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Urban Logistics; a Key for the Airport-Centric Development - a Review on Development Approaches and the Role of Urban Logistics in Comprehensive Airport-Centric Planning

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Abstract

Airport-centric development is relatively a new concept in globalized urban and regional development while airports are experiencing a radical change in services they provide to users. Increasing reliance on non-aeronautical potentials, besides the traditional aeronautical services, grants the opportunity to business providers and logistics actors to enhance their profit and guarantee their business life. City logistics can play an essential role in airport-centric urban system and should be integrated in planning process. The main focus of this research revolved around issues related to this approach and its evolution. As well, the structure and function of city logistics and urban freight as well as airport-centric development has been considered.

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1. Introduction

According to the World Urbanization Prospects (UN, 2014) 54 percent of the world's population lives today in urban areas, increased from 13 percent in 1900 (UN, 2006), a proportion that is expected to increase to 66 percent by

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2050. Projections show that urbanization combined with the overall growth of the world's population could add another 2.5 billion people to urban populations by 2050. Urbanization as one of the dominant trends of socioeconomic change of the 20th century has imposed new growing problems and challenges on the expanding cities. Increasing demand for freight transport and commercial services, as a result of urban growth, is among the major challenges.

The importance of urban areas, and transport systems within them, derives from the increasing proportion of every country's population living there at least some of the time, the greatly increased proportion of economic value-added being produced within them, and the steadily increasing reliance of modern and modernizing societies on mobility and transport, based on the comprehensive approach of Simon (1996) to the urban transport. The great importance of urban freight transport and city logistics has been recently through different kind of studies analyzed and its role in strengthening the urban competitiveness affirmed. The functioning of urban areas, historically, relies on urban economic activities those should be supported with production, movement, and consumption processes which all are considerable within today's metropolitan borders.

In line with the mentioned approach of Simon, Rodrigue et al. (2006) in their book emphasize that cities traditionally viewed more than locations of utmost human interactions with intricate traffic patterns linked to commuting, commercial transactions and leisure/cultural activities. Besides that, it should be noted activities like production, distribution, and consumption happen in urban areas which cause the movements of freight, as well as the related services, from the producers to the final consumers. Benjelloun and Crainic (2009) present clearly the importance of urban goods transport in the way that for the city inhabitants, it supplies stores and places of work and leisure, delivers mail and goods at home, provides the means to get rid of refuse, and so on. For firms established within city limits, it forms a vital link with suppliers and customers. Indeed, there are few activities going on in a city that do not require at least some commodities being moved.

Besides the absolute contribution of urban freight and urban logistics, in quality of urban life, yet nevertheless many problems and inefficiencies are remained as unsolved or less-treated while the contribution of this urban sub-system in negative effects of urban transportation systems is still remarkable. A broad set of inefficiencies and level of contribution of complex urban logistics systems in negative economic, social, and environmental effects has been investigated so far. Compared with urban passenger transport, less focus has been placed on the urban freight transport, but recent efforts show that this realm of research has attracted much consideration, as it merit.

The complexity of city logistics and urban freight can be presented from different approaches. It consists of different actors and their network of interactions. Naturally each element or sector of urban logistics network tends to maximize its revenue and efficiency. The existence of conflicting interactions makes it hard the needs of each actor be completely covered. As well, city logistics interact with many other systems in urban, regional, and even international scale. Linkages between urban logistics and urban transportation systems, social system, environment, land-use, regional and urban economy, and regional transportation infrastructure are among these interactions.

Notwithstanding the conflicting nature of interactions, the internal interactions of urban logistics and its linkages with other inner- and outer-urban systems might be seen also as potentials and opportunities. Investigating the potentials of integration between urban logistics and other systems is not a completely new effort, but in recent studies much efforts has been devoted to that (e.g. Priemus et al., 2001, STRATEK, 2005; C. Richardson, 2005; Russo and Comi, 2012; Lindholm and Behrends, 2010). Considering the fact that for cities seeking to compete in the globalized economy, effective freight transport services are a key success factor (Docherty, 2004), this paper is the early results of a review on the role of city logistics in comprehensive airport-centric planning approach.

