

## **From airports to airport territories: expansions, potentials, conflicts**

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Airports, as nodes in world transport networks, have been studied mostly in their role as hubs in the spatial strategies of airlines. This paper examines the role of airports as engines of growth in their local surroundings and the complexity of the spatial system of the airport at the local and regional scale. It studies how to ensure an efficient movement of planes of the airside and an efficient access point to airports on the landside while taking into account the interests of people living next to airports, who are heavily impacted the noise generated by aircraft, as well as considering where should new airports be built.

**Key Words:** *airport, accessibility, congestion, local economy, NIMBY, noise.*

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### **Introduction**

Geography has been defined as "the science of territories and networks" (Brunet 1995). Airports can be considered as places located at the intersection of global networks and local territories. They are no longer just places where airplanes take off and land but have become significant businesses with spatial impacts and functional implications that extend into metropolitan areas (Freestone, 2009; Freestone and Baker, 2011). The role of infrastructure as a factor of growth and development of countries and regions is now recognized as crucial. Airports are considered as particularly strategic because of the increasing importance that air transport has in connecting territories (Bowen, 2013). At the interface between ground and sky, airports can be analysed both locally and

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globally as nodes in the global space of flows (Schaafsma, 2003), as functional anchor points of globalization (Frétigny, 2012), as tools of international competitiveness (hubs, gateways), as well as structuring elements of local territories and engines of metropolitan growth. As hubs of global flows, they are a part of the knowledge economy (Conventz et al., 2014).

Some now hold a key position in high-speed rail networks (Givoni, 2007), a role formerly reserved for central train stations only (Labasse, 1972). Airports used to confirm the success of a city; they are now a factor in its sustained success. For cities and metropolises, a high-performance airport is an essential factor of competitiveness (Union des Aéroports Français, 2017), a tool at the service of local and regional, economic and touristic development. Contrary to their being perceived as "non-places" (Augé, 1992), airports are also showcases of their country or regions, and they are often named after influential national figures, even if the vast majority of airports' names refer to the city or area they serve. In this article, the author favours the local scale to analyse the insertion of airports in their local territories and the interactions between an airport and an urban/metropolitan area (Varlet, 1997; Cidell and Adams, 2001; Berthon, 2003; Kesselring, 2010).

### **The role of airports as engines of growth**

Airports can be considered as key components for the transformation of metropolitan areas. The economic impact of an airport plays out at different territorial scales. It is at the same time a local economic centre (representing tens of thousands of jobs) and a job attractor in its immediate proximity (freight handling areas, hotels, conference centres, and others). The presence of the airport itself and the excellent quality of the land transport infrastructures which serve it make it an engine of local and regional growth (Zaninetti, 2000; Hakfoort et al., 2001; Hujer, 2008; Cidell, 2015). It has an essential role as a real estate player (Reiss, 2007; Morrison, 2009).

Tourism also gains significantly from the presence of an airport, thanks to the increased accessibility provided by the air transport facility. All the benefits mentioned above reach their maximum effect in the case of islands (Gay, 2000; Karampela, Kizos and Spilanis, 2014). Airports are widely seen as fostering direct employment (airlines' ground staff and air crews, air traffic controllers, airport shops and services employees, security) and indirect employment (offices, logistics zones) jobs (Conventz, 2010; Percoco, 2010). Local governments worldwide are therefore agreeing that an airport has mostly positive effects on a region. However, there are disagreements about just how much additional employment and added value an airport generates. It differs between 200 and 2,000 extra jobs per million passengers. It has been estimated that a 10% increase in the volume of air traffic in a metropolitan area generates a 1% increase in employment in service activities (Brueckner, 2003) and that each airport job leads to the creation of another non-airport job (Berthon and Bringand, 2001). CDG-Roissy airport in Paris and Frankfurt Rhein-Main harbour some 85,000 jobs each, Amsterdam-Schiphol around 60,000, just on airport platforms, while the *Greater Roissy* area employs about 160,000 people.

