

Data-related challenges towards analysing the spatial economic attributes of airport-centric developments in South Africa

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Abstract

Various airports in South Africa are the subject of airport-led development initiatives, epitomised by the models of airport city and aerotropolis. Despite the growing popularity of this form of development, there is a lack of literature discussing factors that might hinder its planning and implementation in South Africa. To partially fill that gap, the paper shows how the lack of appropriate spatial economic data can hinder the empirical analysis and thus the comprehensive understanding of the spatial economic characteristics of airports and their environs. The paper is based upon the empirical research conducted in 2013 and 2014 on the spatial economic attributes of the environs of Cape Town and OR Tambo international airports. The following main findings are drawn from the research: one, there is a dire lack of data that are suitable for detailed spatial economic analyses of airports and surrounds; and two, municipalities tend to aggregate data at the level of land use per property (instead of compiling firm-level data), which particularly hinders the comprehensive analysis of airports and surrounds. To circumvent the continuation of such problems in future, it is proposed that further research be undertaken towards establishing an appropriate form of spatial economic data that are associated with airports and surrounds.

1. Introduction and background

Following trends across the globe, a number of airports in South Africa are the subject of endeavours advocating for the so-called airport-led development, guided by the grand models of airport city and aerotropolis (see literature overview hereunder). The model of airport city is used worldwide to envision and guide the growth of economic activities in the immediate vicinity of airports (for instance, see Conway, 1993; Kasarda, 2009). According to Kasarda (2009), as more activities move towards airport cities and along the transportation networks connecting such developments, a new urban form develops. Known as aerotropolis, the envisaged urban form consists of developments that could extend up to 30km from airports (see Kasarda & Lindsay, 2011). With varying levels of success, South African airports that are the subject of such initiatives include OR Tambo, King Shaka, Cape Town, Lanseria and Bram Fischer international airports (see Mokhele, 2017).

Despite the growing popularity of airport-led development in South Africa, there is a dearth of literature analysing factors that might hinder the planning and implementation of such development. To partially fill that gap, the aim of this paper is to portray how the lack of appropriate spatial economic data can be a hindrance to the empirical analysis and thus the comprehensive

understanding of the spatial economic characteristics of airports and their environs. This focus is informed by an elementary argument that a successful implementation of development on airports and surrounds (as it could be argued with other types of development) is at least in part dependent upon an empirical understanding of the spatial economic workings of an area that is to be the subject of development proposals.

The paper draws from the empirical research conducted in 2013 and 2014 on the spatial economic attributes of the environs of Cape Town and OR Tambo international airports, from which a number of papers were developed. Focusing specifically on the data collection methods, the current paper is thus a component of a series of articles, which, where pertinent, are cited herein.

To put the current paper in perspective, it is particularly important to overview the objectives and main aspects of the study that it hinges on. That study analysed forces that drive development on and around Cape Town and OR Tambo international airports, through addressing the following objectives: one, establishing the mix and reasons for the location of firms on and around the two airports; two, identifying the propulsive qualities of economic activities at the two areas; and three, analysing the linkages between firms on and around the two airports and their metropolitan, regional, national and international contexts.

Towards addressing these objectives, Cape Town and OR Tambo international airports and their environs were classified into three levels of analysis, namely areas that are geographically proximate to (and contiguous with) the airport, areas within the airport premises, and the airport terminals. For each case study, a totality of these levels was referred to as airport-centric development, and the individual firms within those levels were termed airport-centric firms (for instance, see Mokhele, 2017, 2018a).

In light of the foregoing background, the paper is organised as follows: the next section overviews the literature and theoretical points of reference that informed the underlying research. The third section discusses the data-related problems encountered, and simultaneously highlights the approaches adopted to resolve the challenges faced. The last section closes the paper with recommendations for future research.

2. Overview of literature and theoretical points of departure

2.1 Overview of literature

Multifaceted discussions on the relationship between transportation and land use typically acknowledge the negative and positive role that airports play in the spatial distribution of land use. As highlighted by Mokhele (2018a), that acknowledgement is informed by the following considerations: the effects of aircraft noise, as synthesised by Mestre (2008); the economic benefits of airports, commonly captured in airport economic impact reports (see Karlsson et al., [2008] for a synthesis); models that propose the ideal spatial form and mix of developments originating from airports (for an overview, see Freestone and Baker [2011]); the institutional arrangements that influence airport development (for instance, see Van Wijk 2007, 2008; Walker and Barker, 2010;

Mokhele, 2018b); the spatial economic attributes of airports and surrounds, including analysis of land use composition and factors that influence location choice decisions of firms (see, for example, Appold, 2015; Appold and Kasarda, 2013; Prospero, 2007, 2008; Van Wijk, 2007; Warffemius, 2007).

