

# An aerotropolis evaluation tool for decision-makers



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## INTRODUCTION

The aerotropolis has become the new port of the 21<sup>st</sup> century, and it is a major driver of urban form and economic activity. It provides an opportunity for inland cities to develop and to compete in the global economy. Airports around the world are transforming themselves into aerotropoli.

An aerotropolis is a geographic area stretching up to 25 km in radius, with high-density developments around an airport. According to Prof John Kasarda (2013), it is a city that is built around an airport and it offers speedy connectivity to businesses, suppliers, customers and enterprise partners both nationally and internationally. An aerotropolis is a great intervention tool, which municipalities can use to change the structure and the urban fabric of a city. It has been shown that airports attract high technology jobs, indicating that they are an important catalyst for industrial growth requiring technology (Kasarda, 2000).

As an aerotropolis provides opportunities for economic growth and development, municipalities invest large capital into developing an aerotropolis within their municipality. For the period 2013–2014, for example, an amount of R15 million was allocated to the operating budget to conduct detailed planning of the aerotropolis at OR Tambo International Airport, while an additional R50 million was allocated to the capital

budget for bulk services for new developments around the OR Tambo aerotropolis. Similarly King Shaka International Airport (Durban) is also being developed into an aerotropolis, while Cape Town International Airport has expressed interest in developing into one.

This raises a few questions. If there are economic benefits to be gained from developing an aerotropolis, can all the airports then be developed into aerotropoli? In other words, what is the suitability of an aerotropolis at a particular location? As part of my Master's dissertation, I set out to develop a Suitability Index for an aerotropolis in South Africa. The airports under consideration were OR Tambo International Airport (ORTIA), King Shaka International Airport (KSIA), Cape Town International Airport (CTIA), Bram Fischer International Airport (BFIA) and Uppington International Airport (UIA).

## SUCCESS FACTORS

In order to determine if an aerotropolis is suitable for a particular location, the first step was to determine the factors that have contributed towards the success of an existing aerotropolis. Dubai International, Schipol, Singapore, Incheon and Zurich are some of the existing aerotropoli. A variety of factors have contributed towards the success of these aerotropoli.

Based on a comprehensive review, the key success factors for the existing aerotropoli in Singapore (Tongzon, 2004), Dubai (Fernandes & Rodrigues, 2009), Schipol, Hong Kong (Zhang, 2003) and Incheon (Lee & Yang, 2003) were determined. The contributing factors were identified and they were grouped into main factors and sub-factors. The main factors identified were airport characteristics, transportation network in and around

the airport, regional economy, land use around the airport, costs, role of the airport in the global supply chain, political will and legislative policies.

Within airport characteristics, sub-factors such as the size of the airport, number of runways, connectivity of the airport, and number of airlines serving the airport were found to affect the competitive advantage of the airport. The location of the airport was found to be one of the most important sub-factors. It was found that the airport's proximity to a substantial population and a strong economy is critical. For example within 1 000 km of Incheon (approximately 3.5 hours by flight), there are 43 cities with a population of more than 1 million. This amounts to a total population of 197 million people and a GDP of \$1.7 trillion. Similarly, within 1 000 km of Schipol, there are more than ten capital cities including London, Paris, Oslo, Copenhagen, Zurich and Berlin to name a few. The transportation network to and around the airport, the presence of an intermodal transfer hub and the proximity to a sea port also influence the competitiveness of an airport. Cost of using an airport is one of the major factors that influence the number of airlines, passengers and freight traffic through an airport. Airport costs include landing cost, parking fees and other taxes and surcharges. The availability of land and the cost of land determine the ease with which businesses are willing to relocate closer to the airport. Obviously, the lower the cost of land, the more willing the businesses are to relocate. In the literature review, it was found that, in general, various policies and tax incentives are put in place by the govern-

ment in order to attract business. This may include identifying land parcels which are zoned as Special Economic Zones or Free Trade Zones, where tax incentives apply.

Once the critical factors had been identified, the next step was to determine how each of the airports fared across these factors. While the quantitative factors could be easily determined, the qualitative factors, such as political willingness, were hard to quantify. The Analytical Hierarchy Process was identified to be a suitable method for comparing both qualitative and quantitative factors.