2. City Logistics; A System of Conflicts and Interactions

Responding to the main known challenges of the growing demand to freight transportation and distribution in the urban areas, city logistics concept has been introduced and developed in recent decades. Big share of urban activities are accompanied by movements of freight and services due to the needs of inhabitants. For example, according to the previous studies, the share of pick-up and delivery operations, which often take place in urban areas, on the total door-to-door cost is in combined transport about 40% (ETH, 1996), Urban freight represents 10 to 15% of vehicle equivalent miles travelled on city streets and 2 to 5 percent of the employed urban workforce, 13% of Shanghai's GDP is value added by logistics (Dablanc & Rodrigue, 2009), and the share of trading and logistics in Hong Kong was 24.6% of GDP in terms of value-added in 2012 (HKTDC, 2015).

Urban activities are accompanied by large movements of freight characterized by delivery trucks moving between industries, distribution centers, warehouses and retail activities as well as to and from major gateways such as ports, rail terminals, distribution centers and airports (Rodrigue et al., 2006). Dablanc and Rodrigue (2009) identified the functional specialization of cities, the global division of production, the rise of service activities as well as increasing standards of living as correlated items with a higher demand for transport and logistics services in cities, a higher frequency of deliveries, and larger quantities of freight shipments coming from, bound to or transiting through urban areas.

The delivery of consumer goods (not only by retail, but also by other sectors such as manufacturing) in city and suburban areas, including the reverse flow of used goods in terms of clean waste has been defined by OECD (2003) as the definition of urban freight. Due to the nature of freight transportation operation, it is a big contributor in negative impacts in urban areas. To assist in solving negative impacts and challenges of urban freight transport, city logistics has been introduced while it can considers multiple objectives as well as the behavior of multiple stakeholders who are involved in urban logistics activities, which provides the basis for sustainable and livable cities (Taniguchi et al., 2014).

Urban logistics concerns logistics processes and operations in urban areas, taking into account the operational, market, infrastructure and regulative characteristics of the urban environment while it forms an integral part of interurban and international logistics chains (Buck Consultants International, 2001). City Logistics explicitly refers to the optimization of such advanced urban freight transportation systems (Crainic et al., 2007).

People are seeking improved air quality, safer communities and healthier lives. These components are essential for a higher quality of life. City logistics can contribute towards making urban areas more attractive and productive (Taniguchi et al., 2014). Regarding the dynamic environment of urban freight and different users involved in it, city logistics contemplate dynamic planning, management, and operation of urban freight transport and distribution of freight and commercial services within the city regarding other interacting inner- and outer-urban systems. エラー! 参照元が見つかりません. shows the schematic complexity of urban freight and logistics system regarding its actors, operations, and examples of interacting systems.

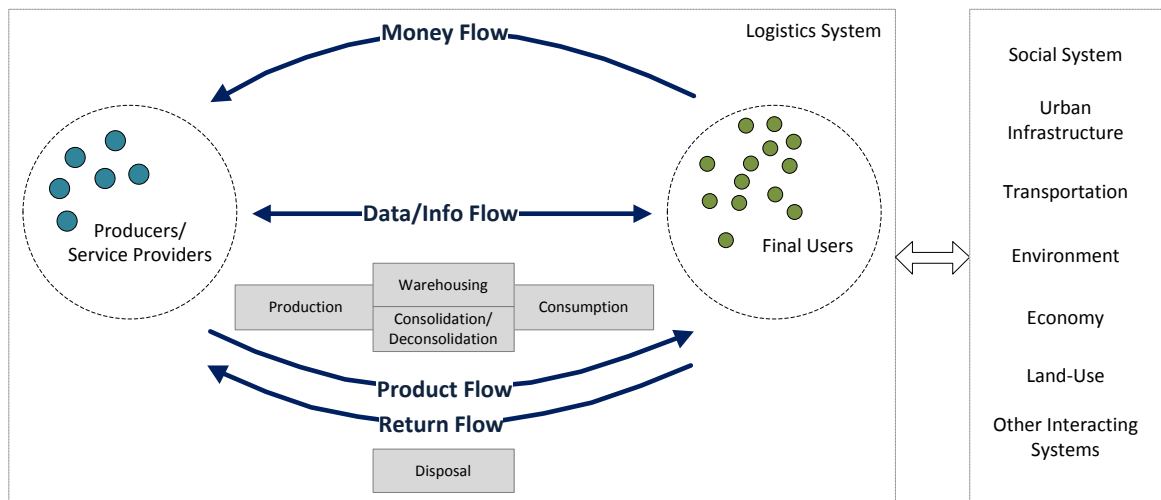


Fig. 1. The schematic complexity of urban freight and logistics system.