Mokhele (2018a) argues that it is important to note two considerations pertaining to the strands of literature above. Firstly, as highlighted in the introduction, the normative models of the so-called airport-led development are rapidly gaining currency across the world. They are promoted by airport authorities, developers and/or governments as economically and physically integrated initiatives of the airport and urban development (Schlaack, 2010). In addition to airport city and aerotropolis highlighted in the introduction, the models of airport-led development include airport region (Schlaack, 2010), airfront (Blanton, 2004), global transpark (Kasarda, 1998; Sit, 2004), airport corridor (Schaafsma, 2003, cited in Schlaack, 2010), aerea (Schlaack, 2010), decoplex (Conway, 1993), aircity, aeropolis, aeropark, aviopolis, avioport, flight forum, sky city, airport, aero city and aeroscape. Secondly, and relatedly, the empirical analysis of the spatial economic attributes of airports and surrounds is particularly crucial in equipping planners, authorities and other stakeholders with a comprehensive understanding of the workings of airports and their surrounds. Such understanding can ensure that planning initiatives pertaining to airports and their environs are appropriately conceived, formulated and implemented (see Mokhele, 2018a).

Notwithstanding the significance of the existing knowledge on airports, the majority of the two noteworthy sets of literature above at least in part, insufficiently explores the fundamental concepts of agglomeration economies, linkages, clustering and propulsive economic qualities. These concepts have been central throughout the history of human geography, economics and related disciplines as regards the analysis of the location of economic activity, and are thus regarded as potential cornerstones of the analysis of airports and their surrounds (Mokhele, 2018a). The underlying study was therefore meant to, among others, address this gap in the existing knowledge.

2.2 Theoretical points of departure

The growth pole theory was adopted as the main theoretical framework for analysing forces that drive the airport-centric developments of Cape Town and OR Tambo international airports. In its original conception, the theory analyses why economic development tends to be concentrated in certain areas, instead of occurring uniformly across space (for instance, see Perroux, 1988). In the study, the growth pole theory was supplemented by elements of the following related theoretical lenses: first, airports were regarded as a variant of locational constants (see Richardson, 1973) that act as a focus for the agglomeration of economic activity. Second, characteristics of airports as locational constants relate to their role in transferring freight, making them transshipment locations. As argued by Hoover (1948), although the economies of freight tend to favour locations at material and/or markets, intermediate locations could hold special advantages when they serve as transshipment points. Some firms situate at such locations because they serve as delivery points, while others travel there to collect supplies. Third, it was pertinent to explore the spread or trickling down effects of airports in the manner of Myrdal (1957) and Hirschman (1958). Finally,

investigations were necessary on the forces of attraction of airport in the manner of the new economic geography, which explains how the economy's geographical structure is shaped by tensions between the centripetal and centrifugal forces (Krugman, 1991, 1998) (see Mokhele, 2018a; and Mokhele and Geyer, 2018).

3. Data-related adversities

This section presents the data-related challenges encountered during the case study identification process, and particularly during the firm collation exercise.

3.1 Case study identification

Cape Town and OR Tambo airport-centric developments were selected as case studies mainly because, compared to other airports in South Africa, the two airports are surrounded by substantial and diverse concentrations of economic activity. In the study, substantial concentration referred to the physical extent of development around the airports and on the landside (airport premises). It was, however, not possible to calculate the densities (number of firms per hectare, for instance) because of the lack of information required for such calculations. Diversity was, in the case study selection process, taken to refer to the existence of firms that are involved in a wide range of economic sectors on and around the airports, understood in contradistinction to a situation where one economic sector dominates a composition (for instance, see Mokhele, 2017).

Through the use of geo-referenced digital aerial photography and topographical maps obtained from the national geo-spatial information, the assessment of substantial concentration and diversity of economic activities focused on the following airports in South Africa: international airports (OR Tambo, Cape Town, King Shaka, Bram Fischer, Port Elizabeth, Upington, Lanseria, Polokwane, Pilanesberg and Kruger Mpumalanga) and national airports (Kimberley, George and East London). Military airports, smaller commercial airports, general aviation airports and non-commercial airports did not form part of the assessment given that they are typically surrounded by negligible urban development.

Due to the lack of proper data that could be used to ascertain the diversity and concentration of economic activity on and around airports, a speculative method that was adopted is described hereunder. The aforementioned aerial photography and topographical maps were loaded on the geographical information systems (GIS) computer program of Quantum GIS (QGIS), followed by a delineation of indicative study boundaries encompassing areas around the airport and the airport premises. Thereafter, an approach used to determine the concentration of economic activities on the maps (that is, within the indicative study boundaries) entailed identifying large buildings on the basis of the extent of land area covered by the various buildings. On the topographical maps, large buildings typically represent non-residential buildings, with community facilities marked with symbols such as P (for post office), PS (for police station) and S (for school). Thus, large buildings with no symbols are understood to accommodate economic activities other than community facilities. Other developed areas, such as residential areas, are marked as 'built-up areas' (high, low

density) and clearly distinguishable from the large buildings mentioned above. As the outcome of this exercise, it was discovered that the environs of Cape Town and OR Tambo international airports had the largest concentration of 'large buildings' and thus considered as accommodating substantial concentrations of economic activity (see Figures 1 and 2).

