Clustering around International airports

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Table of contents

Executive Summary

Due to globalisation, location have become the most important factor for firms to locate their offices and other firm supportive activities like distribution and maintenance. This have lead to land scarcity around important transport nodes like airports. This thesis will focus on several business parks around major airports to gain insight which type of business are locating near airports, what kind of location patterns exist and if there are intercontinental differences.

This thesis is substantiated by comparing theory on clustering, airport land usage and the aerotropolis concept to four selected airports throughout the world in a qualitative manner. The four case studies consists out of the airports of Amsterdam, Madrid, Seoul and Dallas and are being analysed with an aerotropolis-based view. Data from the selected case studies showed a high presence of firms within high technology sectors like ICT, software and high-tech manufacturing. This complies with the aerotropolis concept. Also a high presence of firms within the financial and insurance sectors are visible through the data. Although the aerotropolis concept have been a useful framework, it is not the ideal situation. This is visible in the case of Madrid Barajas airport. The airport is a big catalyst to the regional economy, but lacks a high presence of firms within high-tech sectors. Even though Madrid Barajas airport is not an aerotropolis, it is still an important factor in the location decision for firms.

By looking at the data and comparing them with the aerotropolis concept it was possible to conclude that the typical sectors that are located around the selected airports are in the high technology and financial sectors. Also the location patterns are very clear by looking at these four cases. The clusters are located along the major corridors between the airport and the city centre. It was not possible to make a generalised conclusion on whether or not there is a difference between continents, but based on the four case studies there are no big differences.

1. Introduction

Because of the globalisation throughout the world, accessibility has become the new real estate focus, replacing location as most important factor. The effect of globalisation on location preferences for firms has increase rapidly for the last 20 years. This has resulted in land competition around the optimal locations. The increasing important of location have been shown in a paper by Leinbach and Bowen (2004), research has shown, that in the case of Singapore Changi airport, firms can improve their competitiveness by locating their distribution centres near the airport.

Research done by the International Civil Aviation Organisation (2004) has shown that approximately 5 percent of the world gross domestic product has a relationship with air transport. Further research by Jones Lang LaSalle and Gruen Gruen+Associates (2008) have also showed the economical effect of Aerotropolis operations for an area. Their research has shown, that the multipliers from air transport are 1,41 for the output and 1,60 in terms of employment. The growing importance of air transport and globalisation has lead to cluster development around airports for several sectors. This cluster development have been conceptualised by John Kasarda from the university of North Carolina into the Aerotropolis concept, by adapting the metropolis concept for cities. Currently this Aerotropolis concept by Kasarda (2000) is being applied to several newly developed airports especially in Asia, but also in the US and Europe.

Although the Aerotropolis concept can be used globally, there is no specialised literature in comparing these Aerotropoli throughout the world in order to find regional differences between various countries and continents. In the paper written by Flores-Fillol and Nicolini(2006) distance from three airports to the industrial clusters around it are being compared with each other, but lacks to distinguish the influence of various sectors on distance.

The core of the problem in this thesis, is scarcity of land near big international airports. To make the land usage as efficient as possible, municipalities is able to create a zoning policy, but also multinationals and the airport influence the land usage. Because of globalisation, the proximity of an airport is becoming more important as a location factor. The problem for the various stakeholders is how to maximise efficiency of land. This thesis will focus on two parts

of the Aerotropolis concept: looking for the type of clusters that are located around the airports and secondly, checking for differences and similarities between the four case studies. This have lead to this problem statement:

"Because of the rising importance of accessibility due to globalisation, demand for land around major airports will lead to land scarcity and higher land prices."

The main purpose of the bachelor thesis is to research which types of firms locate their offices close to the airport and a close look to the difference between Asia, Europe and the United States. Also a closer look at policy will be made, especially in Asia where the authorities stimulate clustering by creating free economic zones. Therefore, the research question of this thesis is:

"What types of business locate their offices near airports, is there an location pattern and is there a difference between continents?"

In the subsequent chapter, a small literature review on clustering and airport land usage will be discussed. This chapter will start with discussing the benefits from clustering and location pattern models. After this, airport land usage will be discussed in depth by linking the location pattern with airport land usage. This will be followed by a overview on the Aerotropolis concept by Kasarda (2000) and the Aerotropolis bid-rent model to explain the theory behind the location pattern around airports that comply with the Aerotropolis concept. This is followed by chapter three which contains the analysis of four case studies on clustering near international airports throughout the world. These four case studies will be analysed according to the Aerotropolis concept and the location pattern of companies. Also an short overview on policy will be made. The fourth chapter will contain the conclusion of this research by comparing the case studies with each other, by looking for differences and similarities. This will also be complemented by a small paragraph on the limitations of this thesis and recommendations for further research. This will be followed by the bibliography and at the back of this thesis, the appendix containing all the data on the Schiphol case are attached.

2. Theoretical Background

2.1 Introduction

This chapter will discuss the important topics within clustering and Aerotropolis development. In the subsequent paragraph, the important theories on clustering in general are being these discussed. These agglomeration economies have a significant impact on clustering, within every sector, worldwide. Also around airports, these agglomeration economies are present. Paragraph three will discuss the structure within these clusters. Because of land scarcity around airports, policymakers have to attract the right companies to improve the quality of a cluster and the achieved agglomeration economies. This paragraph will discuss a few of the important models on cluster structure. The next paragraph will discuss the Aerotropolis concept by Kasarda. This concept is one of the leading concepts on cluster development around airports. The last paragraph will discuss an adaptation of the bid-rent model, by combining it to the Aerotropolis concept. This will give an insight in the willingness to pay for land by companies within the Aerotropolis.

2.2 Clustering

For many decades, clustering have played an important trend in economics. Clustering is the geographical concentration of firms within a certain area. Recent development on this part of geographical economics has been done by Nobel-prize winner Paul Krugman (1991) and Michael Porter in his book *The competitive advantage of nations* (1990). By clustering, firms within the cluster are able to benefit from location-specific economies of scale. These agglomeration economies are split into two views.

The theory of Marshall (1920) on agglomeration economies is focused on clusters of firms within the same industry. Marshall describes three sources of agglomeration economies; Information spillovers, non-traded local inputs and local skilled labour pool. Information spillovers are being used to create a better overview of the market by information sharing. This is especially important in the case in dynamic information based markets like the financial sector. Because some sectors require specialist services, firms can benefit by clustering their activities. The major advantage of these non-traded local inputs is the ability to split the costs for specialised activities between firms in the same sector. The local skilled labour pool are most useful for firms in knowledge intensive sectors. As a result of clustering by firms in the same sector, employees tend to move closer to their working place. This will

6

result in lower labour acquisition costs by the firms within the cluster because of the high supply in the area, but another important advantage of this labour pool is that future employees already have enough knowledge and therefore reducing opportunity costs for extensive training.

Hoover (1937, 1948) has developed his own framework on agglomeration economies. His classification of types of agglomeration economies focuses on three levels of agglomeration economies; Internal returns to scale, economies of localization and economies of urbanization. The first level mentioned by Hoover is the firm-specific agglomeration economics. These internal returns to scale primarily focuses on the level of concentration of investment and employment within a firm. By clustering business activities on one location instead of several, firms can achieve location specific internal returns of scale.

The second level is clustering of firms within the same sector. These economies of localization are actually based on the same ideas of Marshall on information spillovers, non-traded local inputs and a local skilled labour pool. Economies of urbanisation are agglomeration economies for firms from different sectors. These urbanisation economies are not directly related to the core activities of the clustered firms, but are still necessary in a supportive manner. Urbanisation economies can be split into a firm-supportive and resident-supportive category. Traditional firm-supportive urbanisation economies are legal and marketing firms for instance, while resident-supportive urbanisation are focussing on the employees by offering retail and leisure facilities.

There is also criticism on the agglomeration effects. Research done by Baptista and Swann (1998) on innovations between 1975 and 1982 in the UK shows that firms are more innovative if the employment in their own branch is strongly developed. This shows that firms should focus on training instead of location to increase innovation. They also conclude that there is not a big spill over effect between firms from different sectors while clusters of firms within the same branche innovate more.

2.3 Cluster models

Next to the ideas of Marshall and Hoover on cluster benefits, several other models have been developed in an effort to gain insight in cluster development. One of the most important models are the growth pole model developed by Perroux (1950). The growth pole model

consist of a cluster, created around one big firm attracting smaller local firms to support their activities. A good example is the Espoo region in Finland, where the global headquarters of mobile phone company Nokia and elevator firm KONE are located. These two firms have attracted many research and development companies and serve the region as growth pole. Richardson (1978) discusses the fact that positive spill over effects will not be created on a short term base but need a long term vision. He also criticizes the growth pole model itself. The most common factor for failure of the growth pole model is the growth pole itself, not attracting local firms in order to create an area wide development. Parr (1999) determined four factors which are of major importance for the growth pole strategy; employment growth, limitation on possible growth pole locations, selectivity for firms that want to be located within the cluster and changing the structure of employment within the region.

In Vernon's paper (1960) on the product life-cycle model research shows that firms tend to locate R&D near corporate headquarters to create an information spill over. When the product moves on in the product life-cycle from the introduction phase towards the growth phase, the company will most likely shift the production towards another location, to reduce costs and start with new R&D.

2.4 Airport land usage

Another important topic is the land usage around airports. One of the leading papers on this topic has been written by Meyer and Miller (1984). In their paper they have created a land use and interaction model based on the development of land around major transport nodes.