John Kasarda introduced and popularized the Aerotropolis model (Kasarda, 2006; Kasarda and Lindsay, 2011; Shen and Cao, 2016), which can be refined by distinguishing Berthon (2001) the *airport city* (Berthon and Bringand, 2001; Güller and Güller, 2002; Appold and Kasarda, 2013) at the very heart of the airport platform, from the airport and its wider environment. A rich array of terms have emerged: *airport region* (De Jong et al., 2008; Van Wijk, 2008), *Airea* (Schlaack, 2010), *aerocity* (Roseau, 2012), *aviapolis* in Helsinki, or *aeroville* (CREPIF, 1989; Ray, 1989; Piercy, 1999) and finally the *airport corridor* (Schaafsma, 2010) between the airport and the city, which is a prime location for the establishment of high-tech activities, as seen in Washington DC alongside the Dulles airport access road (Boquet, 1986, 1989).

According to Kasarda, the 21<sup>st</sup> century will be dominated by air transport, and the airport will function as a city (Drevet-Demettre, 2015) in itself, with living spaces for workers and their families, with factories relying on airline logistics services located near the airport and served by major road and rail infrastructure. Activities within the airport space (aviation, land transportation, shopping facilities, cargo warehousing, hotels, offices) (McNeill, 2009) would provide increased added value (and additional tax revenues) to a larger area, the *aerotropolis*, by stimulating the development of industrial parks, logistics zones, shopping centers, leisure and tourism activities and conferences, which in turn will fuel the growth of air traffic.

The airport would be a magnet attracting economic activities (Hesse, 2014]). IKEA, for example, has set up one of its stores, right next to the runways of Athens airport in Greece (Kasarda, 2008). The Aerotropolis concept has been included in the general layout of large American cities such as Atlanta (Aerotropolis Atlanta Blueprint), Memphis around the Fedex hub (Cox, 2010), or in Detroit, as well as in Dubai (Alkaabi et al., 2013). It is being implemented in Paris, Amsterdam, Frankfurt and Moscow (Thorez, 2010) and has been the subject of symposia for several years in Singapore, which appears with Dubai as a model (Lohmann et al., 2009; Van Wijk, 2011) that other Asian cities want to follow (Yeo et al., 2013), despite the doubts of some authors about the sustainability of the aerotropolis model (related to energy supply and infrastructure safety for example) (Charles et al., 2007).

Airports are part of local territories through the construction of land-based modes of access (road, metropolitan rail, intercity rail, or even maritime access as in Hong Kong, Kobe and Osaka-Kansai), the quality of intermodalities, the environmental constraints they are submitted to (site requirements: long runways on flat terrain, unobstructed approach from the air) and the adverse effects they generate (noise pollution, air pollution), giving rise to local land use conflicts (see section 4). Access to the airport requires substantial investments that will benefit the entire airport area, while it is also an opportunity to shift away from automobile-based mobilities to alternative modes of land transportation. Empirical studies seem to show that individuals who are on business trips, flying alone (or with fewer people), and already trying to reduce their automobile use, in general, are more likely to take alternative modes of transportation to the airport (Akar, 2013). Taxis, bus shuttles and metro systems seem to be the growing forms of access to airports (Tam, Tam and Lam, 2005; Alhussein, 2011), the latter ones being the preferred option if the quality of service is good (no

stairs, easy access from airside facility, secure connection to city transportation downtown), as analyzed by researchers in Hong Kong and Seoul (Tam, Lam and Lo, 2010; Chou, You and Lee, 2011).

### **Reorganising airports for the growth of air traffic**

The increasing saturation of airports complicates this management of airport constraints (Roosens, 2008). The growth of traffic and number of flights with hub strategies on the one hand, which force airports to be able to accommodate at the same time a growing number of aircraft arriving in successive waves, the explosion of *low-cost* traffic on the other hand (Bowen, 2016), which opens small town airports (Bergerac, in southwestern France, for example) to international flights, have combined with the need to develop airports to receiving the largest aircraft (Boeing 747-400 and newer, Airbus A 380) (Berster et al., 2015) and the rise of air cargo hubs (Boquet, 2009) to increase the pressure for expanded airport facilities. Old runway configurations are nowadays inadequate: intersecting runways (Manila) or too close to each other, the insufficient number of runways: no large international airport can operate with a single track. This resulted in the closure from Hong Kong's Kai Tak airport. A new runway configuration means not only allowing more planes to land safely, but also providing them with wider tarmac parking spaces. As far as passengers go, some airport terminals are too small: the number of boarding gates may be too small to accommodate more passengers in tourism cities (Yogyakarta, Indonesia is a good example), hence some unpopular transfers to/from the terminal by buses if there is no boarding/disembarking directly from the air terminal, commercial spaces obsolete and too cramped as airports rely more and more on shopping areas to increase their revenues (Bork, 2006; Graham, 2009; Boquet, 2010). In cities, inadequate access roads to airports (traffic jams, lack of rail links) also lead to major works in the area surrounding airports (Navarre, 2003a).