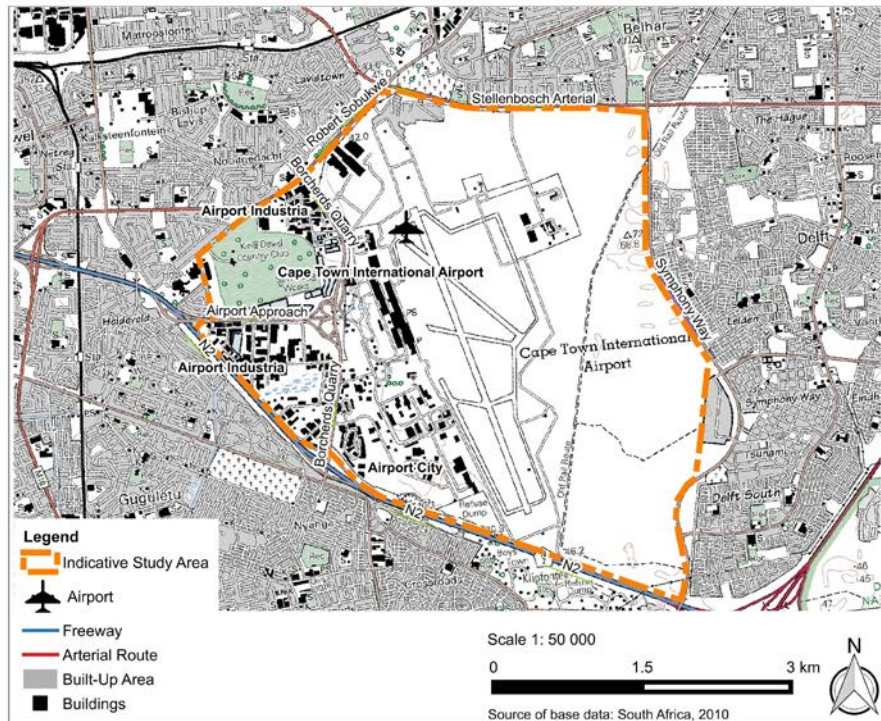


Figure 1. Cape Town International Airport and surrounds

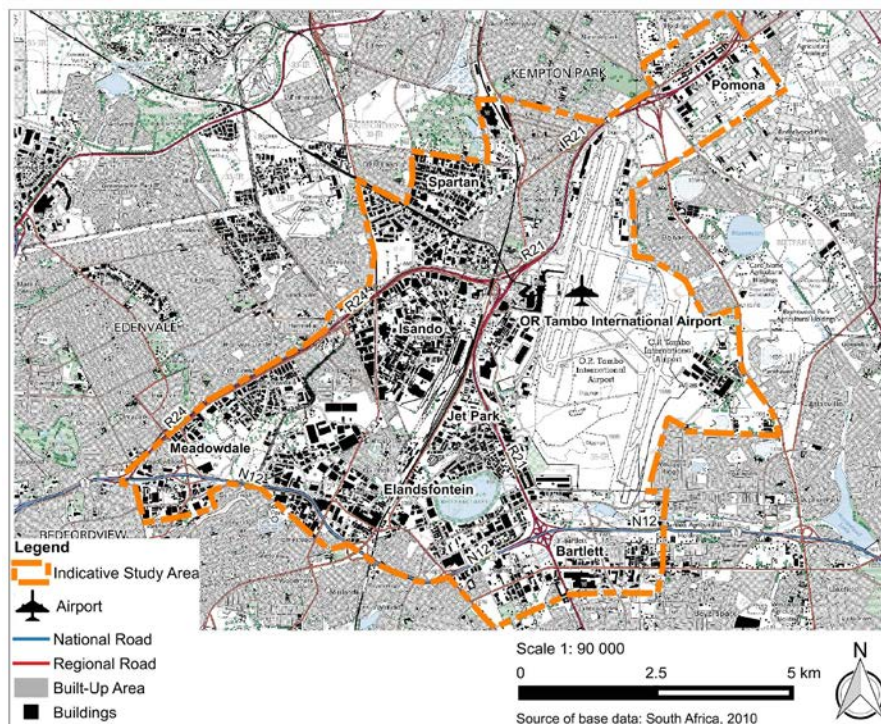


Figure 2. OR Tambo International Airport and surrounds

Though the foregoing crude approach worked (under the conditions of dearth of data) towards identifying the two case studies, it would have been more useful to have access to information that was detailed enough for an accurate understanding of the diversity and concentration of economic activity around the airports in South Africa. The more accurate way of determining the concentration of economic activity at various airports would include the calculation of business densities alluded to earlier.