This cycle starts with development of land, which increases demand for travel, resulting in a higher pressure on the transport infrastructure that will eventually be improved and will result in improved accessibility. The effect of this cycle will result in a higher demand for land around the airport until the infrastructure can't be improved any further due to external factors like slot restrictions at the airport. Meyer and Miller have concluded that land usage and transport nodes are connected to each other by one major factor: accessibility.
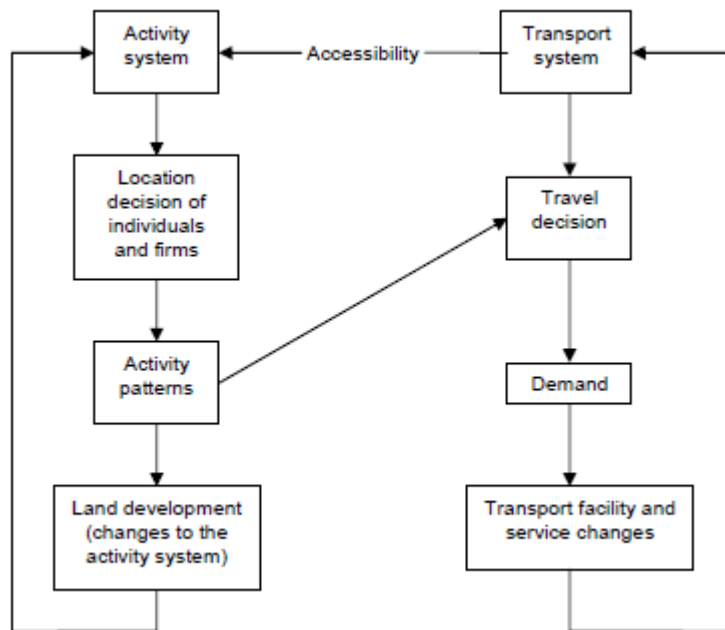
Figure 3.1: Land use and interaction model by Meyer and Miller (1984)

This relationship between land usage and transport nodes have also been discussed by Krug (2002) and Greiving and Kamper (1999). The vision of Pujinda (2006) in its paper on planning of land-use developments and transport systems in airport systems is that airports are currently competing against uncontrolled exploitation of the land around the airport. This will lead to a decreased accessibility and congestion within the airport area, because transport infrastructure lags behind this development. Another airport land usage model has been created by Blanton (2004) called the Airfront. This model described that the area around the airport can be economically developed, by industrial clustering.

2.5 Airport related urban development

Over the last few decades, airports have increased their role as transport nodes for both passenger and cargo transport. This have lead to an increasing demand for land around major airports throughout the world. Over the last decade a few concepts on airport related urban development have been created. This development has started with the concept of an airport city by Conway (1980, 1993) and have been further developed into a wider scale concept by a few authors. This have resulted in the Aerotropolis concept by Kasarda (2000), the Aviapolis concept by Finavia (2004) and the Airfront concept by Blanton (2004). Comparing these three concepts with each other, there are no big differences pointing out. The aerotropolis concept is the most specialised concept and is the leading concept on airport related urban development. Although the aerotropolis concept is an internationally well known and widely discussed concept, there is no ideal concept for airport related urban development.

The aerotropolis concept has been developed and defined by John D. Kasarda in 2000 in his paper on airport driven urban development. The aerotropolis consist of an airport city in the middle, containing aviation related activities like hotels, air cargo facilities and duty free shopping. Kasarda explains in his book *airport cities: the evolution* (2008), the essential drivers of the urban development from airport to airport city and onwards to an aerotropolis. According to Güller and Güller (2002), "*The airport city is a cluster of operational, airport-related activities combined with other commercial and business concerns, on and around the platform*". The most important driver is creating a non-aeronautical revenue source to compete with other airports but also to improve the quality of the airport. Combined with the demand for easy accessible land by real estate developers and the increasing importance as transport node for both passengers and cargo, an airport is being turned into a catalyst for the regional economy.
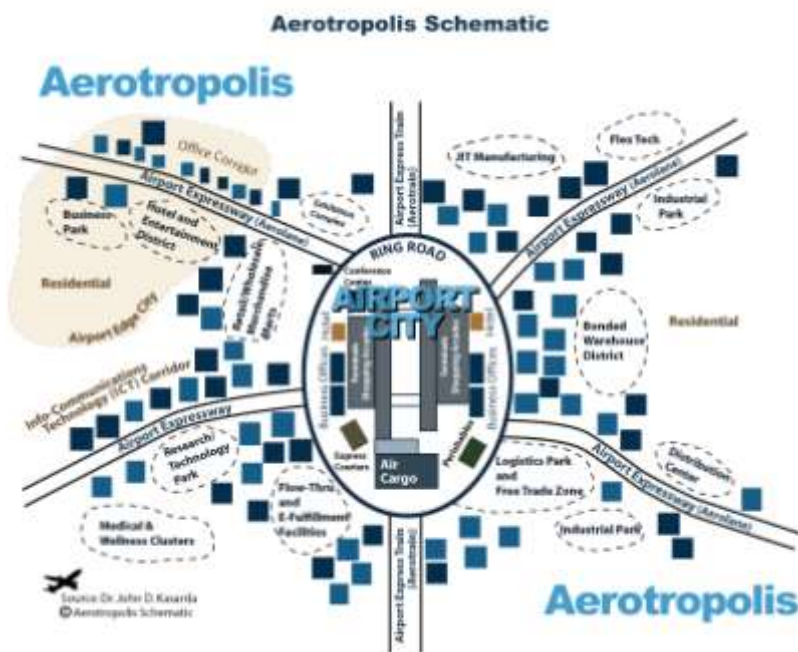
Basically there are two policies of business development within the airport city, discussed in the location study by H+N+S and the planning department of Amsterdam (1998). The first policy is exploiting the site. This policy will result in the establishment of offices next to the airport, by non-aviation related companies that have the highest willingness to pay for it, resulting in a high land price and rent levels. By following this policy, the airport increases the risk of airport congestion. This possibility is also an internal threat to the airport itself.

Because the high willingness to pay for land by non-aviation related companies, the development of the airport itself can be threatened because of land scarcity.

The second one is the protecting the site. This policy restricts the development by giving priority to the airport related activities like cargo handling, maintenance and passenger traffic. With this policy airport land congestion will be reduced to a minimum and secures the possibility for the airport to have enough land capacity for future growth of aviation related activities. In practice we see a hybrid version of these policies benefitting from both the added value created by the non-aeronautical activities and the spare land capacity for future growth of airport.

Because of this hybrid policy, the demand for land is not satisfied because of lack of land capacity within the airport city area. According to Kasarda (2000), the airport attracts business locating along the major transportation corridors between the airport and major cities. This is where the aerotropolis concept starts. The aerotropolis consist of a airport city in the centre, with multiple clusters around it, outside the airport city. These clusters are connected to the airport and city by good infrastructure. By creating a good connectivity between airport and the businesses located around the airport, the airport is able to create value for these firms, by reducing travelling time. Research done by Kasarda, mentioned in his book *airport cities: the evolution* (2008), shows that these clusters can stretch up to 30 kilometres from the airport and that the direct economical impact from the airport can reach up to 90 kilometres for several major airports.

According to Erie et al.(1999), one of the most critical components of creating a successful development of the aerotropolis and clustering near airports is attracting companies that are specialised in ICT and other high tech branches. This has been researched around Washington Dulles airport and Chicago O'Hare airport, two major airports in the US. The high presence of high-tech and ICT branches near airports have also been confirmed by Leinbach and Bowen (2004) for the South-East Asian market. An interesting result of their research is the differences between countries with South-East Asia. Many companies have shifted from Singapore as production facility to regional headquarter, while moving the production facility to countries within the area with low labour costs, like Manilla. But this have also resulted in more high value-adding assembly operations in Singapore. This follows the product life-cycle model by Vernon (1960) that have been discussed in the second paragraph.

Within Europe the leading airport in aerotropolis development is Schiphol, while Asia is lagging behind and slowly introducing the aerotropolis concept for new Greenfield developed airports. The article on logistics and the rise of the aerotropolis by Kasarda (2001) also shows that the switch towards just in time production have boosted the demand for land near airports. By centring distribution centres near airports, companies are able to centralise their stock, resulting in a lower inventory costs.

Although the aerotropolis concept looks successful, there is also critique on this concept. Charles et al.(2007) looks at three different levels on the aerotropolis concept in their critique on the long-term. These three levels are security, energy and export pathways.

By concentrating firms near big international airports, the risk of terrorist attacks will rise because it becomes an even more attractive location to attack. Also disaster with a natural cause can wipe-out entire clusters and critical infrastructure. Especially clusters like ICT and high tech, which are vital to a country are commonly located near airports.

The second dimension the article discusses is the source of energy. By using the airport as centre of economic development, the biggest factor influencing further development is fuel. The current limitation of alternative fuels make the aerotropolis vulnerable for rising fuel prices. These rising prises are being passed onto the consumer by the airline, making air travel more expensive and resulting in a lower demand and less flights. This impacts the connectivity of an airport, but also the connectivity for businesses that are located within the aerotropolis.

Charles et al.(2007) also criticizes the impact of the aerotropolis on the national economy. The aerotropolis model assume that air transport will take over the role of transport by sea. Although an airport offers an high-speed connection for cargo, most international transport is still done by ship. Only perishable and other goods that require fast transport, are being transported by air. Air transport will be used as an complementary way for international transport and not as substitution for sea transport.