Various strategies can be implemented to manage the increase in air traffic at an airport and to reduce increasing congestion that results in delays in flights: banning recreational aviation or private jets, capping the number of flights and/or passengers (Orly airport near Paris), optimizing scheduling of flights through a specialization of runways (one for takeoffs, one for landings) to maximize the efficiency of their use (Netjasov, 2008; Bennell, Mesgaspour and Potts, 2011), especially in hub airports such as Zürich-Kloten or Hong Kong Chek Lap Kok, reallocating flight slots with variable landing fees depending on the time of day (*slot pricing* and *slot auction* strategies) (Madas and Zografos, 2006; Condorelli, 2007; Brueckner, 2009; Basso and Zhang, 2010).

Through an increase in airport fees to finance constructions, one can also transform the airport in order to better respond to the increasing volume of activity and make the airport adaptable to change (Butters, 2010; Carlisle, 2015; Suh and Ryerson, 2017).

In the case of an existing airport, this may involve new, longer, better structured runways, sometimes requiring an expansion of the airport perimeter, which is difficult if the facility is located inside a dense urban fabric or if site constraints limit the size of the airport (Washington Reagan, which can not

accommodate large aircraft). New runways were built recently at Amsterdam Schiphol, Berlin Brandenburg, Brisbane, Dublin, Frankfurt Rhein-Main, Rio de Janeiro Galeão, Shanghai Hongqiao, Tokyo Haneda, Washington Dulles. Projects for new runway are implemented or planned in Hong Kong Chek Lap Kok, London Gatwick, London Heathrow, Lyons St. Exupery, while Chicago O'Hare (Johnson and Savage, 2006; Cidell, 2013) has seen a complete redesign of its set of runways: the O'Hare Modernization Plan included the construction of four new runways, the lengthening of two existing runways, and the decommissioning of two older NW-SE runways in order to give the airport six parallel East-West runways and two crosswind NE-SW runways, all while managing to keep the airport, one of the busiest in the world, fully operational.

Airport terminals can be expanded, or new ones created (Abu Dhabi, Chicago O'Hare, Chongqing, Detroit, Moscow Domodedovo, Moscow Vnukovo, Munich (Ahrens and Stein, 2016), New Delhi, Paris CDG, Beijing Capital, Singapore Changi, Tokyo Narita, and others), resulting in a capacity increase with more boarding gates (although a large airport may not necessarily provide *contact* boarding/disembarking, as the case of Riyadh shows), a higher number of parking spaces for cars on the city side, and a sharp increase in commercial space in airport terminals, while taking into account security requirements and controlled passenger circulations within the airport facility (passengers in transit, traffic inside the European Schengen area, authorized or unauthorized migrants, and others) (Edwards, 2004; Iserte, 2008; Frétigny, 2013a,b; Goodpasture and Hubbell, 2016). In Saudi Arabia, Jeddah airport has built a *Hajj terminal* which is opened only at the time of the pilgrimage to Mecca. When addressing the building's form, functionality, efficiency, sustainability, and adaptability are critical to the design. The spiritual and medical needs of passengers must also be considered, as well as the need for multilingual ground personnel and international signage to help passengers in an unknown language environment (Fuller, 2002; Lam et al., 2003; Kellerman 2008).