3.2 Firm collation

As evident in the research objectives highlighted in the introduction, the underlying study was largely based on the term firm (which can be used synonymously with business or establishment) as opposed to, for instance, land use or industry. This decision was taken so as to permit a logical identification of the study's units of analysis, given that a firm represents an individual legal entity as opposed to land use and/or industry, which comprise a number of individual firms. This focus implied that, for each case study, data had to be obtained at a firm-level across the study's three levels of analysis. The firm-level information was required for two interrelated purposes: one, to establish the economic activity mix of the airport-centric developments; and two, to compile the population of airport-centric firms in preparation of a descriptive survey that would address other research objectives.

In the process of collating information on the Cape Town and OR Tambo airport-centric developments, the aim was to confirm the airport-centric firm's name, physical address, main economic activity conducted, and telephone number. Given that this basic information did not exist in a consolidated fashion, a description of how it was compiled across the three levels of analysis per case study is provided in the subsections below. Through triangulation, different sources were used so as to reduce coverage error towards the descriptive survey. According to Dillman (2007), coverage error occurs when the sampling frame does not include all elements in the population, resulting in elements of the population not having equal chance of being selected to be part of the sample.

Before outlining the data collation methods, two considerations should be noted. One, though the indicative study boundaries (see Figures 1 and 2) inadvertently included pockets of residential activities, such activities were excluded from the data collation exercise and the entire investigations, because they would not assist towards addressing the research objectives. Two, particularly for a fair sampling technique in light of the heterogeneity of the airport-centric firms, it was decided that the firms be categorised in terms of the relevant South African standard industrial classification of economic activities (SIC) sections. According to Statistics South Africa (2012), the SIC provides a standardised framework for the collection, tabulation, analysis and presentation of statistical data on economic establishments. The aforesaid SIC comprises the following 21 sections: (1) agriculture, forestry and fishing; (2) mining and quarrying; (3) manufacturing; (4) electricity, gas, steam and air conditioning supply; (5) water supply; sewerage, waste management and remediation activities; (6) construction; (7) wholesale and retail trade; repair of motor vehicles and

motorcycles; (8) transportation and storage; (9) accommodation and food service activities; (10) Information and communication; (11) financial and insurance activities; (12) real estate activities; (13) professional, scientific and technical activities; (14) administrative and support service activities; (15) public administration and defence; compulsory social security; (16) education; (17) human health and social work activities; (18) arts, entertainment and recreation; (19) Other service activities; (20) activities of households as employers; undifferentiated goods-and services-producing activities of households for own use; and (21) activities of extraterritorial organisations and bodies, not economically active people, unemployed people (Statistics South Africa, 2012).

3.2.1 Cape Town airport-centric firms

Used on a trial-and-error basis, six main approaches were deployed to record the firms that are located around Cape Town International Airport, and on the airport's landside. These are outlined below, followed by an approach pertaining to the firms that are located within the terminals.

Firstly, land use information (dated 2010), covering the entire municipal area, was obtained from the City of Cape Town municipality in geographical information system (GIS) shapefile format (City of Cape Town municipality, 2010). It stands to reason that the 2010 information was old to be used to record the airport-centric firms in 2013 and 2014, given that numerous changes would have occurred in the spatial distribution of the firms. There are particular reasons why this database was used, particularly because it was (though with limitations discussed hereunder) the only available data that captured the firm-level details. City of Cape Town, like other municipalities, update land use information regularly for, among others, urban planning purposes. However, such information aggregates land use at a property (erf) level. This means that for a single property that accommodates different land uses, and different firms, the most dominant land use is assigned to the entire property. Such information does not acknowledge heterogeneity that may exist within the properties, and would have thus been useless for purposes of the firm collation exercise. The aforementioned 2010 database was the latest available information that disaggregated land uses and firms per property.

Through the use of GIS ArcView 3.2's intersect tool, and based upon an indicative study boundary, land use information covering Cape Town International Airport and its environs was isolated into a separate shapefile. Afterwards, the attribute table of the properties located within the study boundary was converted to Microsoft Excel spreadsheet to allow for annotation and cleaning of the data. The information on the municipal database included land use per property, company names, and also recorded individual buildings on each erf. As a result, some firms had duplicate entries relating to different functions of a single firm on the same erf. An example is a firm that had entries in manufacturing, storage, office, and sales; with each entry assigned a different SIC code. It is also important to bear in mind that the SIC codes used by the municipality were outdated and void, because they were based on the 1990 classifications (see Statistics South Africa, 1990), which the researcher had to update to the latest edition published in 2012. Furthermore, the information did not contain any meta-data indicating, among others, the principles and assumptions adopted towards assigning the SIC codes.