3. Urban Logistics Reinforces Urban Competitiveness

There is no doubt that urban economies should be supported in different manners and patterns but in the way that they remain attractive places for inhabitants to live and to do their economic activities. Docherty (2004) reviewed two main theories on the competitiveness of the future cities which in the first one Krugman stressed on the idea that cities

do not compete with one another rather their firms do so, while in the second one Porter claimed that successful companies are attracted to particular cities and regions. In favor of the second theory, Docherty mentions that recent research generally supports Porter's position and the most successful regions have class-leading transport and ICT infrastructure to move goods, services, information and people securely, quickly and efficiently (Docherty, 2004). Porter (1995) clearly suggests that increasing social investments and hoping for economic activity to follow should be stopped and replaced by providing economic model with the premise that inner city businesses should be profitable and positioned to compete on a regional, national, and even international scale.

An efficient city transport system is one of the preconditions of urban agglomeration whose collapsing hampers overall economic activity (Herzug, 2010). Regarding the previous section, big share of urban activities are accompanied by movements of freight and services due to the needs of inhabitants. These movements occur between producers or service providers (industries and logistic areas) and the final users. Product and services flow from providers to the receivers and the money flows in the reverse direction. Time, cost, and quality of service or product always influence the whole process (figure 1). These activities support and guarantee the development process in every urban area and the economic prosperity. According to Lindholm (2012a) urban freight is a contributor and facilitator of economic growth which is necessary for trading activities and the competitiveness of the region as well as for retaining service and for the development of the citizens' lifestyles in the area. Increasing costs for logistics translate into competitive disadvantages compared to other cities and investors move to other regions with a more competitive infrastructure (Herzug, 2010).

In agreement with Dablanc L. (2009b) unless under abnormal conditions (wars, natural disasters, or rationing in state controlled economies), very few cities in the world experience a rupture in goods' supplies. Goods always find ways to reach urban businesses and consumers. However, enhancing the quality and added value of goods' distribution is a very important objective for policy-makers to provide a higher quality of life for inhabitants. This is only possible in the presence of logistics services and means organizing business opportunities, providing space at affordable price, and promoting training in logistics jobs. In エラー! 参照元が見つかりません。 depicted is the general relationship between City Logistics and Urban Economic Development.

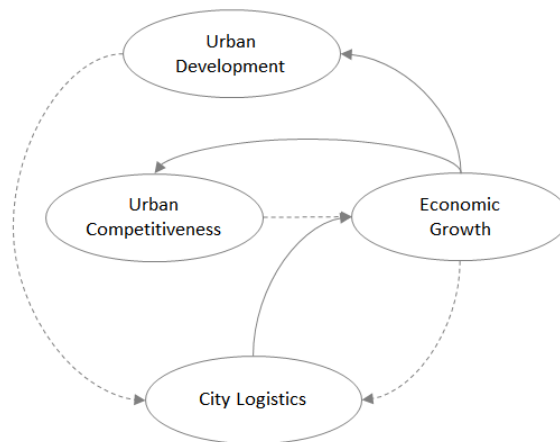


Fig. 2. The relationship between City Logistics and Urban Economic Development.

4. Airport-Centric Development; an Expanding Concept

In the era of globalized economy and highly dynamic competition for economic activities around the world, airports increasingly represent themselves as the most strategically important transport infrastructure. However the airport's primary role was basically to facilitate the shift of traveling passengers and cargos between air and land transport

modes, mainly due to the globalization they got busier, more congested, and consequently larger and more sophisticated in recent decades. Along with these changes, airports' role has been experiencing a radical transformation from just an air-land changing points of transport mode to the large mega centers of economy-related activities or major urban intermodal nodes. Based on the Pujinda (2007) international airports enhance the economic shift from the main cities towards the urban periphery in metropolitan areas, the surroundings of the airport are one of the most consistently growing parts of the metropolises.