### ANALYTICAL HIERARCHY PROCESS (AHP)

R W Saaty developed the Analytical Hierarchy Process (Saaty, 1987) in order to solve a Multi Criteria Decision-Making (MCDM) problem. The AHP method is a way to detect interactions between various decision-making factors, which include factors that may not be easily quantifiable. Given the set of criteria and sub-criteria, one can compare various alternatives to choose the best option, as for example when buying a new car and having to make a choice from the various ones available in the market, bearing in mind various criteria such as reliability, cost, fuel economy and style. Using the AHP process, one can define the relative importance of the criteria with respect to one another, and rate how each car (or alternative) compares on a scale. At the end of the hierarchy process, conclusions can be arrived at easily, simplifying the decision-making process, especially when it includes criteria that are both tangible and intangible.



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The AHP method comprises three steps: (1) decomposition of the problem, (2) comparative judgement, and (3) synthesis of priorities (Winston, 1994; Saaty, 1987). A hierarchical schematic representation of the objective of the problem and the available alternatives is referred to as **decomposition of the problem**. In the AHP method, there are usually four levels or tiers of hierarchy. **Comparative judgement** involves comparing the criteria with one another to understand their relative importance. In other words, how important are airport characteristics with respect to the supply chain logistics of the airport? The criteria (and also the sub-criteria) are compared with one another and weights are determined. The higher the weight, the higher the importance.

When quantifiable or measurable data is available, the data is simply normalised to determine the weights. In the case of factors that cannot be easily measured, pairwise matrices have to be formulated and then compared (Barzilai, 1997; Wedley & Choo, 2004). This is usually done on a fundamental scale of 1 to 9 as indicated in Table 1 (Saaty, 1987; Janic & Reggiani, 2002; Berrittella, *et al.*, 2009).

The last step of the AHP is the **synthesis of priorities**. In this step, priorities are developed by multiplying them with the priority of their corresponding criterion in the level above, and adding to the criteria and the respective element in the level.

The data was collected from various secondary sources, including documents and reports. The Airport Company of South Africa also provided some of the airport-related data. Based on the information collected, the weights of the factors and sub-factors were determined for each airport, using the AHP method.

## FINDINGS AND CONCLUSIONS

Based on the data analysed using the AHP method, the following conclusions were made:

### Critical factors

It was found that the three main criteria influencing the success of an aerotropolis are:

- the airport infrastructure
- transport infrastructure
- strategic location.

The airport infrastructure, which includes sub-factors such as the number and size of runways, parking facilities, and the availability of basic utilities such as water and electricity influenced the airlines' choice of airport. The size of the infrastructure was also found to be an important sub-factor.

In terms of transport infrastructure, the number of accesses and the quality of the road infrastructure were found to be critical factors. The accessibility via roads and highways affect the movement of trucks and goods to and from the airport. Although accessibility via a railway line was found to be important, it was found that accessibility via road was more critical than that by rail. The availability of an intermodal transfer facility at the airport was found to be advantageous. Although the proximity to sea was found to be a factor, it was found that it had little influence as a critical factor, compared to other transportation factors.

The population in the catchment area was also found to be a critical factor. Compared to other aerotropolis, such as Dubai and Singapore, South Africa is at a disadvantage. Firstly, because of its geographic location at the end of a continent, away from the landmass, and secondly, it is not surrounded by major metropolitan economies. Among the airports under investigation, ORTIA has the greatest advantage in terms of strategic location. Given the geographic disadvantage, in the short term to medium term, OR Tambo (ORTIA) & King Shaka (KSIA) should position themselves as a hub for southern Africa, instead of competing with Dubai and Cairo, which have a strong geographic advantage. These airports could position themselves as transit and logistics hubs between Asia and South America, thereby establishing a niche market.