A number of steps were taken to clean, update and make the data useable for the descriptive survey and to understand the economic activity mix on and around Cape Town International Airport. The first problem encountered was that the municipal information did not contain the firms' contact details. To find the details, each record on the database was checked against the hard copy of the 2013/2014 Cape Peninsula telephone book (Trudon, 2012a) and the 2013/2014 Yellow Pages (Trudon, 2012b). The principal information searched was the street address and telephone number of each firm. The street addresses on the telephone book and Yellow Pages were then checked against property numbers and street addresses on the City of Cape Town's information, so as to ensure that the firms mapped from the different sources were indeed the same firms. Since the entries in the Yellow Pages and telephone book were not arranged alphabetically, but rather per use category, each category was perused using the keywords 'airport' and 'airport industria'. However, the search did not confirm the addresses and contact details of all firms on the municipal database, and it was not known whether the firms without contact details were still (or were truly) located in the proximity of Cape Town International Airport. Furthermore, some firms were discovered through other means described hereunder, but not available on the municipal database. This was potentially because the municipality had inadvertently omitted some firms, or new firms may have moved into the area, whilst others may have relocated post the compilation of the municipal database.

The second main source used was Google Earth street view. This was used to check the business names and contact details on the signage placed on the properties, and accordingly update the details on the spreadsheet built from the City of Cape Town's database. Given that Google Earth street view was dated 2010 and therefore old, the information obtained through this method was considered partial. It would have not included the firms that moved into the area after 2010, and still reflected those that would have relocated from the environs of Cape Town International Airport.

It was also crucial to clean the municipal database given the duplicate entries mentioned earlier (in hindsight this should have been the first step). In the Microsoft Excel spreadsheet, property numbers were used to order the entries, and all records with the same property number were colour-coded so that they could be distinguishable. The following ancillary items per property were then deleted right away from the spreadsheet: guard house, open space, parking, automated teller machine and electrical substation. The duplicate entries relating to the various functions of the same firm on the same premises/buildings were also deleted to avoid double counts, and only the perceived primary use of each firm was kept on the database. Following the aforementioned cleaning, the database still could not be completely updated as it had gaps as regards business contact details; and as noted earlier, some establishments discovered through Google Earth, telephone book and Yellow Pages were not part of the City of Cape Town's database.

Though it failed, a third method was tried to update the database. An attempt was made to conduct a land use survey through walking the environs of Cape Town International Airport, recording the business details from signage on the premises, and making enquiries of the business activities conducted. After recording a few properties, the researcher was approached by the Airport

Industria City Improvement District (CID) security personnel patrolling the Airport Industria area. The security noted that due to a high number of burglaries in the area, recording of businesses and photographing of the establishments and/or business signage was prohibited. This land use survey failure, and particularly information obtained from the security as regards the leadership of Airport Industria CID, led to another source below.

Given that there was no other way of knowing which businesses were still located around Cape Town International Airport due to potential relocations that would have occurred post the compilation of the municipal database, Google Earth street view, Yellow Pages and the telephone book, the fourth source of information was employed. For an area to the west of the airport, known as Airport Industria, the information of the firms was obtained from the Airport Industria CID's website (Airport Industria CID, 2013). The availability of this website was learnt from the CID manager, after (per the advice of security personnel mentioned above) being contacted for permission to walk the area and record the firms. The Airport Industria CID website seemed to be more reliable, relatively accurate and up-to-date compared to the municipal database. The information on the website included the category of business conducted, business name, business street address and telephone number per establishment. The business details were transcribed from the website into the Microsoft Excel spreadsheet, and consolidated with the developing database. The limitation of the CID information was its partiality, given that it only encompassed areas under the jurisdiction of the Airport Industria CID, and not the adjoining areas like Airport City.

The fifth main source, although it yielded a limited number of firms, was the online company directory on the Cape Town Chamber of Commerce's (2014) website. The directory was searched using the keywords of Airport City, Airport Industria and Cape Town International Airport.

The sixth method of using Google Maps was discovered late in the process. It involved clicking and viewing the details of the companies listed on Google Maps. The majority of the listed businesses had websites, which assisted towards verifying the information of Google Maps, as well as the information obtained through other methods described above. The Google Maps search exercise proved particularly useful in identifying the firms on the landside that were not discovered through the other methods.

The abovementioned sets of information were verified against each other and consolidated into one business database. Ultimately, the total number of firms recorded at the two levels of analysis was 373, comprising 309 firms around Cape Town International Airport and 64 on the airport's landside.