Access to the airport can be facilitated by new road or rail services, which may be local via a subway line, such as in Bangkok, Hong Kong (Airport express) (Budge-Reid, 1999), Kansai, Kuala Lumpur, CDG-Roissy (RER B line), San Francisco (BART), Atlanta (MARTA), Chicago O'Hare, Shanghai Pudong by maglev service (Fu et al., 2017), Singapore (Phang, 2003) and longer distance by high-speed train (Navarre, 2003b), in CDG-Roissy, Amsterdam Schiphol, Brussels Zaventem, Düsseldorf, Frankfurt (Eichinger, 2007), Lyons or Shanghai Hongqiao (Chen and Lin, 2015). This rail service, now provided in 86 of the world's 100 largest airports, seems to be an increased factor in the competitiveness of metropolitan areas (Murakami et al., 2016).

### **Building new airports**

Another strategy is to open a new airport, which could entirely replace the old one, whose space, often closer to the city center, is reassigned to new non-air uses, in a strategy of brownfields reclamation, as in Hong Kong (Kai Tak replaced by Chek Lap Kok, with the old site earmarked for a new residential district, a park and a cruise terminal) (Loo and Chow, 2011; Lau et al., 2014;

McNeill, 2014) or Denver (closure of Stapleton Airport, now an eco-district following the concepts of *New Urbanism* and *Smart Growth*, replaced by Denver International) (Szyliowicz and Goetz, 1995; Goetz and Szyliowicz, 1997). Of course, there is some contradiction between developing a new airport out-of-town, which induces more sprawl and refocusing urban development to central areas to reduce sprawl (Godschalk, 2004; Goetz, 2013). The problem of reconverting abandoned airport sites also arose in the case of Athens Hellenikon, Austin Mueller, Berlin Tempelhof (Dubeaux and Cunningham-Sabot, 2016; Hilbrandt, 2017), El Toro Marine Air Station in California (Boquet, 2004a), Manila's Makati Nielson Field, Munich Riem, Oslo Fornebu.

Many large metropolises operate a two-airports system, as can be seen in Chicago (Midway, O'Hare), Houston (Hobby, G. Bush), Dallas (DFW, Love Field), Milan (Linate, Malpensa), Rome (Fiumicino, Ciampino), Berlin (Schönefeld, Tegel), Tokyo (Haneda, Narita), Shanghai (Hongqiao, Pudong), Jakarta (Soekarno-Hatta, Halim), Bangkok (Don Muang, Suvarnabhumi), Seoul (Kimpo, Incheon), Taipei (Taoyuan, Songshan), Rio de Janeiro (Galeão, Santos Dumont) or in the ongoing projects of Beijing and Dubai, possibly Atlanta in the near future. Some major metropolitan areas are operating under a multiple airport system, leading to interesting questions of competition and cooperation between airports, air traffic management, passengers' airport choice, and transfers between airports (De Neufville, 1995; Pels, Nijkamp and Rietveld, 2001, Martin and Voltes-Dorta, 2011; Perdana and Moxon, 2014; Yang, Yu and Notteboom, 2016, Pan and Truong, 2017). It is the case of New York City (JFK Airport, Newark, La Guardia, Teterboro, Long Island, Stewart), San Francisco (SFO, San Jose, Oakland), Los Angeles (LAX, Burbank, Ontario, Long Beach, Santa Ana), Washington (Dulles, Reagan National, BWI Baltimore-Washington International), London (Heathrow, Gatwick, Stansted, Luton, London City), Paris (Roissy-CDG, Orly, Le Bourget, Beauvais-Tillé), Moscow (Sheremetyevo, Vnukovo, Domodedovo, Zhukovsky) and the Pearl River delta area of southern China (Hong Kong, Shenzhen, Guangzhou, Macau, Zhuhai).

The list of new airports built in the last twenty years is long: Athens Eleftherios Venizelos, Bangkok Suvarnabhumi, Denver International, Fort Worth Alliance Freight Airport (Boquet, 1998), Guangzhou New Baiyun, Guiyang, Hong Kong Chek Lap Kok, Kobe, Kuala Lumpur International, Nagoya Centrair, Osaka Kansai, Seoul Incheon, Shanghai Pudong, and ongoing projects (Atlanta 2, Chengdu, Dakar Blaise Diagne, Dalian, Doha Hamad, Dubai Al-Maktoum, Islamabad, Lisbon (Abreu e Silva et al., 2015), Manila, Mexico (Sanchez, 2017a), Beijing Daxing, Qingdao). China, with the very rapid development of its air transport (Boquet and Song, 2007; Zhang et al., 2010; Chen, Barros and Yu, 2017), has been the most active country in the construction of new airports: thirteen new airports were built in the period 1986–1995 and another 37 existing airports were upgraded.

