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Foundation for a Theoretical Framework on the Location of Manufacturing Firms in the Vicinity of Airports

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1 ABSTRACT

Manufacturing plays a crucial role in economic development. Peculiar geographical patterns of production are accordingly observable, wherein the environs of airports are some of the areas that accommodate the concentration of manufacturing firms. However, most of the literature on the placement of manufacturing firms relative to transport infrastructure focuses on road, rail and sea. The objective of this paper is thus to advance a foundation for a theoretical framework that analyses the spatial economic factors that influence the location of manufacturing firms in the vicinity of airports. The paper draws upon research conducted on the case study of the environs of Cape Town International Airport in South Africa. The analysis conducted in the underlying study explored the interconnections between the concepts of space, proximity, linkages, agglomeration economies, clustering and pattern. These concepts are accordingly used as building blocks towards the foundation for a theoretical framework. The contribution hinges on five layers of the economic space: the airport's environs, municipal area, functional region, other parts of a country and multi-country economic space. Different forms of manufacturing establishments' clustering, proximity and intensity of intra- and inter-firm linkages characterise these interrelated layers. The paper sensitises policymakers, spatial planners and authorities to the spatial economic dynamics of manufacturing firms situated near airports.

Keywords: Cape Town International Airport, airports, South Africa, industrial clustering, manufacturing

2 INTRODUCTION

Despite the transition to a service-driven economy in some parts of the world, manufacturing continues to play a paramount role in economic development (Haraguchi, Chen & Smeets, 2017; Naudé & Szirmai, 2012; Ndiaya & Lv, 2018; Pandian, 2017; Li, Xue & Huang, 2018). At particular periods in history, certain geographical patterns of manufacturing facilities are observable, and with the transition from one regime of production to another, the range of locational outcomes is extended. As shifts in manufacturing occur, a pattern of spatial responses is also discernible, spanning from the reorganisation of industrial areas developed in the earlier regimes of production to the establishment of new industrial nodes (Scott, 1988). These evolving patterns bring to the fore the importance of manufacturing facilities geography or locational patterns. It should be acknowledged that the problem of facility location (geographical positioning of facilities) has existed for a long time wherein it is argued that the appropriate location can, among other benefits, assist the firms to augment their operational performance (Chen, Olhager & Tang, 2014).

The paper intends to contribute to the literature on the location of manufacturing firms, with particular reference to the environs of airports. Discussions about the nexus between transportation technology improvements and land use recognise that airports can, at least in part, influence the geographical positioning of economic activities (Mokhele & Geyer, 2018), which could include manufacturing firms. Regardless of this acknowledgement of the influence of airports on the geography of economic activities, the majority of the literature on the connection between manufacturing facility location and transport infrastructure focuses on the impact of roads, railways and ports (Buurman & Rietveld, 2004; Holl, 2004; Rothenberg, 2011; Ghani, Goswami & Kerr, 2014; Xu & Nakajima, 2017). This focus on other modes shows a paucity of empirical literature on the placement of manufacturing firms near airports.

Using the study area of the environs of Cape Town International Airport in South Africa, this paper aims to contribute towards the foundation for a theoretical framework that analyses the spatial economic factors that drive the location of manufacturing firms in the vicinity of airports. The paper understands theory as a framework that assists towards conceptualising the phenomenon being analysed (Sayer, 1992), which is the spatial economic factors that influence the location of manufacturing firms in the vicinity of airports. This understanding contradicts a popular and at times misplaced position, which regards theory as a rigid framework for establishing laws and predictions (Wilson, 1992).

3 LITERATURE OVERVIEW: A CONCEPTUAL FRAME OF REFERENCE

The location of economic activities (such as manufacturing firms in the context of the paper) in the vicinity of airports can be analysed through the normative models of airport-led development, which are used worldwide to advance proposals on the idealised urban form of economic activities that are understood to be linked to or dependent on airports. A plethora of models of airport-led development include: aerotropolis, airport city, airport region, airfront, global transpark, airport corridor, airea, decoplex, aircity, aeropolis, aeropark, aviopolis, avioport, flight forum, sky city, airpark, aero city and aeroscape (Mokhele, 2018). Amid this extensive list, the model mainly used in contemporary literature and development policies (and more explicit on the location of manufacturing facilities) is the so-called aerotropolis. An aerotropolis is a sub-region wherein infrastructure and various components of the economy hinge on a major airport. The logic of the aerotropolis is that businesses in the region benefit from the speedy connectivity offered by the airport to suppliers, markets and business partners nationally and globally (Kasarda, 2019). An aerotropolis is anchored by a core airport area, responsible for providing logistics and transportation services. The airport area is surrounded by manufacturers and distribution facilities, which facilitate the quick transportation of manufactured products (Huo & Guo, 2021).