For the firms located within the Cape Town International Airport's terminals, the business database information was obtained from ACSA in Microsoft Excel format (Thethiwe, personal communication, June 2013). The database contained the business name, contact person, email address, telephone number and fax number per establishment. The information was obtained in two sets: one, airside tenants, which are firms that are located beyond the airside (check-in) gates, and two, landside, which in this case referred to firms which are located before the airside gates, but still

within the terminals. The two sets were combined to allow for the cleaning of the database. The first pattern that emerged was that some firms had multiple offices or stores/outlets within the terminals. To confirm that such stores were part of a single firm, those that had the same contact person and/or contact details were highlighted. Multiple entries and kiosks of the same firm were then deleted, and only one entry per firm remained on the database. The database also contained entries of the car rental companies. Given that car rental companies were classified under the landside, this information was integrated with the landside database and omitted from the terminal database. Finally, to assess at least in part the correctness of the information, the terminal database was checked against the company information available on ACSA's website (ACSA, 2014a). After cleaning and consolidating the database, the total number of firms recorded within the terminals of Cape Town International Airport was 88. The overall population encompassing the three levels of analysis was 461 Cape Town airport-centric firms. Each firm was then assigned a category in terms of the major SIC sections (on the basis of the perceived primary focus of each firm), subsequently used as bases for the sampling process in preparation for the survey.

Despite the successful collation of the information above, the completeness and accuracy of the population compiled can be questioned in light of the speculative approaches employed to particularly record firms that are located around the airport and on the landside.

3.2.2 OR Tambo airport-centric firms

Informed by the experience from the Cape Town case study, five approaches outlined below were used to record the firms that are located around OR Tambo International Airport, and those located on the airport's landside. It should be noted that land use data was obtained in GIS shapefile format from the Ekurhuleni municipality in 2013. However, the information was aggregated at the property level, it did not contain any individual firm details, and therefore not useful for the airport-centric firm collation exercise. For instance, as noted earlier in the paper, such information would assign a 'commercial' land use to a given erf, without recognising the various firms or activities that may exist on that erf.

Unlike the Cape Town case study, the OR Tambo firm collation exercise commenced from a clean sheet. As a starting point, the businesses on and around OR Tambo International Airport were searched on the online business database of www.yellowpages.co.za (Trudon, 2013). The categories (as captured on the website) of industrial, commercial, offices, manufacture, laboratories, logistics and courier were used as search words for businesses located at the areas around the airport. These are Jet Park, Isando, Aeroport, Meadowdale, Rhodesfield and Spartan. Some of the firms located on the airport's landside formed part of the results of the search using the aforementioned keywords, and were identifiable by the address of OR Tambo Airport. The information captured included business name, category of business activity conducted, physical address, and telephone number of each establishment. The information was captured in Microsoft Excel spreadsheet and used as a basis for developing the OR Tambo airport-centric firms' database. The apparent limitation of the information obtained through this method is that it was biased towards businesses that had the will and the means to register their details on the Yellow Pages website. It goes without saying that not

all firms do this. It was also not known whether the businesses recorded in the Yellow Pages were truly located (or were still located) on and around the airport. Related to this approach, the online business database of www.brabys.com was also checked, particularly with the objective of uncovering the company websites, and sourcing the information directly from the websites.

Secondly, though it yielded a few firms, a business database (in Microsoft Excel format) was obtained from the Ekurhuleni municipality's town planning department, which had been compiled by the municipality as part of the aerotropolis initiative centred on OR Tambo International Airport (Engar, personal communication, May 2013). The municipality had placed a notice on its website urging businesses that were interested in being part of the aerotropolis planning to submit their names and contact details to the municipality. As the database contained businesses within the broader Ekurhuleni municipal area, the keywords of Jet Park, Isando, Aeroport, Meadowdale, Rhodesfield and Spartan were used to identify firms that are located in the vicinity of OR Tambo International Airport. The database included company name, name of the establishment's representative, contact number, email address, postal address, physical address, industry type, and organisation size in terms of number of people employed at each establishment. The limitation of this information is that it only recorded businesses that had interest in the aerotropolis initiative; and surprisingly, only 4 firms were discovered on the aerotropolis database.

The third source was discovered late in the OR Tambo airport-centric firms' collation exercise, namely a link on the website of the East Rand Chamber of Commerce (2014). The link, is known as datadex, and contained details of businesses that are members of the said chamber. Using the keywords of Spartan and Jet Park (the only keywords available on the website pertaining to the surrounds of OR Tambo International Airport), the datadex was used to check and update the information compiled from the other sources of information above. The limitation of this information is that it depicted only businesses that are members of the East Rand Chamber of Commerce and Industry. Relatedly, although it yielded a limited number of firms, the website of www.kemptalk.com was also searched (see Van Wyk, 2013).

Drawing lessons from the Cape Town case study, the fourth main firm-identification method entailed the use of Google Maps. Google Maps has a function that shows the spatial location of businesses, which when clicked, reflects the business name, physical address, company contact details and websites where available. This method was particularly useful for identifying the websites of the airport-centric firms, and obtaining the company information from there.

After noticing the apparent low number of the firms recorded on the landside, the fifth opportunistic method was used and proved fruitful. The keyword 'new agents building' was used to explore the Google Internet search engine. This 10-storey building (which is situated at OR Tambo International Airport) and accommodates multitudes of firms, mainly those involved in freight clearance, forwarding and logistics in general. This Google search revealed numerous company websites that were used to confirm the location and contact details.