The Civil Aviation Administration of China (CAAC) then announced its intention to commence up to 100 upgrading projects and new airports. The construction of new airports brought the total number to 160 by 2005 and 206 in 2016. The *Go West* strategy continued to favour the building of new air facilities in the country (66 more airports currently being built): Guizhou province, for example, now boasts 11 commercial airports (while there were

only 2 in 1997: Anshun - opened in 2002, Bijie - 2013, Guiyang - 1997, Kaili - 2013, Libo - 2007, Liping - 2005, Liupanshui - 2014, Tongren - 2001, Xingyi - 2004, Zunyi - 1970, Zunyi-Renhuai - 2017). Sometimes the *new* airport is the result of the reassignment of military bases to the civilian sector, such as Austin Bergstrom, Chateauroux-Deols, Columbus Rickenbacker, Frankfurt Hahn, Paris Vatry, Rome Viterbo, Angeles City Clark and Subic Bay in the Philippines. Many of them are freight airports or used by low-cost airlines.

Site constraints are important: a modern international airport must have a large land area, to allow for unobstructed air approaches, keep sufficient distances between runways, and significant spaces for aircraft parking. The airport footprint can, therefore, be considerable, as in Saudi Arabia: King Fahd Airport (Dammam) who occupies 78,000 hectares, seven times the size of the city of Paris. King Khalid Airport in Riyadh (22,500 ha), King Abdulaziz Airport in Jeddah (15,000 ha), Denver International (13,726 ha) and Kuala Lumpur International (10,000 ha) are also more extensive than the French capital, as is the new Dubai Al Maktoum Airport (14,000 ha) under construction. Roissy-Charles de Gaulle is the largest in Europe (3,200 ha) ahead of Madrid Barajas. It is sometimes difficult to build an airport in very rugged terrain. Those of Guiyang, the capital city of the Chinese province of Guizhou, and Hechi (Guangxi) could only be built at the cost of levelling dozens of karstic peaks and the construction of an artificial plateau.

Proximity constraints are also essential elements to consider. The most desirable situation is maximum proximity of an airport to the city, if one considers the need to reach a large manpower pool (mechanics, building maintenance staff, security, shops, staff of the world aeronautics) and meet passengers' demand for a proximity airport reducing access time, such as in San Diego-Lindbergh, Salt Lake City, Boston-Logan or Washington-Reagan, whose airports are located just minutes from downtown.

In contrast, the higher distance of the airport from urbanised areas has the advantage of minimizing the number of people affected by noise and odours but is hugely inconvenient to recruit staff and is not appreciated by airlines, which understand the wishes of their passengers to avoid long land trips to and from the airport. It may, therefore, happen that a new airport *in the middle of nowhere* is a failure, because it is too far from the city it serves, and thus shunned by airlines listening to their passengers. Classic examples are Ciudad Real, Montreal Mirabel, St Louis Mid-America or São Paulo Viracopos. Washington-Dulles, at its inception, was also considered a *white elephant* before an access highway connected it to the US capital Beltway ring road. Today a subway is under construction on the access road's central strip, scheduled to serve the airport in 2020. Only specialized freight activities, such as in Vatry, between Troyes and Châlons-en-Champagne, can develop there, unless a low-cost company chooses to *sell* the airport as Paris (Vatry), Frankfurt (Hahn), Brussels (Charleroi), despite being located tens of kilometers from the main city, with the need to design a correct ground service of the airport, which is far from being the case. In Europe, Ryanair is using this strategy to circumvent major hubs, but land access is difficult for passengers.