Several concepts are appropriate for analysing the location of economic activities in general, specifically those located on and around airports, and may be embodied in aerotropolis and other normative models of airport-led development. The concepts can also be applied specifically to the analysis of the location of manufacturing firms in the environs of airports. The concepts, which have historically been central to the analysis of the location of economic activities in human geography and allied disciplines include linkages, agglomeration economies and clustering. These are given substance by the associated concepts of space, proximity and pattern (Mokhele & Geyer, 2021).

Although the concept of agglomeration economies has historically received considerable attention in the literature, the work of Parr (2002) advances an all-embracing consideration of the concept, which is understood to be based on internal economies and external economies. The economies internal to the firm (categorised into economies of scope and scale) are controlled by the firm concerned and are not directly influenced by the activities of other firms. The concept of internal economies of scale, also known as horizontal integration, denotes benefits to the firm that result from increases in the extent of its operations. Internal economies of scope (lateral integration) are realised because of the firm's diversity of products and/ or services. The notion of economies of scope is based on the understanding that the undertaking of several activities by a firm could happen more efficiently than would be the case if different firms undertook such activities (Parr, 2002; Panzar & Willig, 1981). It is important to note that agglomeration economies based on internal economies do not necessarily influence a spatial concentration of related firms but result in the individual firms becoming large (Parr, 2002).

In contradistinction to internal economies, external economies are affected by the operations of other firms and are, therefore, beyond the total control of the individual firm (Parr, 2002). External economies comprise localisation economies, urbanisation economies, and activity-complex economies. Localisation economies emanate from the common location of independent firms in the same economic sector or industry. Though external to the firm, these economies are internal to the industry (Marshall, 1920). Urbanisation economies are characteristic of diversified urban areas, and result from the common location of firms involved in diverse and unrelated activities. Urbanisation economies, which are external to the individual firm and the industry or sector, are internal to the urban concentration. Urbanisation economies may therefore be understood as economies of scope - benefits from the scope or diversity of production and services within the urban concentration (Parr, 2002). Finally, activity-complex economies result from the common location of firms operating in a production and/ or service provision chain, forming an activity complex. These economies are mainly a result of the interrelatedness of firms. In this regard, a firm has backward or upstream linkages to the firms supplying it and forward or downstream linkages to the firms it supplies with the services or products/ goods. Activity-complex economies are therefore external to the firm but internal to the complex it is a member (Parr, 2002).

Linkages, which refer to the flows of information, materials and/ or services between and within individual firms, are essential for realising the different forms of agglomeration economies. The linkages of a firm can be classified into three categories: one, backward (upstream) linkages, which provide goods and/ or services as input for its activities or output; two, forward (downstream) linkages, which provide links with the

customers purchasing its products or services. If businesses are connected through an input-output (i.e. buyer and supplier) arrangement, the downstream industry forms the market for the upstream industry (Malmberg & Maskell, 2002; Porter, 1990; Venables, 1996). Therefore, the firms in such vertical arrangements are partners and collaborators (Malmberg & Maskell, 2002). The third category pertains to horizontal, lateral or sideways linkages, which are interactions with other firms or economic actors involved in the same processes and share the market (customers) and technology (Malmberg & Maskell, 2002; Porter, 1990).

The existence of linkages and the subsequent realisation of agglomeration economies can result in the clustering of manufacturing firms. Two interrelated categories of clustering, differentiated by spatial proximity, can be discerned in the literature. In the first understanding of what could be referred to as spatial clusters, clustering is defined as linked firms that are located in the same geographical area (Porter, 1990). Several categories of spatial clusters can be identified in the literature, including pure agglomeration, industrial-complex, and social-network (Gordon & McCann, 2000); Marshallian and Italianate industrial districts, hub-and-spoke industrial districts, satellite platforms, state-anchored industrial districts (Markusen, 1996).

In the second interpretation, clusters are understood linked firms, regardless of their separate geographical locations. These can be referred to as organisational clusters. The paper adopts the position that clustering can be based on agglomeration economies that are internal and/ or external to a firm. In terms of internal consideration, when the head office of a manufacturing firm has strong functional linkages with other units of the same firm, whether located within the same geographical area, city, country or even across national borders, such a situation would be regarded as organisational cluster emanating from internal economies.