Another point of critique is that the aerotropolis will extract businesses from the central business district from the major cities. According to Frej and Al Chalabi(2004), this have

already happened at Schiphol. The willingness to pay for land is higher in the area surrounding the airport in comparison with the central business district. This will lower the economical impact of the aerotropolis if it extracts businesses from the central business districts.

2.6 Aerotropolis bid-rent model

The bid-rent model created by Alonso (1964) has been a development of the Von Thunen model. In contrast to the Von Thunen model, the bid-rent model uses variable coefficients for land and non-land production factors. The bid-rent model by Alonso is based on these two production factors to decide the optimal location and the amount of land for a firm. The bid-rent curve for an individual firm is based on the amount of rent that a firm is willing to pay, assuming a stable level of profitability. By increasing distance to the market place, the amount of rent per square meter will drop in an decreasing rate. This also results in an increase of land quantity, while the quantity of non-land inputs will decrease.

By adapting the bid-rent model, it is possible to introduce land competition by introducing multiple sectors. With this adaption there are a few assumptions. Supply of land is fixed, no technological advantage for a firm within a sector and also the outputs bear the same value and quantity. At the origin, market point M will be the central business district. The bid-rent curve for a sector is based on the individual bid-rent curves for a firm, and shows a different willingness to pay between the various sectors. By combining the Aerotropolis concept with the adapted bid-rent model it is possible to create an Aerotropolis Bid-Rent curve. Central Business District M will become the airport. The highest willingness to pay will be from companies within the Airport city who need to have a direct link to the airport, typical sectors are airplane maintenance, airplane handling, but also the airport retail sector. The second ring around the airport are for aviation related activities like logistical and transport handling, warehousing and distribution, but also for companies that have been described in the Aerotropolis concept, with a high willingness to pay. The third ring will compromise all sectors that have been described in the Aerotropolis development concept, but is also influenced by the distance to the city centre.
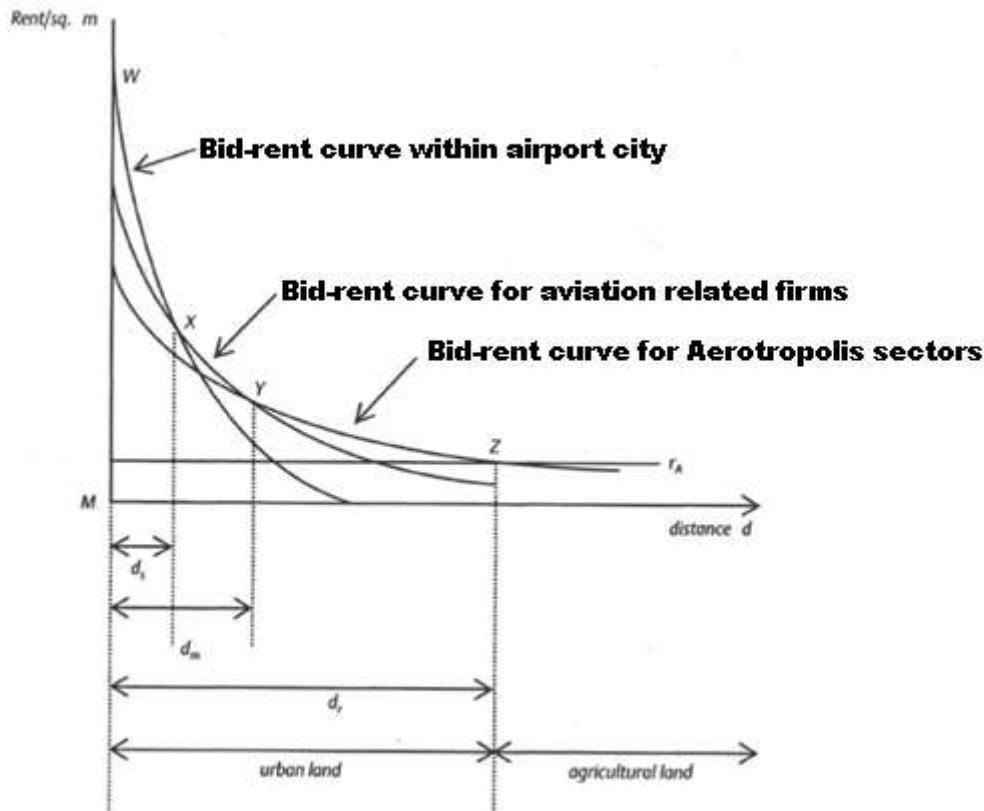
Figure 3.1: Adapted Aerotropolis version of the Bid-Rent curve for multiple sectors, source: Urban and Regional Economics by P. McCann

2.7 Conclusion on literature review

This chapter have discussed several important topics on clustering related to urban development around airports. Although the agglomeration economies are playing an important role on airport related urban development, the main factor of clustering around the major international airports is the presence of the airport. This has been showed by the model discussed in paragraph four. The Meyer Miller land usage model has shown that the relationship between location decisions of firms and travel decision is linked to each other by the accessibility of the location. Accessibility is also a major factor within the aerotropolis concept. Kasarda and other authors that have been discussed, have researched on which sectors typically locate their offices around the airport. Although there is not a single airport in the world that complies to all the characteristics of the aerotropolis concept, it is the most optimal concept for the time being. Therefore this thesis will use the aerotropolis concept as the most optimal concept to analyse the case studies. This will be done by focussing on both the similarities and differences between the case studies and the aerotropolis concept.

14

3. Case Studies

3.1 Case study research design and analysis

For this thesis, there will be 4 case studies. These airports have been chosen based on multiple airport-based factors like amount of flights, passengers and type of airport, but also city-based factors like distance to the city centre and an comparable market. Within Europe Amsterdam and Madrid will be used. Both are important financial centre's of Europe, are close to the city centre, have a similar amount of passenger traffic (43 million versus 48 million), amount of traffic (407.000 flights versus 435.000 flights) with an big hub carrier based on the airport (KLM and Iberia).

For Asia, this thesis will focus on the area around Incheon, which has been developed as International Business district as part of the Incheon Free Economic zone and is therefore an interesting case for looking at policy. Another advantage of Incheon is the fact that it is a Greenfield airport development and have been developed with the aerotropolis concept in mind. For the United States, the focus will be on the Dallas Fort Worth area. The Dallas-Fort Worth metropolitan area has the largest concentration of corporate headquarters in the USA. Although a major airport, traffic at Dallas/Fort Worth airport is primarily focused on domestic passengers traffic within the United States.

The scope for this research will be on a local basis, to reduce the influence of other factors. Therefore, the business areas that are being used for gathering data, will be located within a small distance of the airport. By using four case studies, this thesis will create a closer look about clustering near airports on a worldwide scale, but also focuses on continental differences.

The categories of the types of business that will be used in Schiphol and Dallas cases are based on the ranking of the Forbes Global 2000, containing the 2000 largest companies in the world, based on the sales, profit, market value and total amount of assets. In the Schiphol case, the company specific data is supplied by the Amsterdam Airport Area and have been categorised manually by looking up the company on Google. The data from the Dallas case have been supplied by the US census bureau and have already been categorised into multiple sectors. This data have been adapted to match the categories from the Forbes Global 2000. The selected zipcodes for the Dallas case are: D/FW Airport(75261), Centreport(76155), Las

Colinas(75038, 75039, 75063), Grapevine(76051) and Richardson(75080, 75081). For the case of Madrid Barajas airport, data supplied by the Instituto de Estadistica of Madrid. This data differs from the Schiphol and Dallas case due to the fact that this data have already been categorised into large sectors, that are not adaptable into the Forbes Global 2000 categories. Therefore, this data is rather limited.

The data will be analysed in a qualitative manner as part of the case studies combining both the data and the policy of local authorities. This analysis will look at the sector of the company that is being based in the cluster and look for location patterns within the area. This will result in a clear overview of the location factors influencing the clusters near the four airports that have been used as case study. By comparing it with the other airports from the case study, we hope to detect specific branches that cluster near these airports and intercontinental differences.

3.2 Amsterdam Airport Schiphol

3.2.1 Introduction of the Amsterdam airport area and economic structure

Over the last decades, Amsterdam have become one of the major capitals in Europe. One of the major sectors in Amsterdam is the ICT sector. Nearly 15% of the total amount of jobs in Amsterdam is in the ICT sector. In 2009 the city of Amsterdam was ranked at the 3rd place in the Innovation Cities Index. Also the financial sector in Amsterdam is important for the Dutch economy. The zuidas currently contains the headquarters of global financial giants like ING and ABN AMRO.

The airport of Schiphol is one of the largest airports in the world with approximately 45 million passengers a year. Schiphol Airport is characterized because of its proximity and connectivity with the Amsterdam city centre. Although the airport is an important catalyst for the regional economy, the airport is slot restricted. This means that the authority have set an limit on the amount of flights departing and arriving each year. The structure of Schiphol is rather unique compared to the major airports in the world by having a single terminal instead of multiple terminals like London Heathrow and Paris Charles de Gaulle. The major airlines at Schiphol are easyJet and the airlines in the KLM/Air France group (KLM, Transavia, Martinair and Air France). Because the low amount of origin-destination passengers, the KLM network is focused on connecting traffic. With this type of network, it is possible to offer many destinations through Schiphol.