Japan has developed an original solution by building airports on man-made islands (Nijkamp and Yim, 2001), Osaka Bay (Kansai International and Kobe

Airport) or Nagoya (Centrair Airport). Planes can operate 24/24 without obstacles or awakening the nearby population in the middle of the night. Such a project is currently considered in Manila Bay, Philippines. Several other airports are built mostly on reclaimed land just off the coastline, in Nice, Hong Kong, San Francisco or Seoul-Inchon. The Pointe-à-Pitre runway (Guadeloupe) extends in the middle of mangroves. Two significant difficulties here are the very high cost of construction (including rail and road links) and maintenance (against the risk of ground subsidence under the repeated weight of aircrafts) (Douglas and Lawson, 2003; Puzrin et al., 2010), which cause airports to impose high airport taxes on airlines, and create major disruptions to fragile coastal and marine environments.

### **Contesting airports**

Airport-driven urban development, despite its capacity and potential employment and income generation, however, has costs and presents risks in different realms, economic, environmental, social and cultural. An airport close to the city causes noise pollution (despite the remarkable progress by aircraft and plane engines manufacturers in reducing the volume of aircraft noise), which is strongly opposed by residents) especially at night, and air (unpleasant kerosene odors) (Cohen et al., 2007). Except maybe for thrill seekers like tourists at Maho Beach, on the Caribbean island of Sant Maarten, standing behind the barrier of Princess Juliana airport, to *enjoy* the flying of jetliners a few meters above their heads in the final landing phase, or the blast of reactors at the time of take-off. This unique hobby killed a New Zealand tourist in July 2017.

Noise, as the strongest airport nuisance, impacts heavily and repeatedly large areas, either metropolitan (Dos Santos and Saad, 2014) or touristic spaces, such as France's Côte d'Azur (Spill and Spill, 1973). Some airports have set night-time curfews that constrain airline activity, particularly for freight carriers with maximum nighttime activity (Fedex Superhub in Memphis, UPS Worldport in Louisville) (Kasarda and Sullivan, 2006; Boquet, 2009). This led DHL to abandon its Brussels hub for Leipzig due to growing opposition to nighttime airport noise by Brussels citizens (Dobruszkes, 2008; Oosterlynck and Swyngedouw, 2010).

There is also concern about risks: even though air transport is now extremely safe, there are still accidents, which occur mostly in the delicate phases of take-off and landing, thus near airports. The value of real estate is affected by the frequency and intensity of aircraft noise (Tomkins et al., 1998; Espey and Lopez, 2000; Faburel and Maleyre, 2007; Mense and Kholodilin, 2014; Sedoarisoa et al., 2017) and the effects of noise on health (sleep disorders, hypertension, cardiovascular disorders) (Eriksson et al., 2007; Järup et al., 2008; Huss et al., 2010), as well as those of air pollution (asthma) are better known by medical researchers (Meister and Donatelle, 2000; Passchier et al., 2000; Rosenlund et al., 2001; Franssen, Staatsen and Lebrecht, 2002; Black et al., 2007; Faburel and Charre, 2008; Schreckenberget al., 2010; Callejas et al., 2012; Ancona et al., 2014). The NORAH concept (Noise-Related Annoyance, Cognition, and Health) encapsulates these disagreements (Schreckenberget al.,

2012). In developing countries, the immediate vicinity of airports is colonised by shanty towns, in a typical example of environmental injustice where the poor live in dangerous places and marked by many nuisances, as in India in Mumbai (Arputham and Patel, 2010) or Kolkata.

NIMBY-style opposition reactions to airport expansion or creation have developed, for example, at London Heathrow against a new runway (Hayden, 2014) and London Stansted (Griggs and Howarth, 2008), as it was also the case for a long time about the second runway of Tokyo Narita, the many delays incurred at the new Berlin Brandenburg Airport (Becké et al., 2011) or at the long fight of farmers and environmentalists against the planned Notre-Dames-Landes airport site near Nantes, France. Here, after decades of planning, and prolonged conflict with environmental and anarchist groups, the French government decided in early 2018 to pull the plug on this project, while deciding to refocus on the development of the existing Nantes airport. An airport in rural areas may indeed be challenged by farming circles (Rialland-June, 2006) as obliterating good farming land or ruining a landscape forever. An example is the abandonment of the "3rd Paris Airport" project (Boquet, 2004b; Subra, 2004) envisioned either in Beauce or Picardie rich farmlands.