As reflected earlier in the paper, agglomeration economies, linkages and clustering are given substance by the vague concepts of space, proximity and pattern. Unlike absolute space, which is essentially a fixed frame that contains economic agents and their activities, relative space is defined by the interrelations between economic agents (Friedman & Alonso, 1964; Garretsen & Martin, 2010), and in relational understanding, space does not exist without linkages and underlying relationships (Massey, 2005). Space cannot be comprehensibly understood without the concept of proximity or distance, wherein a distinction can be made between geographical and organisational proximity (Boschma, 2005). While geographical proximity refers to the physical distance between actors (such as firms), organisational proximity denotes the closeness of actors regardless of the physical distances between them (refer to the overview of spatial and organisational clustering earlier in this section). Finally, the activities of firms are understood to create particular patterns in absolute, relative and/ or relational space. Historically, the geographical pattern in absolute space comprised points, lines and areas, which are understood through the measures of, inter alia, point pattern, nearest neighbour analysis and quadrant sampling (Coffey, 1981). The paper is inclined towards an understanding that the spatial economic factors that influence the location of manufacturing firms in the vicinity of airports may not necessarily create observable patterns in geographical space.

The foregoing conceptual frame of reference was used to inform the empirical analysis and the findings that the paper draws on, as well as the subsequent contribution to the theoretical foundation that analyses spatial economic factors that influence the placement of manufacturing firms in the vicinity of airports.

4 STUDY AREA AND RESEARCH METHODS

The paper is based upon the study area of the environs of Cape Town International Airport (CTIA) in South Africa, which is situated in the City of Cape Town municipality, Western Cape province. The second busiest airport in South Africa, CTIA processed around 41 000 tonnes of cargo in the 2020/ 2021 financial year, which was a reduction from 68 191 tonnes in the preceding financial year (Airports Company South Africa, 2021) due to, at least in part, travelling restrictions associated with the Covid-19 pandemic. The development node around CTIA is one of the notable industrial areas in the municipality – hence it was considered suitable for analysing the connection between the location of manufacturing firms and airports. The beginnings of the concentration of manufacturing in the vicinity of CTIA can be traced to the 1970s and 1980s when the government attempted to promote industrial activity in the area by zoning the landholdings for industrial purposes. In 2021, 67 manufacturing firms were documented near CTIA (Fig. 1).