3.2.2 Policy and main actors

The policy for urban development around the Schiphol area has been divided in multiple levels of authority. The national policy looks at the competitive function of Schiphol, while the policy made by the province of Noord-Holland and the policies by the municipalities of Haarlemmermeer and Amsterdam tend to have a more regional vision and include strict zoning policies. The Dutch government stated in the coalition agreement (2006) that Schiphol should maintain its role as one of the major European hubs. This was also mentioned in the Nota Ruimte (2006) together with the objective to facilitate and stimulate clustering to improve the competitive advantage of the Randstad area. This is being done by reserving enough land for further airport development and prevent new real estate development next to the airport perimeters. The policy follows the protect the site policy created by H+N+S and the planning department of Amsterdam (1998).

The province of Noord-Holland has a more regional vision published in the regional plan Noord-Holland Zuid (2003). On a midlong term, the province targets at increasing the current land usage at Schiphol Centrum, while bearing the protect the site policy in mind. The province of Noord-Holland also applies a very strict zoning policy. The province has set up three different qualifications which will be discussed later on. These qualifications has been based on the Alonso bid-rent model, by creating three rings around the airport while bearing the protect the site policy in mind.

The municipalities of Haarlemmermeer and Amsterdam are combined with the province of Noord-Holland in the bestuursforum Schiphol to coordinate land supply for the development of industrial and offices areas near the airport. To prevent inter-municipal competition on land supply, municipalities that participate in the bestuursforum Schiphol, following the Regional Economic Vision Schiphol 2009-2030. The Regional Economic Vision Schiphol distinct ten promising business sectors that are able to boost the regional economy. Aerospace, ICT, media, fashion, perishables, financial services, health, high-tech, tourism and business supporting companies like legal firms. This vision is in line with the main sectors mentioned in the Aerotropolis development concept by Kasarda. These time-sensitive manufacturing and high-tech companies tend to boost Aerotropolis development by the high demand of air transport and higher willingness to pay for land near the airport. Research done by Berthon

and Bringand (2001) show that around fifty percent of the companies located at Schiphol are American and primarily specialised in ICT technology.

To centralise the land supply and airport business park planning, the main actors in the bestuursforum Schiphol and the Schiphol Group have set up the semi-public Schiphol Area Development Company(SADC). The main goals for this company are area development, centralising marketing and create a connection between commercial and social objectives.

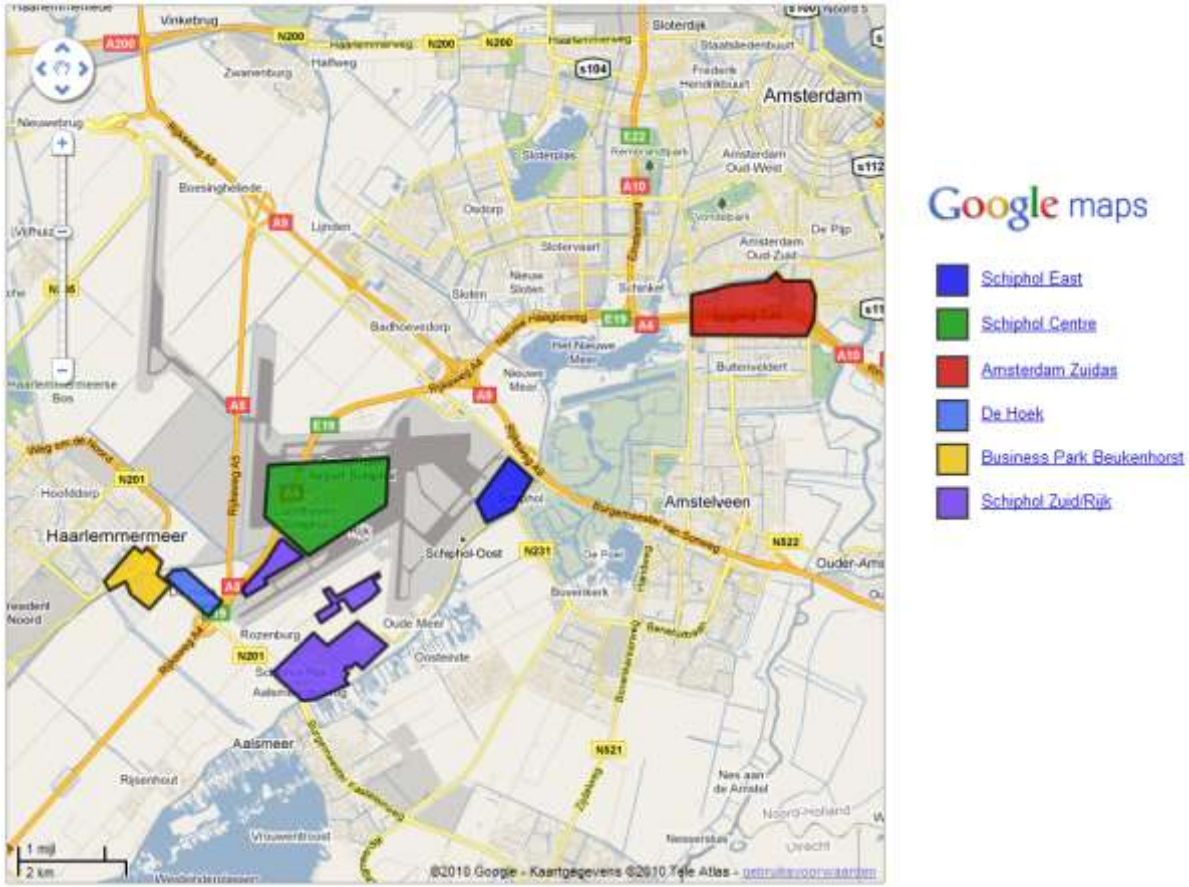*3.2.3 The location patterns of companies around Schiphol airport*

Figure 3.1: Map with the selected business parks highlighted around Schiphol Airport. Source: Google maps

| | | Bedrijvenpark | | | | |
		Schiphol Centre	Schiphol East/Rijk/De Hoek	Business Park Beukenhorst	Zuidas	Total
Category	Banking	1	0	0	11	12
	Conglomerates	0	3	1	1	5
	Oil and Gas	0	1	0	7	8
	Telecommunication	1	6	1	5	13
	Retailing	0	2	0	2	4
	Insurance	0	0	1	2	3
	Utilities	0	2	1	5	8
	Household & personal products	0	1	3	0	4
	Software & Services	1	19	22	19	61
	Technology harware & Equip	0	12	6	5	23
	Food, Drink, Tobacco	1	1	5	6	13
	Drugs & Biotechnology	0	6	8	10	24
	Semiconductors	1	3	3	3	10
	Automotive industry	0	14	3	6	23
	Media	1	2	4	12	19
	Chemicals and raw materials	1	1	2	2	6
	Diversified financials	6	1	2	39	48
	Aerospace	1	6	0	0	7
	Electronics	0	9	15	11	35
	Construction	0	1	0	2	3
	Marketing	2	1	0	11	14
	Legal	0	0	0	6	6
	Fashion	0	0	1	7	8
	aviation and cargo	21	10	0	6	37
	Transportation	5	35	3	7	50
	Education	1	1	0	6	8
	Consultancy	1	4	0	28	33
	Industrial	2	4	3	20	29
	Hotels	2	1	0	3	6
	Other	4	5	9	38	56
Total		52	151	93	280	576

Table 3.1: Frequency table for the selected Schiphol business parks. Data adapted from Amsterdam Airport Area.

Schiphol Centre

The data in table 3.1 shows a high presence of aviation-related companies in the Schiphol Centre area. Especially airlines are located in the Schiphol Centre area, although this result can be biased because some of the airlines are represented by agency's serving multiple airlines. There is also a higher presence of diversified financial companies in comparison with other sectors. These results partially comply with the policy set by the province of Noord-

Holland. Companies are allowed to located their office at Schiphol Centre when they meet one of the three criteria set up by the province.

- Companies are required to have a strong link with high level international transport.
- Part of a highly dynamic business environment.
- Contribute to the movement and exchange of passengers and freight.

This is the first level of the qualification that has been created by the province. Furthermore there is a remarkable and unique situation at Schiphol Centre. Research by Jones Lang LaSalle (2000) shows that the price per square meter of office per year, is almost 45% higher for the Schiphol Centre area, then a comparative office in the city centre of Amsterdam. This can be explained because of globalisation and the importance of accessibility for a firm, instead of location.

Schiphol East, Rijk and De Hoek

The clusters Schiphol East, Schiphol Rijk and De Hoek are the main areas for the Aviation & Cargo and Logisticial sectors. Also the Software & Services and Technology hardware & equipment sector have a high presence in this area. While Schiphol Centre contains the Benelux headquarter of software giant Microsoft, Research and development is being done at their office in Schiphol Rijk. This has clearly attracted other local software companies to locate near the R&D office of Microsoft and complies to the growth pole model by Perroux (1950). Another remarkable result from the data is the high presence of European distribution centre's for fourteen companies in the automotive industry. This complies to the Aerotropolis concept of just-in-time manufacturing and centralised warehousing of companies near airports. Because of the airport, companies are able to rapidly distribute parts throughout whole Europe while keeping a single continental distribution centre.

The main sectors within Schiphol East/Rijk/De Hoek clusters are Aviation & Cargo and the logistical sector. This is related to the cargo handling at the east and south side of the airport.

These clusters are level 2 clusters according to the classification by the province of Noord-Holland. Companies that are willing to locate their office in these clusters have to meet one of the criteria:

- Offices of aviation related companies operational on Schiphol.
- Headquarters of international operating companies who require the presence of an airport because its core activities require frequent flights.