The results of the five main firm collation methods above were checked against each other, cleaned and consolidated into one dataset. The total number of firms recorded at the two levels of analysis was 1473 (comprising 1387 firms around OR Tambo International Airport and 86 on the landside). One limitation of the information of establishments around the airport is that property numbers did not form part of the information collected. Nonetheless, this was not regarded as a major problem as it did not negatively impact the ability to address the research objectives and prepare for the survey.

As regards the firms that are located within OR Tambo International Airport's terminals, the business information was obtained from ACSA in Microsoft Excel format (Flayser, personal communication, May 2013). The information reflected the business name, location, telephone number, name of management's representative and email address. Per the Cape Town case study process, the duplicate entries at the different sections of the terminals were deleted and only one entry per firm left. The car rental information was also omitted and integrated into the landside database. Finally, to check the correctness of the information pertaining to firms in the terminals, the database was checked against company information available on ACSA's website (ACSA, 2014b). The number of firms recorded within the OR Tambo International Airport terminals was 156.

The overall population of across the three levels of analysis was 1629 OR Tambo airport-centric firms. These firms were each assigned a category in terms of the major SIC sections, so as to permit the sampling process for the survey. Similar to the Cape Town airport-centric development case, the accuracy and completeness of the OR Tambo International Airport's population compiled can be questioned in light of the limitations of the secondary sources that the information was compiled from.

4. Conclusion

Despite the growing popularity of the so-called airport-led development in South Africa, the difficulties encountered in accessing the data that would be required for the planning and implementation of such development are not well documented. Drawing lessons from the empirical research conducted on the Cape Town and OR Tambo airport-centric developments, the paper presents the trials and tribulations of obtaining the information required for the analysis of spatial economic attributes of airports and their environs. Although there are speculative and rudimentary approaches that could be used to circumvent the data unavailability problems (involving the triangulating of various secondary sources), the paper showed that the accuracy, quality and comprehensiveness of the information compiled could be questioned.

In light of the shortcomings presented herein, it is proposed that further research be undertaken towards establishing an appropriate form (including the necessary variables and attributes) of spatial economic data that are associated with airport-centric developments. That research could particularly explore ways that GIS could be used as a primary platform for capturing, presenting and updating the requisite information. The outcome of such efforts would at least in part guide

municipalities, airport authorities and other stakeholders on how to compile the information on airport-centric firms.

5. References

- ACSA (Airports Company South Africa) 2014a, Cape Town International Airport: Airlines, shops, restaurants and services database, viewed 09 June 2014, <http://www.acsa.co.za>.
- ACSA (Airports Company South Africa) 2014b, OR Tambo International Airport: Airlines, shops, restaurants and services database, viewed 09 June 2014, <http://www.acsa.co.za>.
- Airport Industria CID (City Improvement District) 2013, Business directory [online], viewed 01 October 2013, <http://www.airportcid.co.za>.
- Appold, SJ 2015, 'The impact of airports on US urban employment distribution', *Environment and Planning A*, vol. 47, no. 2, pp. 412–429. <https://doi.org/10.1068/a130114p>
- Appold, SJ & Kasarda, JD 2013, 'The airport city phenomenon: Evidence from large US airports', *Urban Studies*, vol. 50, no. 6, pp. 1239–1259. <https://doi.org/10.1177/0042098012464401>
- Blanton, W 2004, 'On the airfront', *Planning*, vol. 70, no. 5, pp. 34–35.
- Cape Town Chamber of Commerce 2014, Company directory, viewed 01 May 2014, <http://www.capechamber.co.za>.
- City of Cape Town Municipality 2010, Base data (GIS shapefiles).
- Conway, M 1993, *Airport cities 21: The new global transport centers of the 21st century*, Conway Data, Atlanta.
- Dillman, DA 2007, *Mail and internet surveys: The tailored design method*, 2nd edition, John Wiley & sons, New Jersey.
- East Rand Chamber of Commerce 2014, East Rand Chamber of Commerce and Industry datadex, viewed 07 April 2014, <http://www.chamberlink.co.za>.
- Freestone, R & Baker, D 2011, 'Spatial planning models of airport-driven urban development', *Journal of Planning Literature* vol. 26, no. 3, pp. 263–279. <https://doi.org/10.1177/0885412211401341>
- Hirschman, A 1958, *The Strategy of Economic Development*, Yale University Press, New Haven.
- Hoover, EM 1948, *The Location of Economic Activity*, McGraw-Hill Book Company, New York.
- Karlsson, J, Ludders, RJ, Wilde, D, Mochrie, D & Seymour, C 2008, *Airport economic impact methods and models. A synthesis of airport practice*, Washington, DC Transportation Research Board.
- Kasarda, JD 1998 'The global transpark: Infrastructure for industrial advantages', *Urban Land*, vol. 57, no. 4, pp. 107–110.
- Kasarda, JD 2009, 'Airport cities', *Urban Land*, vol. 68, no. 4, pp. 56–60.
- Kasarda, JD and Lindsay G 2011, *Aerotropolis: The way we'll live next*, Penguin Group, London.
- Krugman, P 1991, 'Increasing Returns and Economic Geography', *The Journal of Political Economy*, vol. 99, no. 3, pp. 483–499.
- Krugman, P 1998, 'What's New About the New Economic Geography?', *Oxford Review of Economic Policy*, vol. 14, no. 2, pp. 7–17.
- Mestre, V 2008, *Effects of aircraft noise: Research update on selected topics. A synthesis of airport practice*, Washington, DC, Transportation Research Board.
- Mokhele, M 2017, 'Spatial economic evolution of the airport-centric developments of Cape Town and OR Tambo international airports in South Africa', *Town and Regional Planning*, vol. 70, pp. 26–36. <http://journals.ufs.ac.za/index.php/trp/article/view/593>
- Mokhele, M 2018a, 'Spatial economic attributes of O.R. Tambo and Cape Town airport-centric developments in South Africa', *Journal of Transport and Supply Chain Management*, vol. 12 <https://doi.org/10.4102/jtscm.v12i0.344>