4.1. Impacts on Regional and Urban Economy

The influence of air transportation and related services in the airports on regional economic developments has been already discussed in different studies. Tittle et al. (2010) investigated and confirmed the role of facility expansion (runway) on the economic development. The results of Blonigen and Cristea (2012) suggest that air service has a significant positive effect on regional growth, with the magnitude of the effects differing by Metropolitan Statistical Areas (MSA) size and industrial specialization. Airports play a significant role in regional economic development, which is resulted by Florida et al. (2012), those scale of effect is similar to that of Human Capital, a factor which the literature identifies as a key contributor to regional development, and greater than High-Tech Industry, which many also think of as an important driver of regional development. They also found that the size of the airport and scale of its activities matter to regional development.

Yigitcanlar et al. (2008) imply that airports are increasingly recognized as general urban activity centers; that is, key assets for cities and regions as economic generators and catalysts of investment, in addition to being critical components of efficient city infrastructure. They conformingly believe that the entrepreneurial idea of the modern airport goes beyond the movement of aircraft towards providing a variety of commercial and industrial opportunities. As reported by Stevens et al. (2007) airports are a dynamic and integral part of the urban fabric, their management and future development are integrally interlinked with urban and regional land use, infrastructure planning and economic development. Brueckner (2003) in his research provided new evidence on the link between airline traffic and employment in a metro area which confirms that good airline service is an important factor in urban economic development.

Through their study on the airport efficiency in the European network Malighetti et al. (2009) found that the greater airport's level of contribution to the development of the network (and therefore to passenger and freight mobility within the European Union), the more complete its utilization of physical assets. The showed that airports with more than 10 million passengers are more efficient than medium-sized airports with between 5 and 10 million passengers, confirming that efficiency is related to the airport size. According to their findings they recommend air transportation policies should focus on increasing the competition within important catchment areas. As well, public policy should provide incentives for airports to develop their role in networks. As well, the majority of the studies that were reviewed by Zak and Getzner (2014) indicate significantly positive economic effects associated with the functioning of the airport in central Europe, in particular with regard to the effects on employment and gross added value for the region in which the airport is located.

According to the report provided by ACI Europe (2015), total economic impact of European airports has been estimated about 4.1% of National GDP. As well, 10% increase in a country's air connectivity, GDP per person in that country increases by an additional 0.5%. Of companies relocating to the area around Munich Airport 31% cited the airport as the primary factor in their location decision, 61% used the airport to ship cargo of which 33% stated that air cargo was their primary means of good transport. A survey of the business in the Hamburg area found that 80% of manufacturing companies reported air service connections as important to getting customers to look at their product (ACI, 2004). 25% of all companies' sales are dependent on air transport while 70% of businesses report that serving a bigger market is a key benefit of using air services (ATAG, 2004).

4.2. Development-Oriented Models

Few generic development-oriented models of airports e.g. "Aviapolis", "Airfront", "Airport-City", and "Aerotropolis" have been conceptualized in two recent decades. Aviapolis (Finavia, 2004) relies on business and

commercial opportunities related to the presence of an international airport by taking into account the comprehensive strategic planning and integration between urban commercial planning and airport activities. Airfront concept (Blanton, 2004) considers the spectrum of aviation-related businesses and industries tied to the airport. He aims to get planners to understand how they can shape emerging Airfront districts to achieve regional and local objectives. Based on the review of Stevens et al. (2007) the core of Aviapolis is the strategic re-organization of an existing urban area into an aviation orientated business while Airfront tends to support the airport with an array of services based on industrial clustering.

Kasarda (2008) defines his previously propounded idea of Airport City model as it is grounded in the fact that in addition to their core aeronautical infrastructure and services, major airports have developed significant non-aeronautical facilities, services and revenue streams. At the same time they are extending their commercial reach and economic impact well beyond airport boundaries (Kasarda, 2008). The Aerotropolis model, also brought up by Kasarda, has been introduced as an airport-centric urban economic region, emphasizing the connectivity between airport and business and economic activities (Kasarda, 2000, Kasarda, 2001, Kasarda, 2008, Kasarda & Lindsay, 2012). Kasarda champions the development of the ‘aerotropolis’, a logistics based model of airport city Development (Stevens et al., 2007). The aerotropolis consists of an airport city core and extensive outlying areas of aviation-oriented businesses and their associated residential developments.