- Offices of airport bounded distribution and production firms.
- Offices of firms that are part of the airport related logistical chain.
- Offices of firms that are currently located at the airport but have to relocate their office.
- Offices of foreign companies, that want to locate their first office in the Netherlands or Europe.

Business Park Beukenhorst

Business park Beukenhorst is located in the Hoofddorp area 2,5 kilometres from Schiphol. The area has a direct connection with the airport by public transport and by road. These are one of the main requirements of creating a succesful Aerotropolis cluster. The data in table 3.1 shows a high presence of companies in the Software & Services and Electronics sector. This corresponds with the sectors that can are attracted by the Aerotropolis development concept. Looking at other sectors, there is also a slightly higher presence of firms within other high-tech sectors like Drugs & Biotechnology and Technology hardware & equip. The high presence of these knowledge based sectors can point out to a local skilled labour pool and economies of localisation. In comparison with the other clusters researched, Business Park Beukenhorst has the highest presence of companies within high-tech sectors.

Zuidas

The Zuidas is a newly developed international business district located at the south side of Amsterdam. The Zuidas has a very good connection to various types of public transport. Schiphol is approximately 8 minutes by car, the future North-South subway line will improve the connection with downtown Amsterdam and the Amsterdam Zuid train station is a stop for the ICE towards the Ruhr-area. The public transport connectivity boost Aerotropolis and cluster development. The data in table 3.1 shows an significant high presence of companies related to the financial sector. The main sectors in the Zuidas are diversified financial firms, most of them have investment banking and leasing activities as core business. Another high presence can be found in the consultancy sector, with nearly 10% share in the Zuidas sector. This sector, is together with the marketing and legal sector, part of the firm supportive activities. These clustering activities achieve firm-supportive economies of urbanisation by Marshall. There is also a notably higher presence of software firms, most of them are specialised in developing financial software

Both the Zuidas and Business Park Beukenhorst are level 3 clusters according to the Schiphol zoning policy by the province of Noord-Holland. Firms located in these clusters have several criteria for being allowed to establish an office.

- Offices of foreign owned companies, with activities in several countries.
- Offices of Dutch firms with substantial activities in foreign countries.
- Offices of firms that are part of the airport related logistical chain.
- Offices of firms that are currently located at the airport but have to relocate their office.
- Offices of airport bounded distribution and production firms.

Overall, the results of the Aerotropolis development concept is quite visible in the Schiphol area. This concept has been applied in the policy making process by all actors. The typical industries that an Aerotropolis attracted are all highly present. Especially the high amount of software and other high-tech industries have boosted the development of clusters near the airport. Also Just-In-Time manufacturing and logistics are important markets for Aerotropolis development. The spatial distribution of the sectors comply with the Aerotropolis development concept, being located around the airport city in the core, next to important highways and public transport facilities.

3.3 Madrid Barajas Airport

3.3.1 Introduction of the Madrid Barajas airport area and economic structure
Over the last 20 years, Madrid has developed itself from Spanish capital towards a European capital. Since the 90's, Madrid has had the highest economic growth compared to other European and OECD cities (2008). The two major sectors that have contributed to this growth are the service sector and logistical sector. Although Madrid has become one of the major cities in Europe, the amount of research and development lies below the European average. Nevertheless, Madrid has a high potential to increase its role, by improving the clustering of the aerospace, electronics and financial sectors.

Madrid Barajas airport is characterized by its proximity to the city centre of Madrid in comparison with other airports located near a capital. The airport of Madrid Barajas has been expanded in the beginning of the 21st century to accommodate further passenger growth and traffic movements by the construction of a new terminal, for Iberia and its alliance partners, and the construction of 2 new runaways. This resulted in a rapid increase of passenger

movements and took over the fourth place of busiest European airport(based on passenger amounts) from Schiphol. Although the airport of Madrid is one of the largest airports in the world and has a high market potential for companies to locate their office next to the office, real estate development has not been the primary objectives of airport operator AENA.

3.3.2 Policy and main actors

The main actor that plays a role in the real estate development near the airport is by the Madrilean institute of urban development IMADE. The IMADE is responsible for urban economic development in the community of Madrid, but also responsible for the planning of new business parks. Another major objective of the IMADE is implementing the logistic infrastructure plan of Madrid. This plan will create approximately 120.000 jobs in 12 years and has been created to minimize transport costs by the relocating and clustering of logistical activities in newly developed clusters and optimizing the transport chain.

Further real estate development is being done by private actors around the airport, but on a much smaller scale compared to Schiphol. AMB Property Cooperation has recently developed a major logistic park near the airport but also the logistical cluster in Coslada has been privately developed.

To coordinate and connect the logistics sector with each other , the local and regional administrations in the community of Madrid have set up the Madrid Logistic Platform Association together with the private companies that are part of the sector. The main reason of the establishment of this platform is to improve the competitiveness of the Madrilean logistic and transport sector by implementing innovations in intermodal transport, research & development and education of skilled employees.

3.3.3 The location patterns of companies around Madrid Barajas airport

The five business parks that have been chosen for this paper are all located within a 20 kilometre radius from the airport. The data that is supplied by the community of Madrid, consists out of 18 categories and is categorised in a very broad manner. The data also hasn't been split into firms per business park, but the town as a whole.
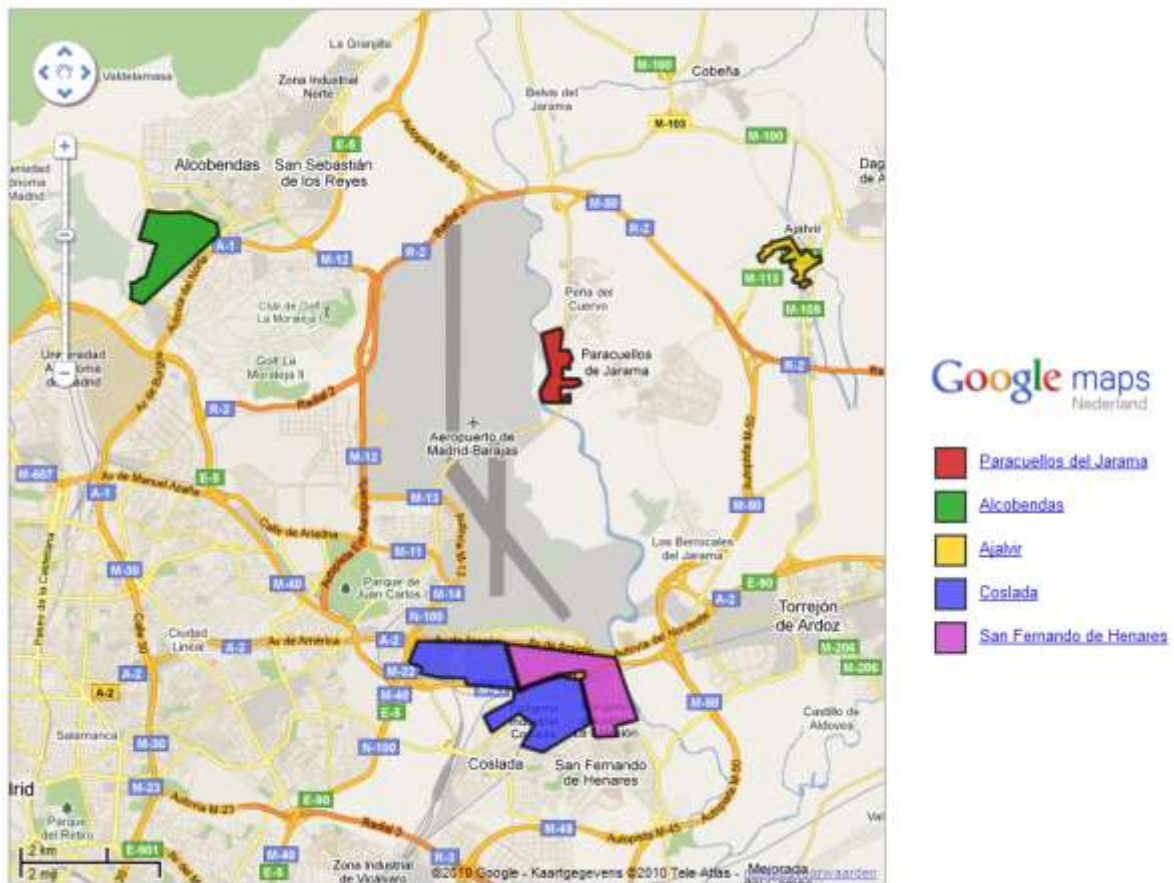
Figure 3.2: Map with the selected business parks highlighted around Madrid Barajas Airport Source: Google maps

	Bedrijvenpark					
	Ajalvir	Coslada	Paracuellos del Jarama	San Fernando de Henares	Alcobendas	Total
Energy and Mining	0	0	1	1	7	9
Basic metals	2	1	1	3	3	10
Metal products	18	10	10	10	8	56
Industrial machinery	8	16	2	4	15	45
Electrical and electronic goods	4	9	2	19	27	61
Textiles, clothing and footwear	0	4	0	1	6	11
Paper, Print	6	13	6	22	28	75
Chemical industries	5	15	6	23	24	73
Non-metal industries	2	3	2	2	4	13
Other manufacturing	6	4	14	7	10	41
Construction	13	62	12	31	67	185
Hotel and catering	2	50	1	9	86	148
Transport and Logistics	4	110	8	37	48	207
Real estate and rental	2	4	4	11	26	47
Business Services	4	55	7	36	219	321
Personal services	4	1	0	2	12	19
Financial services	0	9	1	5	39	54
Transport material	2	1	0	3	3	9
Total	82	367	77	226	632	1384

Table 3.2: Frequency table for the selected Madrid business parks. Data from Instituto de Estadistica of Madrid.