### Competitive advantage

In terms of the regional economy, ORTIA was found to have the greatest advantage. Being located in the Gauteng Global City

**Table 1:** Fundamental scale to formulate and compare pairwise matrices

Intensity of Importance on an Absolute Scale	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance of one over another	Experience and judgement strongly favour one activity over another
5	Essential or strong importance	Experience and judgement strongly favour one activity over another
7	Very strong importance	An activity is strongly favoured and its dominance demonstrated in practice
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between the two adjacent judgements	When compromise is needed
Reciprocals	If activity I has one of the above numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	
Rationals	Ratios arising from the scale	If consistency were to be forced by obtaining n numerical values to span the matrix

Source: Janic & Reggiani (2002); Berrittella *et al* (2009)

Region, it is within close proximity of businesses and skilled labour in Johannesburg and Tshwane. It also has the advantage of being connected to both metropolitan areas by highways and by rail. It has the added advantage that it is served by the Gautrain, which links ORTIA with major nodes such as Sandton, Rosebank, Midrand, Hatfield and Centurion. However, ORTIA is at a disadvantage in that the airport is surrounded by brownfield. The land use around the ORTIA may not necessarily complement the airport. There are industries around the airport which may not directly benefit from being within close proximity of the airport. However, relocation of the businesses or expropriation of land in order to expand the airport in the future may have high cost implications.

On the other hand, KSIA is surrounded by greenfields, giving it the opportunity to plan and identify businesses and industries that can support the growth of the aerotropolis. Other advantages of KSIA are the low cost of land around the airport and its close proximity to the sea port. Ideally, the area around KSIA should have value-added services and industries that produce high value, time sensitive goods. Raw material could be imported by sea and then transported to the industries via rail or by road. The industries could use the raw materials to produce high value goods that can be exported by air. One of the major shortfalls or bottlenecks of KSIA is the issue of accessibility. The N2 highway is the only highway providing access to the airport. In case of an accident on the N2 or a road closure, access to the airport would be severely hampered. In the global supply chain, delays in the transfer of goods may have huge cost implications to companies.

A dedicated truck lane on the N2 highway may reduce the travel time and delays that trucks experience, and this needs to be investigated further. There is a need for an alternate highway or a high-capacity road linking King Shaka Airport and Durban. Given the capacity constraints on the highway and the distance between the airport and the central business district (CBD), high-capacity public transportation alternatives, such as a metro should be investigated. A good quality, high-capacity rail service, similar to the Gautrain, could benefit KSIA in the long run. Currently, from an aerotropolis standpoint, CTIA has a better transportation system and airport infrastructure than KSIA.

#### Suitability index

The suitability index was developed using the AHP method. A comparative model that took into account the different criteria and their weights was developed, and then the suitability index of the airports was determined. Based on the study, the suitability index of OR Tambo and Cape Town International Airport was found to be 0.4190 and 0.2138 respectively. The suitability of King Shaka, Bram Fischer International Airport and Upington International Airport were found to be 0.1859, 0.0954 and 0.0858 respectively. It is evident that OR Tambo is the most suitable location for an aerotropolis, while Cape Town is the second most suitable location. However, it is important to note that, although Cape Town Airport is more suitable than King Shaka Airport, King Shaka Airport is currently being developed into an aerotropolis. This is based on the current situation, but in the long run, KSIA has a higher potential to develop into an aerotropolis. One should be careful when interpreting this index, as a higher index does not guarantee success. It only means that, based on the current situation and airports under investigation, an aerotropolis would be the most suitable at OR Tambo Airport.

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The municipalities and airport authorities could use the model for making strategic decisions. If the City of Cape Town plans to spend R50 million on the CTIA, then using this model, the City could identify current bottlenecks and target the investments in the right direction. For example, if ACSA plans to increase the capacity of the passenger terminal in KSIA, then, using the model, the authorities could evaluate the increase in the competitiveness of the KSIA and also its impact on the competitiveness of the CTIA. For example, if the accessibility to KSIA is increased by constructing another highway and by providing high-capacity public transport to the airport, then the suitability index increases from 0.1859 to 0.2298, while CTIA's suitability index reduces from 0.2138 to 0.2113. In other words, by increasing the competitiveness of KSIA, one is taking the competitive edge away from CTIA, making it the third most suitable location for an aerotropolis in South Africa.

Lastly, the model can be extended to evaluate South Africa's competitiveness with other cities such as Dubai, Nairobi and Cairo. By doing so, one can compare the suitability index of OR Tambo with other existing aerotropolis and identify opportunities to improve its competitiveness. This is essentially an economic development strategy for South Africa to increase its competitiveness in the global market, by leveraging the air accessibility to global customers.

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