4.3. Airport Centric Development; a Comprehensive Approach

In the detailed report of Government Accountability Office (GAO) in 2013 twelve commercial airports and their surrounding region for in-depth study of airport-centric development activities are considered. In this report it is resulted that some domestic and international airport operators, airport owners, official administrations, and business owners are analyzing and exploring the opportunities to develop the airports and their surrounding regions to strategically strengthen the economic power of the region and get more benefitted mutually.

Increasing the efficiency of airport operation which is reflected in passenger and cargo movement lies at the heart of this concept while airports are viewed as central piece of the development efforts of the mentioned forces, believing that businesses in close proximity to an airport can use that proximity as a marketing tool (GAO, 2013). According to this report, airport-centric development is a type of development on the airport property to enhance the airport’s non-aeronautical revenue and development outside the airport that is intended to help the region economically by leveraging its proximity to the airport those are shown respectively in panel A and B of エラー! 参照元が見つかりません。 .

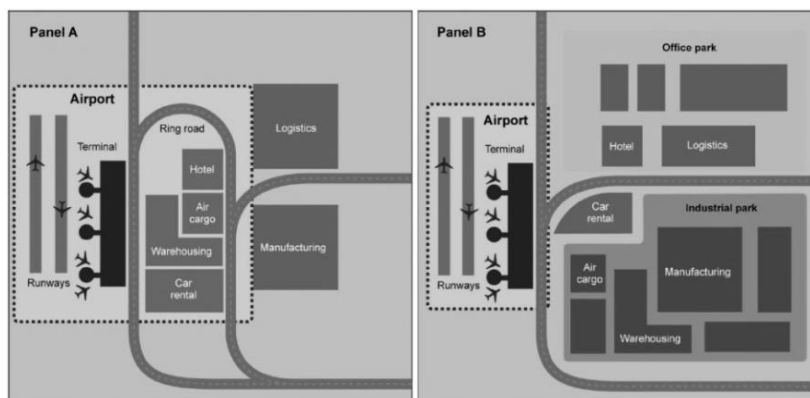


Fig. 3. Examples of Airport-Centric Development (Source: GAO).

5. Airport-Centric Development; Strong Ties with City Logistics

Economic validity of cities is strongly attached to freight movements and all related activities those could be formed between suppliers and end-users. As discussed before, various actors with conflicting interests, a sophisticated set of interrelating activities as well as many currently investigated and proved negative impacts; among them air pollution, noise emission, capacity decrease, and unnecessary vehicle-miles traveled are the most considerable ones, indicate the need for more focus in light of more comprehensive planning approaches. Airport-centric development which contemplates the airport as the kernel of a recent development approach potentially might have strong connections with city logistics for the sake of its ties with daily urban inhabitants' needs. Presenting the core of this paper and taking a reciprocal approach, these issues are documented in following subsections.

5.1. Airports; Substantial Infrastructures

Similar to all transportation networks, air transportation networks also consist of airport (terminals or nodes) and air routes (links) connect airports in different regions to facilitate the movement of cargo and passengers between those regions. Besides the technical and operational importance of these essential nodes of the air transportation networks, they are strategic infrastructures for regional development. Based on previous reviews, airports are morphing into the big economic facilitators of their catchment regions in urban, regional, and not surprisingly, even international scale. Airport-centric development is a recent comprehensive development concept which reasonably considers the technical importance and functional highlights of airports and their surrounded regions.

The results of Sheard's study on the airports and urban sectoral employment confirm the intuitive notion that airports promote activity in the service sector (Sheard, 2014). According to the report of ATAG (2008) the air transport industry carried over 2.2 billion passengers and 44 million tonnes of freight while generating almost 5.5 million direct jobs globally in 2006 within the air transport industry and contributed USD 408 billion to global GDP. As a fact, in エラー! 参照元が見つかりません。 depicted is the employment impact of airports in United States based on data prepared by ACI which shows clearly the strong economic power of airports.