Ajalvir

The town of Ajalvir consists of four industrial business parks at 14,5 kilometres from the airport. Data shows a high presence of the metal and construction sectors. This higher presence can also be detected in other industrial sectors like industrial machinery and other manufacturing sectors. The location pattern of these sectors near the airport are not in line with the Aerotropolis development concept of the typical sectors within the Aerotropolis. This can also be explained due to the fact that the major corridors between the airport and Madrid are towards the southwest while Ajalvir is located in the northeast of the airport.

Alcobendas

The city of Alcobendas is one of the largest cities around Madrid and has one very large business park, Valdelacasa. This business park has increased the total area with over 400.000 square metres over the last few years and is currently the largest business park in the whole

Madrid area. Valdelacasa is being developed as an high-tech and high skilled business park. Because the area development hasn't been complete yet, there is still a lack of high-tech firms. This is clearly shown in the data from table 3.2, which only shows a very large presence of business services in this area. This sector is complemented by the slightly higher presence of financial services. The high presence of business services can be explained due to the presence of the major highway that leads alongside the business park and is very close to the newly Cuatro Torres financial district. One of the big advantages of this area is the proximity of the university of Madrid and will most likely improve the research and development within the Madrid area. Being located next to a major university improves the information spillovers between companies as well as between the university and companies. Because of its proximity to both the airport and the new offices, Alcobendas is also an important location for hotels and logistical firms. Although Alcobendas fits within the Aerotropolis development concept, it is remarkable to see the high presence of firms within the construction sector. This can be explained by the fact that Spain is the leading country within Europe for the construction sector which has been researched by Eurostat (2010).

Coslada and San Fernando de Henares
Coslada is the major area for logistical firms to locate. This is due to the proximity of the cargo activities side in the southern part of the airport. Coslada is located 11 kilometres from the airport and contains the majority of logistical firms compared to the other clusters that have been researched. This cluster is very comparable to the Alcobendas area. Both have attracted hotels and business services due to its location between airport and city, which is clearly described in the Aerotropolis development concept. Also the presence of the highway next to the cluster is part of the concept. Like Alcobendas, the construction sector also has a large share in this area. These four sectors have a combined share of 75% within the Coslada cluster.

Just like Coslada, its neighbour town San Fernando de Henares also shows an higher presence of logistical, construction and business services sector. There is also a higher presence in industrial sectors while the hotel sector is lacking. This can be explained because of the distance to the airport. Both Coslada and Alcobendas are located approximately 11 kilometres from the airport and are the main hotel locations, while San Fernando de Henares is located at 17 kilometres from the airport.

Paracuellos del Jarama

Paracuellos del Jarama is located on the east side of the airport and consists of one small business park, Polígono El Cerbellón, with 77 firms in total. The 3 major sectors in this area are construction, metal products and other manufacturing. Although its proximity to the airport, this cluster can't be seen as an cluster that is part of the Aerotropolis development concept. Another interesting result from the data is the lack of hotels in the area. Comparing this to Coslada and Alcobendas, which are also located at 11 kilometres from the airport it shows that access to major highways to the city is an important factor for location decisions.

The lack of an developed airport city at the airport is one of the reasons why Madrid Barajas airport can't be seen as an Aerotropolis. Also, even though Madrid has a high presence of firms within the business and financial sectors, the area around the airport misses the presence of high-tech and ICT firms. Combining both data and a map of the area, shows that the clusters with a high presence of firms within the logistical sector and hotel sector are both near major corridors between airport and city. The area of Madrid Barajas airport is still not in line with the Aerotropolis development concept, but have a high potential to become one in the future when the Valdecasa business park has completely developed and generating knowledge spillovers between firms and the university resulting in an improvement of the high-tech and contributing to a high skilled labour pool.

3.4 Seoul Incheon Airport

3.4.1 Introduction of the Seoul Incheon airport area and economic structure

Since its opening in 2001, the newly developed Seoul Incheon airport have became one of the world's largest airports in the world. Seoul Incheon airport is located on the Yeongjong island 70 kilometres from Seoul and is connected by rail and road to the South-Korean mainland. The Incheon Free Economic Zone consists of three areas: Yeongjong, Songdo and Cheongna and are created to transform the area into the most important hub for logistics, international business, leisure and tourism within the Northeast Asian region by stimulating economical growth within these sectors. The most important area within the Incheon Free Economic Zone is the privately developed Songdo International Business District. The Greenfield development has been built on reclaimed land from the sea and is located 65 kilometres from the South-Korean capital Seoul and 13 kilometres from Seoul Incheon Airport. Songdo is currently the world's largest private real estate project in the world. Songdo is being

developed to become the world's greenest city by implementing environmental friendly techniques.

The South-Korean economy is one of the most important economies is the world. The main sectors within South-Korea are the automotive industry, electronics, shipbuilding and high-tech sectors like biotechnology and ICT. After the 1980s the South-Korean government decided to shift from an industrial to a high-tech economy by putting education as one on their top priorities. Although the South-Korean economy is important within the region, research done Oum and Park (2004) shows that out of the 83 surveyed European and American multinational cooperation's, only 2 have located their regional headquarters in South-Korea, compared to 15 in Singapore. This result is also visible when looking at the regional distribution centres. In this case, only 5 out of 83 are located within South-Korea. Oum and Park also measured the relative importance of locational determinants for distribution centres, specified per country. For South-Korea, the top three consisted of accessibility to the county via port or airport, skilled labour force and the ICT infrastructure within the country.

3.4.2 Business incentives with the Incheon Economic Free Zone

The national South-Korean government and local government are eager to attract new companies and new foreign direct investment to the area by implementing several tax incentives. Especially high-tech and logistical companies profit from this tax reduction. South-Korean taxes have two levels, national taxes like corporate and income tax and regional taxes focussed on the acquisition of land and property. High-tech companies gain the most benefits from these tax reductions. These companies can import capital goods without paying tax for 3 years, don't have to pay corporate taxes for 5 years and no property taxes for the first 10 years. These tax rebates also apply to manufacturing, tourism, logistic and R&D sectors, the only difference is that there is a minimum investment level to apply for these tax rebates.

3.4.3 The location patterns of companies within the Incheon Economic Free Zone

Because the Incheon Economic Free Zone still has to be fully developed, the research is being done based on the current plans for economic development and zoning policy within this area.

The data supplied by the authority only consist of foreign invested companies within the three areas.

Figure 3.3: Map with the selected business parks highlighted around Seoul Incheon Airport Source: IFEZ guide book (2010)

Yeongjung

Seoul Incheon Airport is located on Yeongjung island. The presence of the airport have contributed to the development of two major clusters, aviation and logistics. The development of Yeongjung will also be focused on the leisure and tourism sectors. Seoul Incheon airport is a good example of the protect-the-site policy near the airport. Data shows that the majority of companies located next to the airport are logistical or other aviation related companies. The Yeongjung aviation cluster will have 2 separate functions.

This aviation cluster will focus on research and development but also on maintenance. The Incheon Free Economic Zone authority intends to create a fashion and design cluster on Yeongjung island. Also the medical sector will be cluster on Yeongjung island, particularly due to the high amount of tourist that visit South-Korea each year for medical treatments. To stimulate R&D within this sector, also pharmaceutical companies and medical universities are

being located in this cluster. This will increase knowledge spillovers between the various institutes. Yeongjung will also become the major island for leisure and living by the development of the residential Sky City area.

Cheongna

The second area of the Incheon Free Economic Zone is Cheongna. Cheongna will become the major international finance and business hub within the area. The most important cluster on Cheongna will be the automotive industry. To improve research and development within one of South-Koreas most important sectors, the Incheon Free Economic Zone authority have attracted GM Daewoo Motors to build a new R&D facility and test track in the area. This growth pole will most likely attract foreign companies from the automotive industry. By creating an automotive cluster on Cheongna companies can achieve agglomeration economies that have been discussed by Marshall. The development of this test track can be seen as a non-traded local input, but also the attraction of a local skilled labour pool will create agglomeration economies. Cheongna

Songdo

Songdo is the biggest of the three areas within the Incheon Free Economic Zone. This Greenfield investment led to the possibility to create the optimal Aerotropolis by NSIC, the joint venture between real estate developers POSCO E&C and Gale International. In cooperation with the local authority NSIC has set out a very strict zoning policy for the area, to achieve the highest willingness to pay from firms that want to locate within Songdo. The main sectors within Songdo will be education, biomedical and other high-tech industries. The main objective for the development of Songdo is creating knowledge spillovers by combining business, universities and research & development. But also creating an optimal location for establishing continental headquarters for multinational cooperation's. When looking at the current zoning plan of Songdo, it is possible to divide the area in three parts: education, the international business district and knowledge based business.

