loughborough Airport Consultancy.

AYRES, E. (2001). "Airports and cities: can they co-exist?" *World Watch*, 14: 4, 22-35.

BAKER, D. and FREESTONE, R. (2012) "Land use planning for privatized airports." *Journal of the American Planning Association*, 78: 3, 328-341.

BEIGUELMAN, G. (1996). *No Ar*: 60 anos do aeroporto de Congonhas. São Paulo: INFRAERO. (In Portuguese).

BERSTER, P., GELHAUSEN, M.C. and WILKEN, D. (2015). "Is increasing aircraft size a common practice of airlines in congested airports?". *Journal of Air Transport Management*, 46: 40-48.

BOWEN, R. W. (1975). "The Narita Conflict". *Asian Survey*, 15: 7, 598-615.

BUREAU OF TRANSPORTATION STATISTICS (BTS, 2017). [Passengers' throughput data of airports of the United States webpage, monthly data for 2002-2016]. Available at: https://www.transtats.bts.gov/data_elements.aspx?data=1, Viewed in Jul.-Aug. 2017.

BUTTON, K. and TAYLOR, S. (2000). "International air transportation and economic development". *Journal of Air Transport Management*, 6: 209-222.

CIDELL, J. (2004). *Scales of airport expansion*: globalization, regionalization, and local land use. Minneapolis: Center for Transportation Studies (CTS 04-01); Department of Geography, College of Liberal Arts, University of Minnesota (Ph.D. Dissertation).

CIDELL, J. (2008). "Challenging contours: critical geography, local knowledge, and the public". *Environment and Planning A*, 40: 1202-1218.

COSER, L. (1956). *The functions of social conflict*. Nova York: The Free Press.

CWERNER, S. (2009). "Introducing Aeromobilities". In: CWERNER, S., KESSELRING, S, and URRY, J. (eds.). *Aeromobilities*. London: Routledge. p.1-21.

DAHRENDORF, R. (1959). *Class and class conflict in industrial societies*. Stanford: Stanford University Press.

DE NEUFVILLE, R. and ODONI, A. (2003). *Airport systems*: planning, design, and management. New York: McGraw-Hill.

DEAR, M. (1992). "Understanding and overcoming the NIMBY syndrome". *Journal of the American Planning Association*, 58(3): 288-301.

DELIUS, M. (2017). *Personal communication*.

DOGANIS, R. (1992). *The airport business*. London: Routledge.

EGAN, J. and WILSON. D. (2002). *Private business, public battleground*: the case for 21st century stakeholder companies. London: Palgrave.

ERIE, S. (2004). *Globalizing LA*: trade, infrastructure and regional development. Stanford: Stanford University Press.

FAINSTEIN, S.S. and CAMPBELL, S. (2012). "Introduction". p. 1-21. In: FAINSTEIN, S.S. e CAMPBELL, S. (eds.). *Readings in planning theory* – 3rd Edition. Chichester: Wiley-Blackwell.

FORSYTH, P. (2007). "The impacts of emerging aviation trends on airport infrastructure". *Journal of Air Transport Management*, 13: 45-52.

FREESTONE, R. and BAKER, D. (2010). "Challenges in land use planning around Australian airports". *Journal of Air Transport Management*, 16: 264-271.

FREESTONE, R. and BAKER, D. (2011). "Spatial planning models of airport-driven urban development". *Journal of Planning Literature*, 26: 3, 263-279.

FULLER, G. and HARLEY, R. (2004). *Aviopolis*: a book about airports. London: Black Dog.

FRIEDMANN, J. and WOLFF, G. (1982). "World city formation: an agenda for research and action". *International Journal of Urban and Regional Research*, 6: 3, 303-344.

GAO – GOVERNMENT ACCOUNTING OFFICE (2001). *Aviation and the environment*: transition to quieter aircraft occurred as planned, but concerns about noise persist. Washington: GAO.

GAO – GOVERNMENT ACCOUNTING OFFICE (1995). *Denver International Airport*: information on selected financial issues. Report to the Honorable Hank Brown, U.S. Senate. Washington: GAO.