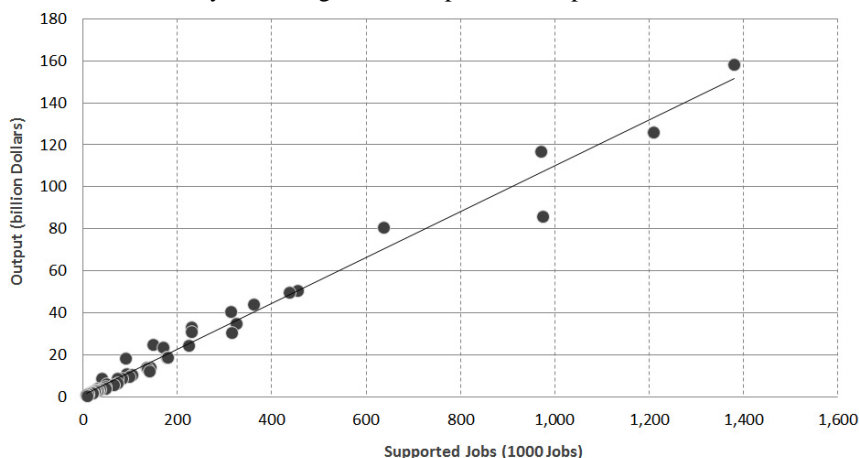


Fig. 4. Employment Impacts of Commercial Airports in the U.S. in 2010 (Source: CDM Smith; prepared for ACI).

A recent survey attempted by ATAG (2008) shows that 52% of companies consider international transport links to be an essential factor when locating businesses in Europe, as well, the absence of good air transport links has significantly affected the investment decisions of firms in a wide range of countries. These facts confirm the encouraging role of air transport; and consequently airports, in connecting markets and businesses as well as supporting the economic growth of the catchment region (urban area in this study). While urban logistics has a proved

supportive role for urban economy and urban competitiveness, potentials of synergy between these two would be considerable.

5.2. Non-Aeronautical Revenues; Crucial for Airport Operation Life

Rapid expansion of airport-centric commercial development is transforming today's gateways into leading urban growth generators as they become significant employment, shopping, trading, business, meeting, entertainment, and leisure destinations in their own right (Ashford et al., 2011). US Government Accountability Office (GAO, 2013) indicates some critical factors for pursuing airport-centric development: development at the airport, air and surface connectivity, funding sources for development, development in the region, and collaboration among stakeholders. These critical factors rely on logistics on the grounds that freight movements and logistics are the basics of urban and regional economic activities and development.

Considering the previously discussed points, airport operators and airport owners try to both reach higher levels of profitability and covering more passenger and freight demand to compete with other competitors as well as to guarantee a reasonable market-share. Contribution of non-aeronautical activities in today's airport operation and related activities is considerable. エラー! 参照元が見つかりません。 shows the share of this type of revenue from the total revenue of airports at 30 large commercial US airports in 2012. Non-aeronautical activities consist of a wide spectrum of activities which can be directly or indirectly connected to the movement of passenger and cargo and all airport visitors and users.

Grant 7%	Passenger Facility Charge 14%	Fee charged to airlines and aircraft operators 42%	Nonaeronautical Revenue 37%
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Fig. 5. Contribution of non-aeronautical revenue in total revenue of 30 US airports in 2012 (adapted from GAO analysis of FAA data).

Duty-free shops, airline lounges, catering, food and beverage, parking, currency exchanges, and automobile rentals are among those have been normally by airport operators in recent decades as classic profitable activities and the easiest ones to run. Besides these revenue sources, others such as retail and factory outlet centers, cultural and entertainment attractions, exhibition centers, hotels, business complexes and business offices, recreation and fitness venues, logistics and distribution, cold storage, different sorts of value added services, free trade zones and special economic zones are being implemented by airports around the world. These facilities, enterprises, and business activities strengthen the economic competitiveness of the airport region and increase the number of enplaned passengers and tonnage of cargo in return. Consequently, the airport would benefit from increased aeronautical and non-aeronautical revenues.

Some fact from one of the major international hub airport; London Heathrow (LHR), might be interesting in this regard those are mostly extracted from a report developed by the Heathrow Airport (2013). Heathrow connects the UK to the long-haul destinations and competes with other long-haul hub airports at Frankfurt-Main, Amsterdam Schiphol and Paris Charles de Gaulle in the Western Europe region. 202 of the UK's top 300 company HQs are within a 25-mile radius of Heathrow and more than 100,000 jobs in the area depend on Heathrow. Since the 1970s, around £20–25 billion of rail infrastructure with a connection to Heathrow has been invested or committed. The airport generated £422 million and £131 million in retail and property revenues respectively. These levels equate to revenue per passenger of £6.02 from retail activities and £1.87 from property, based on the 70.1 million passengers who used the airport in that year (Steer Davies Gleave, 2013). エラー! 参照元が見つかりません。 shows a view of some of the business and commercial clusters around Heathrow (Heathrow Airport, 2013).