- Mokhele, M 2018b, 'The Volatility of Institutional Arrangements That Influence Development: The Case of Bram Fischer International Airport in South Africa', *The Journal for Transdisciplinary Research in Southern Africa*, vol. 14, no. 1. doi:10.4102/td.v14i1.436.
- Mokhele, M & Geyer, H 2018, 'A theoretical framework for airport-centric developments: The cases of OR Tambo and Cape Town international airports in South Africa', *African Journal of Science, Technology, Innovation and Development*, vol. 10, no. 4, pp. 493-506.
- Myrdal, G 1957, *Economic Theory and Underdeveloped Regions*, London, Duckworth.
- Perroux, F 1988, 'The pole of development's new place in a general theory of economic development', In B Higgins and DJ Savoie (eds.), *Regional economic development: Essays in honour of Francois Perroux*, Unwin Hyman, Boston.
- Prosperi, DC 2007, 'Airports as centres of economic activity: Empirical Evidence From Three US Metropolitan Areas', In M Schrenk, VV Popovich and J Benedikt (eds.), *REAL CORP 007*, Vienna, May 2007, pp. 215–224, CORP, Schwechat-Rannersdorf, 2007.
- Prosperi, DC 2008, 'MIA: Miami International Airport or Miami Innovation Area', In M Schrenk, VV Popovich, D Engelke and P Elisei (eds.), *REAL CORP 008*, Vienna, May 2008, pp. 13–22, CORP, Schwechat-Rannersdorf, 2008.
- Richardson, HW 1973, *Regional Growth Theory*, London, Macmillan Press.
- Schlaack, J 2010, 'Defining the Airea. Evaluating urban output and forms of interaction between airport and region', in U Knippenberger and A Wall (eds.), *Airports in cities and regions: Research and practise*, Karlsruhe, July 2009, pp. 113–125, KIT Scientific Publishing, Karlsruhe, 2010.
- Sit, V 2004, 'Global transpark: New competitiveness for Hong Kong and South China based on air logistics', *Geografiska Annaler. Series B, Human Geography*, vol. 86, no. 3, pp. 145–163. <https://doi.org/10.1111/j.0435-3684.2004.00159.x>
- Statistics South Africa 1990, *Standard industrial classification of all economic activities (SIC)*, Statistics South Africa, Pretoria.
- Statistics South Africa 2012, *Standard industrial classification of all economic activities (SIC)*, 7th edition, Statistics South Africa, Pretoria.
- Trudon 2012a, *The phone book: Cape Peninsula 2012/2013*, Trudon, Johannesburg.
- Trudon 2012b, *Yellow Pages: Cape Peninsula 2012/2013*, Trudon, Johannesburg.
- Trudon 2013, *Yellow Pages business database*, viewed 17 April 2013, <http://www.yellowpages.co.za>.
- Van Wijk, M 2007, *Airports as cityports in the city-region*, Doctoral thesis, Utrecht University, Utrecht.
- Van Wijk, M 2008, 'Development of airport regions: Varieties of institutions in Schiphol and Frankfurt', *Airlines Magazine*, Airports: e-zine edn. 40, viewed 12 August 2011, from <http://www.airlines.nl>
- Van Wyk, M 2013, *The Kempton Park Website: Directory*. Viewed 12 June 2013, <http://www.kemptalk.com>.
- Walker, AR & Baker, DC 2010, 'A planning support system for airport city development', Paper presented at the 14th Air Transport Research Society Conference, Porto, 06–09th July.
- Warffemius, PMJ 2007, *Modelling the clustering of distribution centres around Amsterdam Airport Schiphol. Location endowments, economic agglomeration, locked-in logistics and policy implications*, PhD dissertation, The Netherlands TRAIL Research School.