The development of an airport can no longer be exclusively centred on the needs of air transport (Kasioumi, 2015), but it must take into account the local environment, and local planning must take into account the requirements of air transport (Suau-Sanchez et al., 2011; De Barros, 2013; Scholl and Nebel, 2014). For example, zoning around Amsterdam Schiphol Airport (Van Wijk et al., 2011) allows only air transport-related activities (e.g. warehouses), and the airport's expansion (new runways) has moved away from the most populated areas, to minimise its impact on residential areas. Conversely, in Las Vegas, reducing the noise footprint of aircraft by using quieter engines has opened up new residential areas in the urban area (O'Reiley, 2013).

In many airports, as in London (Wolfe et al., 2017), Amsterdam, Paris, Boa Vista (Brazil) (Souza et al., 2017), GIS programs that offer noise modelling according to the planes trajectories, putting it in relation with the densities of population and the volume of recorded complaints, have made it possible to redefine approach and departure corridors. Pilots are requested to manoeuvre their aircraft in such a way as to limit noise over urbanised areas, especially during takeoff: they stabilise at low altitudes before resuming their climb over less populated areas, where engine thrust will be less troublesome (Girvin, 2009). In France, two regulatory documents, the Noise Exposure Plan (PEB, Plan d'Exposition au Bruit) and the Noise Awareness Plan (PGS, Plan de Gêne Sonore), represent a complementary approach for the reduction of aircraft noise conflicts.

The PEB (Noise Exposure Plan) is an urban planning document that delineates areas of potential noise nuisance from an airport. It defines urban planning rules at a regional, supra-municipal scale, that would supersede the various urban planning documents (SCOT, Schéma de Cohérence Territoriale, PLU, Plan Local d'Urbanisme, etc.) by prohibiting or limiting the possibilities of construction in areas subject to aircraft noise. These zones are defined from medium and long-term traffic hypotheses (15-20 years) as a function of the frequency, flight direction and known sound characteristics of a sample of

different aircraft. It is divided into three time slots: daytime 6<sup>00</sup>-18<sup>00</sup>, evening 18<sup>00</sup>-22<sup>00</sup>, night 22<sup>00</sup>-6<sup>00</sup>.

The PGS is a geographical document, exclusively dedicated to helping residents, which delimits urban areas adjacent to an airport. It delineates an area of "real" noise nuisance from an airport, based on forecasts of actual short-term traffic (1 to 2 years) using the same calculation model as that used for the calculation of the PEB. The noise limit defines an area within which existing dwellings are eligible for financial assistance for sound insulation work. The PGS is revised every 2 to 3 years; according to the evolution of air traffic.

## Conclusion

Airports, as nodes for worldwide air networks and local land transport networks, are also generators of two types of superposed territories. These are territories of economic activity and employment boosted by the presence of an airport, especially in the case of air freight airports or aircraft assembly sites (Toulouse, Hambourg, Everett, Renton), but also social territories where public dissatisfaction with the negative aspects of aviation can lead to anti-aircraft movements.

Opposition to airports is currently evolving towards a criticism of aviation itself, with issues such as climate change (Griggs and Howarth, 2013), degradation of coastal environments (offshore airports in Japan, Hong Kong, airports built on mangroves or coral reefs), or neo-liberal system of hypermobility as a corporate norm, inviting the consideration of airports as creators of an airport territory (Faburel, 2003a, 2010) defined by the area of mobilization against its negative impacts, and not just as nodes in a globalized airline network.

The continued growth of air transport in the years to come – despite the looming *peak oil* that may force a reduction of airline activities, jointly with growing preoccupations with global warming and climate change where aviation plays a role not yet fully assessed by atmosphere scientists (in February 2017, a planned expansion of Vienna airport - construction of a third runway - was temporarily blocked by Austrian justice under the novel ground of its future impact on climate (Hollaus, 2017)) – may lead to more local conflicts about the development of large facilities. Airports, usually seen as meeting places, engineering challenges, and economic assets have also become a political question pitting economy and ecology against each other and requiring a mediation of potential conflicts (Faburel, 2003b; Geis, 2010; O'Doherty, 2014; Sanchez, 2017b).

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