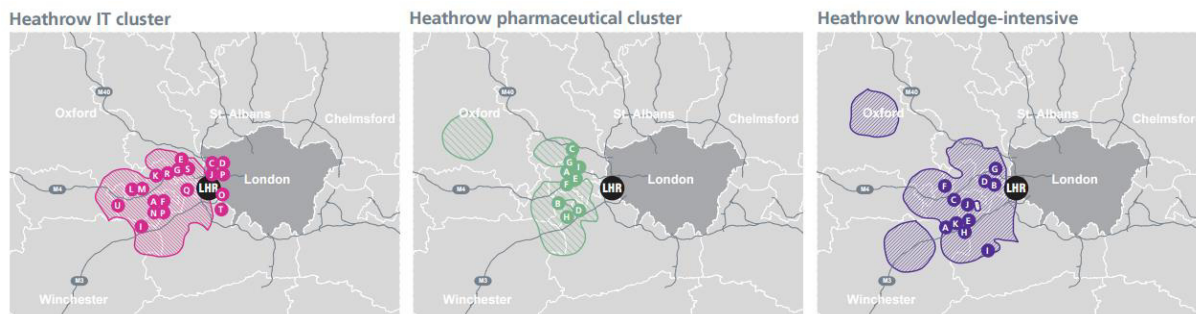


Fig. 6. a view of some of the business and commercial clusters around Heathrow (Source: Heathrow best placed for Britain, 2013).

Frankfurt, the Europe's third largest hub, airport is another example of strong contribution to the regional economy and benefiting from non-aeronautical revenue. The airport handled more than 60 million passengers in last year, 40% of them were business travelers (Frankfurt Airport 2015). More than 500 companies are based on the Frankfurt airport. Specially in the field of air cargo, this airport is hub with more than 2 billion tons of air cargo per year and about 5,000 tons daily, about 240 in CargoCity located leading logistics companies and cargo airlines, around 11,000 employees work at CargoCity, and up to 200,000 tons of fresh and refrigerated goods a year (Frankfurt Airport, 2010). It had in 2013 a workforce of more than 20,000 employees and generated revenue of EUR 2.56 billion (Frankfurt Airport, 2014). CargoCity and logistic park, office and service spaces, hotels, conference centers, trade show and exhibition space, leisure amenities, hospitality and retail facilities, and warehouse spaces are among many facilities those have been provided by the Frankfurt Airport.

5.3. Leverage of Logistics Activities into Airport Development

Airports are not more just transportation infrastructure as they are becoming multi-dimensional functioning complexes their effect on the surrounding region might be huge and considerable in different ways. Today's airports present themselves as large business and commercial magnets due to conceptual changes and reforms happened in recent decades, abstractly discussed through the development patterns in previous sections. Firms are clustering near major airports because of the accessibility, speed, and ability of airports to provide new economy global supply chain and connecting to corporate customers nationally and internationally (Sengupta, 2007). As well, rapid commercial development in and around major airports are making them leading urban growth generators, and airport areas develop a "Brand Image" affecting even non-airport linked businesses (Sengupta, 2007).

Urban logistics serve the need of inhabitants of the urban region by promoting a wide spectrum of services which definitely support every kind of business and commercial activity in the region. Under the concept of airport-centric development, the logistics network of the urban area should serve the airport related businesses properly. As well, the airport region provides a huge potential for cargo transport companies and manufacturers to develop a part of their business on the region in order to increase productivity and decrease the final cost of their products. These activities might reshape the urban logistics network according to the scale of activities. Therefore, city logistics should be integrated in such development approaches those seem to be dominant in many areas in future.

The airport-centric development approach can potentially include all kinds of business and non-business activities comprehensively which can provide a path of mutual profitable relationship between airport operation and regional and urban activities. Based on the reviewed evolution of airport development, the logistics related activities can be divided into four categories from the basic one to the very recent approach. These are depicted in エラー! 参照元が見つかりません。 including some examples of non-aeronautical activities.