The World Best Business City

Songdo
- (A) NEATT (B) Songdo ConvensiA (C) Songdo International School
- (D) Songdo Central Park (E) IFEZ Arts Center
- (F) 151 Incheon Tower (G) Jack Nicklaus Golf Club Korea
- (H) RFID/USN Center (I) POSCO R&D Center (J) Tomorrow City
- (K) Shopping Mall (L) International Passenger Terminal (M) Canal Walk

Figure 3.4: Map with the selected business parks highlighted in Songdo Source: IFEZ brochure (2009)

The Songdo Technopark is focused on research on biotechnology. Because of the joint trial and testing facility that have been build in this cluster, the biotech companies in the Technopark can achieve agglomeration economies. The Technopark will also be home for venture capitalists to invest in these firms. The Technopark is located next to the university cluster in Songdo. Also for these universities special requirements apply to be allowed to locate a campus in Songdo.

31

Data shows that the majority of universities within this cluster are focused on either biotech, high-tech or IT education. The two knowledge based clusters within Songdo are primarily focussing on the development of IT research and development and other high-tech industries. Clustering within these two clusters is also being done. By clustering the companies that are specialised in radio- frequency identification and ubiquitous sensor networks within one building, policy makers hope to achieve economies of localization. When comparing the Aerotropolis development concept to Songdo, it complies with the main sectors that have been described by Kasarda; located very close to the airport and attract several travel demanding sectors.

The area around Seoul Incheon airport complies with the characteristics described in the Aerotropolis development concept. Although this area still has to be fully developed, the Incheon Free Economic Zone authority has implemented an almost ideal plan to develop the area into an Aerotropolis. Even though Seoul Incheon airport is located far away from downtown Seoul, good connections by road and public transport to Songdo, Cheongna and onwards to Seoul stimulate the Aerotropolis development. But, the current three area structure have created a major disadvantage. At this moment, the designated living area on Yeongjung island fails to attract residents due to the fact that crossing one of the two bridges to Songdo or Cheongna costs 15000 Korean won on a daily basis. Because of this disadvantage, people tend to live in one of these two areas. All in all, the area around Seoul Incheon airport will most likely become a major Aerotropolis and an important area for high-tech research and development, but not in the current short term. The three areas within the Incheon Free economic zone will be totally developed in the years between 2015-2020 and later.

3.5 Dallas/Fort Worth Airport

3.5.1 Introduction of the Dallas/Fort Worth airport area and economic structure
The Dallas metropolitan area has two major airports, Dallas Love Field and Dallas/Fort Worth. Because Love Field is a low-cost carrier airport without international flights, this case will focus on Dallas/Fort Worth. The airport of Dallas/Fort Worth is located in the Dallas Fort-Worth metropolitan area and is one of America's busiest airports based on passenger figures. The airport of Dallas/Fort Worth is being controlled by the municipalities of Dallas and Fort Worth. The airport is the largest hub for Dallas-based American Airlines, but also an important hub for cargo airline UPS.

The Dallas Fort-Worth metropolitan area is the major location for corporate headquarters throughout the United States. The most important firms that are located in this area are IT, telecommunications, electronics and computing firms, but also financial firms have a high presence in the metropolitan area.

The area around Dallas/Fort worth contains a few business parks, which are mostly public-privately developed. This results in a strict zoning policy to prevent inefficient use of land in these business parks. The three important business parks around the airport are: Las Colinas, Centreport and Grapevine. But also the further located Ricardson area has a big influence on the airport.

3.5.2 Policy and main actors

The municipality of Richardson has a quite strict zoning policy. Along the highway US 75, the majority of the technology firms are located. To attract companies to the area, the municipality of Richardson have set up an tax increment finance zone in the area. The projected rise in property tax value within this zone, is being used to finance specific infrastructure. The main objective for setting up this specific zone is encouraging redevelopment in the telecom corridor. By financing specific infrastructure, the municipality creates a non traded local output to boost agglomeration economies.

Creating a tax increment finance zone is a common practice in the area. Also for the Las Colinas, the city of Irving have created a tax increment finance zone. To attract companies, the city of Irving also uses another tool to attract companies to Las Colinas, by implementing a tax incentive for new, relocating and expanding companies. This tax incentive is focused on lowering property taxes with more than 30% up to 10 years.

3.5.3 The location patterns of companies in the Dallas/Fort Worth metropolitan area

For the analysis of the cluster in the Dallas/Fort metropolitan area, five areas are being analysed. Three of these areas are located directly next to the airport, the airport area itself and a high-tech area at 40 kilometres from the airport. The data have been supplied by the US census bureau and the Richardson chamber of commerce.
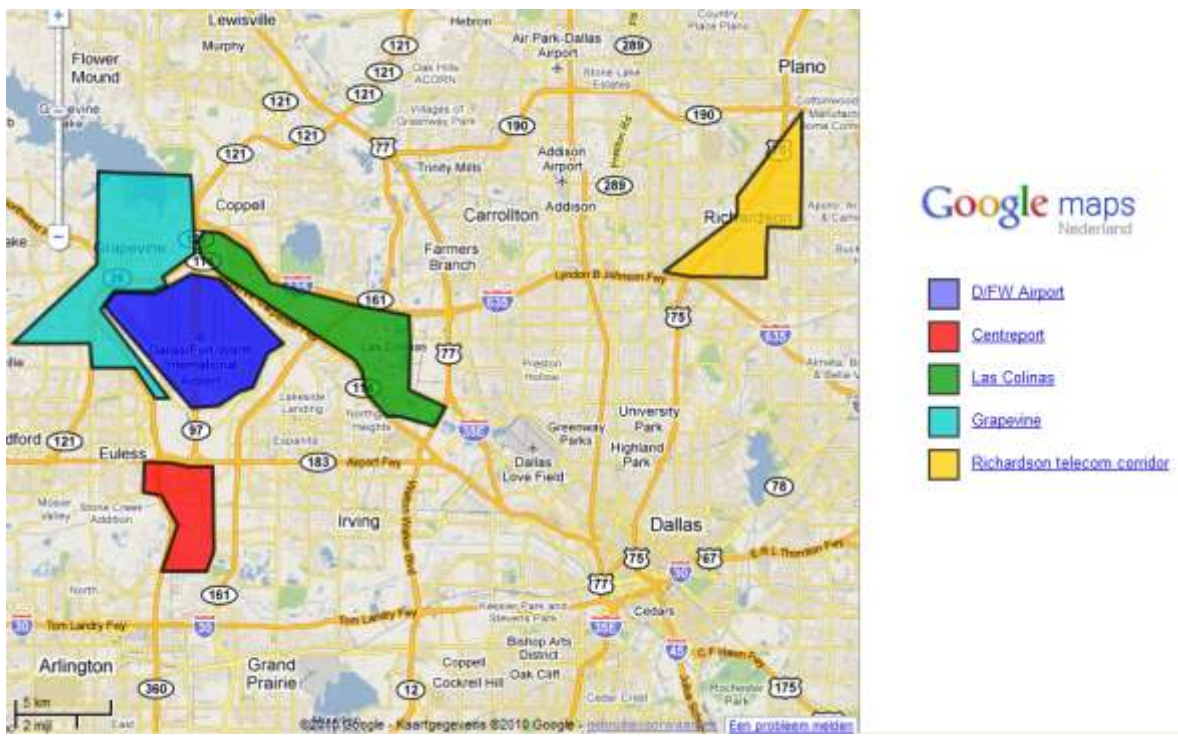
Figure 3.5: Map with the selected areas around Dallas/Fort Worth Airport Source: Google maps

	Bedrijvenpark					
	D/FW Airport	Centreport	Las Colinas	Grapevine	Ricardson	Total
Banking	0	4	48	25	55	132
Oil and Gas	1	0	26	3	20	50
Telecommunication	30	15	108	18	168	339
Retailing	51	24	21	14	0	110
Insurance	0	0	145	31	115	291
Utilities	0	3	5	2	6	16
Household & personal products	0	0	56	0	0	56
Software & Services	0	0	128	48	148	324
Technology hardware & Equip	0	0	49	3	102	154
Food, Drink, Tobacco	59	3	29	30	0	121
Drugs & Biotechnology	0	2	14	0	10	26
Semiconductors	0	0	5	0	70	75
Media	0	12	65	6	7	90
Diversified financials	4	14	362	91	155	626
Electronics	0	6	80	5	72	163
Construction	3	6	19	14	53	95
Marketing	0	5	55	11	5	76
Legal	0	0	33	28	61	122
Fashion	0	0	2	0	3	5
Aviation and cargo	42	41	11	20	1	115
Transportation	57	19	97	142	25	340
Education	5	3	9	6	5	28
Consultancy	4	8	106	42	84	244
Industrial	5	0	31	11	0	47
Hotels	2	3	57	8	12	82
Other	41	32	83	57	57	270
Total	304	200	1644	615	1234	3997

Table 3.3: Frequency table for the selected areas in the Dallas/Fort Worth metropolitan area. Data from the

US census bureau: County Business Patterns.

Dallas/Fort Worth airport area

The Dallas/Fort Worth airport area is in line with the airport city concept. Although the Dallas/Fort Worth airport authority has a very strict zoning policy, data shows that it follows a hybrid version of the exploit/protect-the site because of the small amount of offices from non-aviation related sectors on the airport grounds. Also the transportation and logistical sector has an high presence in the area, primarily due to the large The Dallas/Fort Worth area is definitely an airport city because of its high presence of firms in the aviation and cargo sector, airport retailing and catering.

Centreport

The Centreport area is located south of Dallas/Fort Worth airport. It is completely developed by a private developer commissioned by GM asset management. An important advantage of the Centreport area is the fiber optic network that have been specially developed for this area. This network will achieve agglomeration economies by the advantage of this non-traded local input. When looking at the data supplied by the US census bureau, a high presence of firms in the aviation related industries are being found. This high presence is not in line with the Aerotropolis development concept that clusters the aviation sector at the main centre in the airport city. Also the telecommunication and diversified financial firms have a slight higher presence. Centreport can be seen as an mix of an airport city and an Aerotropolis cluster. Its connectivity and location is in line with the Aerotropolis development concept but the high presence of aviation related firms are more in line with the airport city.