GILLEN, D. (2011). "The evolution of airport ownership and governance". *Journal of Air Transport and Management*, 17: 3-13.

GLAESER, E.L. (2011). *Triumph of the city*: how our greatest invention makes us richer, smarter, greener, healthier, and happier. New York: Penguin.

GOOGLE MAPS®. (2017) https://www.google.com.br/maps/, visualized in July to September 2017.

GORDON, A. (2004). *Naked airport*: the cultural history of the world's most revolutionary structure. Chicago: University of Chicago Press.

GRAHAM, S. and MARVIN, S. (2011). *Splintering urbanism*: networked infrastructures, technological mobilities and the urban condition. London: Routledge.

GRU AIRPORT. (2017) "História do Aeroporto de Guarulhos" (In Portuguese). Available at: http://www.aeroportoguarulhos.net/historia-do-aeroporto-guarulhos. Viewed in March, 2018.

HAMMARSKJÖLD, K. (1967). *The Future.* In: "Airports for the Future" Conference. London: The Institution of Civil Engineers, p. 121-123 (1970 reprint). *Proceedings*…

HEALEY, P. (2003). "Collaborative planning in perspective". *Planning Theory*, 2: 2, 101-123.

HOUDRY, N. et HOUDRY, G. (2000). *Gousainville*: memoire en images. Saint Avertin: Editions Alan Sutton. (In French).

JESSOP, B. (2000). "The crisis of the national spatio-temporal fix and the ecological dominance of globalizing capitalism". *International Journal of Urban and Regional Research*, 24: 2, 323-360.

KASARDA, J. D. and LINDSAY, G. (2011). *Aerotropolis*: the way we'll live next. New York: Farrar, Straus and Giroux.

KUZNETSOV, V. M. (2003). "Noise control problems of passenger airplanes (a review)". *Acoustical Physics*, 49: 3, 241-262.

MASTNY, L. (2002). "Mexican Government back off controversial airport". *World Watch*, 15: 5, 40.

OUM, T. H., ADLER, N. and YU, C. (2006). "Privatization, corporatization, ownership forms and their effects on the performance of the world's major Airports". *Journal of Air Transport Management*, 12: 109-121.

PURCELL, M. (2007). "City-regions, neoliberal globalization and democracy: a research agenda". *International Journal of Urban and Regional Research*, 31: 1, 197-206.

RAU Jr., J. W. (1930). "Airports and subdivisions". *The Journal of Land & Public Utility Economics*, 6: 2, 205-208.

RYERSON, M. (2016). "Planners take flight: integrating air transportation into planning education". *Journal of Planning Education and Research*, 36: 4, 427-439.

SCHIPPER, Y., RIETVELD, P. and NIJKAMP, P. (2001). "Environmental externalities in air transport markets". *Journal of Air Transport Management*, 7: 169-179.

SIMMEL, G. (1955). *Conflict & the web of group-affiliations*. Nova York: Free Press.

SUAU-SANCHEZ, P., M. PALLARES-BARBERA, V. PAÜL. (2011). "Incorporating annoyance in airport environmental policy: noise, societal response and community participation". *Journal of Transport Geography*, 19: 275-284.

SZUROVY, G. (2003). *The American Airport*. St. Paul: MBI Publishing.

URRY, J. (2009) "Aeromobilities and the global". In: CWERNER, S., KESSELRING, S, and URRY, J. (eds.). *Aeromobilities*. London: Routledge. p.23-38.

WERNECK DE OLIVEIRA, L. H. (2006). "O conflito dos aeroportos com as comunidades: de distração gerencial a imperativo do negócio". In: WEIGANT, L. e SANTANA, E. (Eds.) Avanços do Transporte Aéreo Brasileiro: Simpósio de Transporte Aéreo (SITRAER), 5. São Paulo: EPUSP, p. 31-35, *Proceedings*... (in Portuguese).

WOLFE, P. J., KRAMER, J. L., BARRETT, S. R. H. (2017). "Current and future noise impacts of the UK hub airport". *Journal of Air Transport Management*, 58: 91-99.