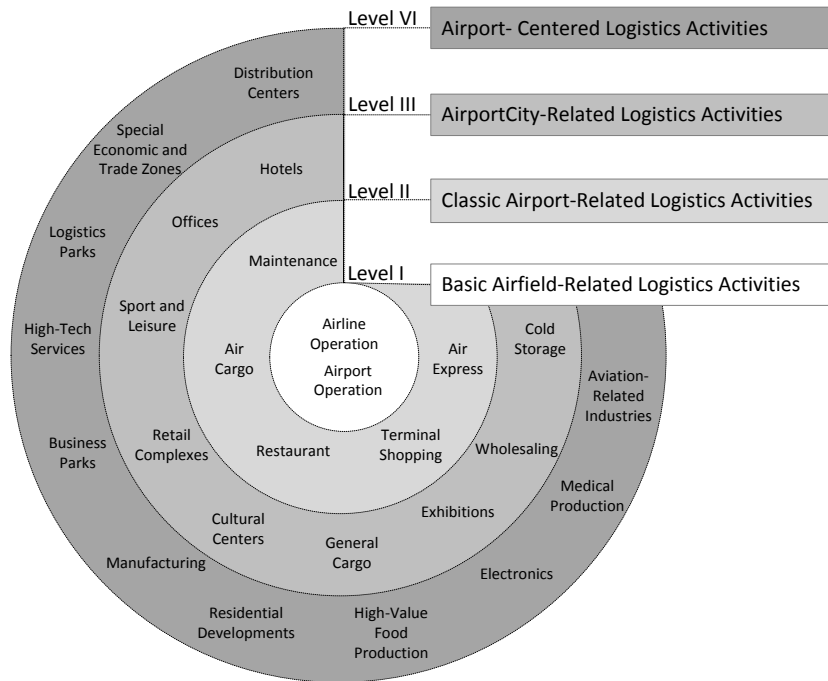


Fig. 7. Examples of logistics activities in different airport and airport-related development patterns.

According to the function of urban logistics and the specification of airport-centric development, this urban transportation subsystem plays an essential role in establishing a comprehensive development approach to guarantee the competitiveness and economic growth of the area. However, to support an efficient linkage between city logistics and airport-centric development, city logistics should have the potentials to serve the area productively. Following concerns are important in this regard:

- Availability of infrastructure and logistics facility,
- The inefficiencies and negative social, economic, and environmental impacts of urban freight and city logistics,
- Integration between city logistics and other urban subsystems,
- The presence of efficient access network including railway, highway, and road in urban area and the airport region,
- Integrated planning in the whole urban region (including airport),
- Diversity of aeronautical and non-aeronautical activities which can be supported by city logistics,
- Demographic characteristics of the urban area and the whole target region, and
- The negative impacts of airport-centric development on the urban area.

6. Conclusion

This research basically aimed to review and shed some light on the critical issues required for the emergence of airport-centric development; as the most important kind of infrastructure-centric development, considering the role of urban freight transport and city logistics as well as their interaction toward enhancing the competitiveness and development of the city. Economic development of every urban area relies strongly on an efficient urban logistics network. However, different involved actors those have conflicting interests and dynamic changes in business environment make urban logistics a very sophisticated system. Development and planning approach in the urban realm should consider and include urban logistics and its related issues.

Based on the logic of the airport-centric development and the activities which can strongly support the revenue of the airport, city logistics plays an essential role to cover the needs of different users of the airport and all interested business providers who aim to use the provided opportunities at the airport region as well as the urban area. It can be concluded that city logistics remains as the most important urban subsystem that should be involved in different parts of airport-centric development plan due to the powerful linkages between this subsystem and the economic and business-related activities. The availability of urban logistics infrastructures and facilities and the level of integration between inter- and intra-urban freight transport and services are essential to the concept of airport-centric development because the catchment area of airport in this kind of development include a wide spectrum of commercial activities. That means a mutual relationship between city logistics and airport-centric development must be formed to support business and industrial activities. This gives a great opportunity to leverage synergy between these two sophisticated system; airport and urban logistics.

Almost all of activities in mega airport areas are directly and indirectly linked to the urban logistics and freight transport, as discussed. Despite the mentioned mutual relationship, some challenges such as operational inefficiencies and capacity problems may threaten the performances and they should be considered in future studies. As well, airport-centric development should be integrated with urban planning process which is a very challenging issue in presence of many conflicting urban subsystems. This also need more focus and research in future while it contains a range of dynamic challenges.

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