Las Colinas

Las Colinas is the largest area around Dallas/Fort Worth airport and is the most important area as business location. The area is being developed by the city of Irving and has a strict zoning policy focused on gaining the highest clustering benefits. Data shows that the diversified financial sector has the highest presence. This can be explained by the high amount of venture capitalists and investment banking activities in this area. This correlate to the high presence of firms in the telecommunication, software and services and the electronics sector. Because research and development for these high-tech sectors require a lot of funds, venture capitalists are able to ask high yield on their investment. Also the transportation and logistical sector has a high presence in this area. Las Colinas is definitely in line with the Aerotropolis development concept. Its location and the type of sectors within the area contribute to the

airport development, while local authority improves land usage efficiency by setting up a strict zoning policy.

Grapevine

Grapevine is located on the northern edge of the airport. And is one of the smaller communities near the airport. Data shows that Grapevine is the most important area for the transportation and logistical. This can be explained due to the fact, that the northern part of Dallas/Fort Worth airport is reserved for cargo activities. By looking at the data in table 3.3, it can be concluded that the Grapevine area is exploiting firm-supportive urbanisation economies. The important sectors in the Grapevine area are the banking, diversified financial, insurance and consultancy sectors which are supported by marketing and legal firms around it. Another sector with a high presence is the software and services sector. The location and connectivity to the airport of the Grapevine area comply with the Aerotropolis development concept. Also the high presence of transportation, logistical and software sectors are in line with the concept.

Richardson telecom corridor

Although located at almost 40 kilometres from Dallas/Fort Worth airport, the telecom corridor that is based near Richardson is a major specialised cluster in the Dallas area. Data shows that the main sectors within this area are specialised in high-tech technologies. This complies with the Aerotropolis development concept. In the Ricardson area, a major sector is the telecommunication sector which is located near two major growth pole firms: AT&T and Verizon, the two biggest telecom firms in the United States. These two growth poles have attracted several smaller telecommunication firms to the area to support their activities. Another major employer within this area are the financial services and insurance sectors. This follows the same trend as the data in table 3.3 about Las Colinas. An logical explanation for this is the dynamic financial market. By clustering this sector, firms are able to gain information spillovers to create a better overview of the market.

Another major sector in the Richardson area are sectors that are related with high-tech electronics like the semiconductor sector, software and services sector and the technology hardware and equipment sector. By clustering these sectors, it is able to reduce transport costs of materials. This will also created knowledge spillovers and improves high-tech research and

development within the area. While comparing the infrastructure around the telecom corridor to the Aerotropolis development concept, an usual characteristic shows up. Although the telecom corridor is located along a major highway, it is not directly connected to the airport. Also the public transport system has no direct connection to the airport. Travellers are required to switch lines at Dallas Union Station. The Ricardson area comply with most of the Aerotropolis development concept characteristics, but its location and suboptimal connection with Dallas/Fort Worth airport are a disadvantage for the area.

All in all, the area around Dallas/Fort Worth is in line with the Aerotropolis development concept. The characteristically high-tech and time-sensitive sectors like transportation are all present in a high amount near the airport. Also the area of the airport itself complies with the airport city concept. Although Ricardson is located further away than the other areas that are analysed for this case, it is still part of the Aerotropolis area, but has a disadvantage because of its location and connectivity to the airport to become the major business district in the Dallas Fort-Worth metropolitan area.

4. Conclusion and final remarks

4.1 Conclusions

The research question of this paper is:

"What types of business locate their offices near airports, is there an location pattern and is there a difference between continents?"

The main objective of this thesis was to find out whether or not, certain sectors cluster around large airport throughout the world. By comparing the areas around four major international airports in the world, it was possible to detect several sectors that can boost Aerotropolis development. The aerotropolis concept have proven to be a good framework, but is still not ideal. This is especially in the case of Madrid Barajas airport. The framework has been an important feature in the analysis to compare with.

The airport of Schiphol has showed to be one of the best developed Aerotropolis areas. The Aerotropolis development have been boosted by local authority with strict zoning policies and a high connectivity from the airport to the several clusters within the area. The most important

clusters in the proximity of Schiphol are the Zuidas, Schiphol Rijk and Beukenhorst areas. Data has showed that especially ICT, high-tech, financial and logistical firms have located near the airport. These sectors are the main sectors that are able to boost Aerotropolis development. Also within the airport city, non-aviation related business activities are present.

Real estate development and Aerotropolis development around Madrid Barajas airport is lagging behind, compared to the other three airports. Madrid Barajas airport lacks an airport city, but also the absence of the ICT and high-tech manufacturing sectors have led to the conclusion that it can't be seen as Aerotropolis. This is also visible in the gathered data. Two small sized business parks in Ajalvir and Paracuellos del Jarama are both not compliant with the Aerotropolis development concept. The high presence of the business services sector can also be explained because of the growing importance of Madrid as European metropolis and financial centre. Another interesting point has been the policy by the airport authority. Compared to Schiphol, Seoul and Dallas, the Madrid Barajas airport authority AENA is exercising a strict protect the site policy on airport grounds.

The areas around Seoul Incheon Airport have been totally developed to serve as Aerotropolis. Because of its Greenfield development, it is possible for local authority and the private developer to improve land usage by setting a very strict zoning policy. Also the potential for agglomeration economies is very high in this area, by the combination of internationally well-known universities near the high-tech and biotech clusters in Songdo. One of the major advantages is the presence of the Incheon Free Economic Zone authority to coordinate the land usage within the area. Although the majority of the area still has to be developed, it is possible to conclude that the Seoul Incheon area is a rising Aerotropolis and will most likely become one of Southeast-Asia's most important logistical and business hub.

Like Schiphol, the area around Dallas/Fort Worth airport is also a highly developed Aerotropolis. The high amount of corporate headquarters in the area has lead to the attraction of several smaller firms, compliant to the growth pole model by Perroux. The difference however is, that the area contains multiple growth poles within the same sector. When looking at the dominant sectors within the clusters that have been researched, it can be concluded that it are all sectors that are mentioned in the Aerotropolis development concept, high-tech,

logistical and financial sectors. The bad connectivity by public transport can be explained due to the fact that the US has the highest amount of vehicles per 1000 residents.

It was also possible to detect a location pattern of firms with the cases of Schiphol, Madrid, Seoul and Dallas. The clusters that have been located near the airport are all along the corridor between the airport and the city. The importance of the corridor between the airport and the city was clear in the Madrid case, when looking at the Ajalvir and Paracuellos del Jarama business parks. Although these parks are located very near the airport, they are relatively small in size.

When comparing the airports with each other, it can be concluded that there is also no difference between the various continents, all four airports attract high-tech, ICT, logistical and financial firms in the area. The presence of the logistical sector is understandable due to the cargo activities of these major airports. Also due to globalisation, the firms within the financial sector are locating offices near the airports. These case studies have also confirmed the research done by Erie et al. (1999), stating that the ICT and high-tech sectors are crucial in Aerotropolis development, and the validity of the Aerotropolis development concept created by Kasarda (2000). Based on these four case studies, it can be concluded that a good connection between the airport and the clusters are not necessary for Aerotropolis development. The areas around these four airports are limited to a strict zoning policy set up by local authority, but does not require intra-municipal planning.

	Airport Area			
	Schiphol	**Madrid**	**Seoul**	**Dallas**
Airport City	x		x	x
Protect the site policy		x	x	
Exploit the site policy				
Hybrid Exploit/Protect the site policy	x			x
Clusters along corridors to the airport	x	x	x	x
Good connectivity by public transport between airport and clusters	x	x	x	
ICT clusters	x		x	x
High-tech manufacturing clusters	x		x	x
Logistical and transport clusters	x	x	x	x
Financial clusters	x	x	x	x
Intra-municipal planning authority	x	x		
Strict zoning policy	x	x	x	x
Rising Aerotropolis			x	
Fully Developed Aerotropolis	x			x

Table 4.1: Summary of policy and clusters from the case study

4.2 Limitations of research

The small scope of this thesis have also lead to an important limitation. Because of the small amount of case studies, it is not possible to give a general conclusion what kind of business locate their offices near airports. Also within the case studies there is a small scope. By selecting only 4 or 5 business parks, it is impossible to see the impact on regional basis. The influence of the city on clustering is also neglected in this thesis. Although the aerotropolis concept is not the ideal concept, it was the most optimal concept available or this thesis. The data from the Madrid case is not optimal for this kind of research, but can be used in an adapted way.

4.3 Recommendations for further research

This thesis have been created with an Aerotropolis-based view. Therefore, a good recommendation for further research is looking at the influence of an airport on location preferences with an firm-based view. This can be done by looking at the corporate headquarters throughout the world and compare average distances between headquarter and airport for various sectors. I hope to do this for my master thesis with the headquarters of the

2000 largest companies in the world to see if there is a relation between these two variables. Also increasing the scope by increasing the amount of airports is an option to research why for instance Madrid Barajas Airport is not compliant to the aerotropolis concept, while they have a good location. Another important variable to research is the influence of major cities on location preferences. Is it actually the airport, the city or a combination of both that have attracted the companies that are located around the airport?

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