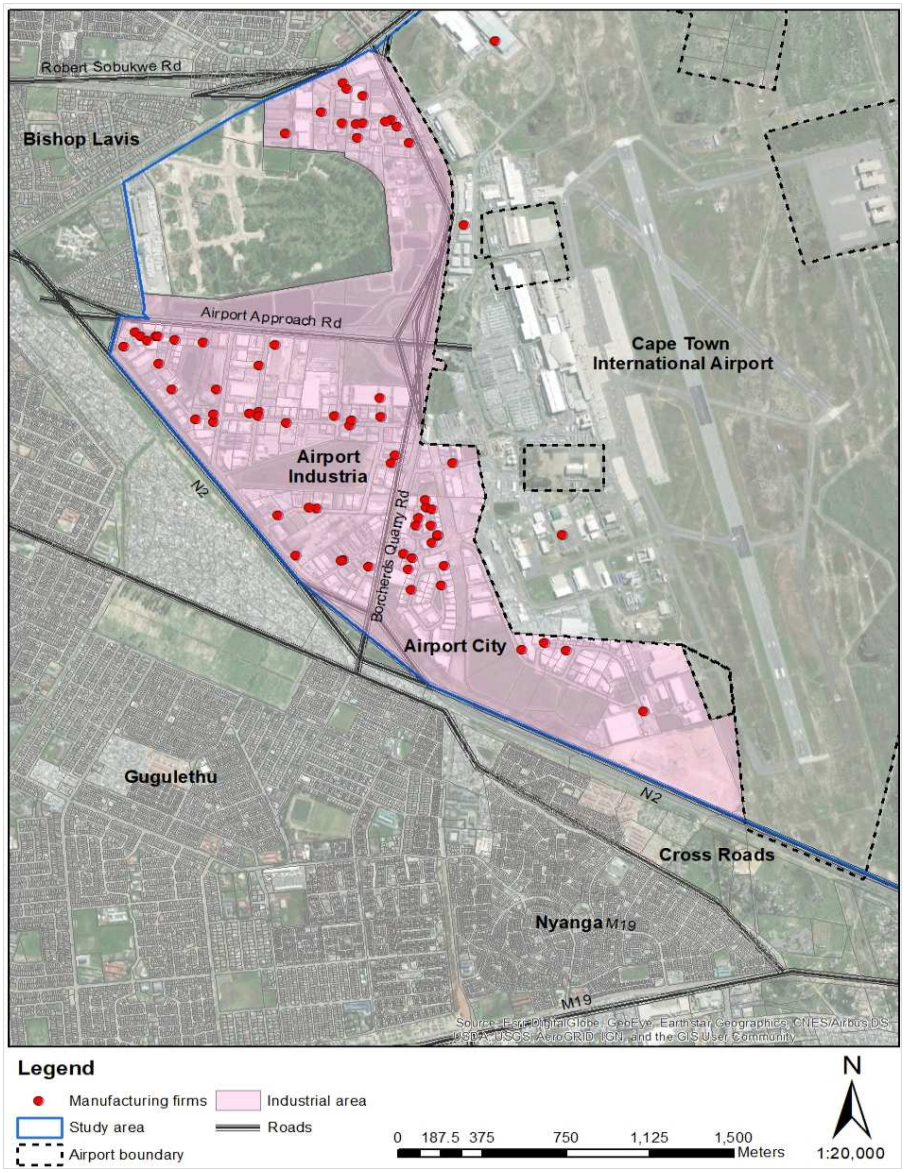

Fig. 1: Study Area.

The study the paper draws upon (Mokhele & Garatsa, 2023) was based on descriptive survey research, which generally intends to understand the population through investigating a sample. However, the literature recommends not applying sampling to a population of fewer than 100 units (Leedy & Ormrod, 2015). In this regard, because the population of the study area was 67, an effort was made to interview the representatives of all manufacturing firms in the vicinity of CTIA. Primary data were collected in November 2021 wherein the representatives of the firms were requested to respond to a structured questionnaire, which entailed a range of closed- and open-ended questions. The data were collected through face-to-face, self-administered and telephonic interviews. This combination was employed because some respondents were not willing or not available to participate in the preferred technique of face-to-face interviews. This situation that was worsened by the Covid-19 lockdown restrictions. Of the total population of 67 manufacturing firms in the vicinity of CTIA, 23 representatives (approximately 33% of the population) participated in the survey interviews.

5 A SUMMARY OF THE FINDINGS

The section summarises the research findings, which are used as a base for advancing a contribution towards a theoretical framework that analyses spatial economic factors that influence the placement of manufacturing firms in the vicinity of airports.

5.1 Overview of the firms

Informed by the data from the survey interviews, the manufacturing firms were categorised in terms of the divisions of the South African Standard Industrial Classification (SIC) (Statistics South Africa, 2012). Showing there was no distinct manufacturing specialisation in the vicinity of CTIA, the firms' business activities ranged widely, from the manufacturing of wood products to the manufacturing of fabricated metal products (Table 1).

SIC Manufacturing subcategories	Number of firms	Percentage
Manufacturing of wood and of products and cork	2	8.7%
Manufacturing of food products	2	8.7%
Manufacture of other non-metallic mineral products	2	8.7%
Manufacture of computer, electronic and optical products	1	4.3 %
Manufacture of machinery and equipment	2	8.7 %
Manufacture of furniture	1	4.3 %
Manufacture of chemicals and chemical products	1	4.3 %
Manufacture of textiles	1	4.3%
Manufacture of rubber and plastic products	3	13%
Manufacture of other transport equipment	1	4.3 %
Manufacture of motor vehicles, trailers and semi-trailers	1	4.3 %
Manufacture of chemicals and chemical products	1	4.3%
Manufacture of fabricated metal products	1	4.3 %
Other manufacturing	4	17.4%
Total	**23**	**100%**

Table 1: Activities of manufacturing firms located in the vicinity of CTIA.

It was essential to analyse the size of the manufacturing firms, using the number of employees as a rudimentary proxy for size. The following classification of the size of manufacturing businesses was used: micro (five employees), very small (20 employees), small (50 employees), and medium (200 employees) (South Africa, 1996). The findings revealed that close to half (about 45%) of the firms had between 1 and 19 employees, showing that most manufacturing firms near CTIA were very small or micro.

On the background of the size of the manufacturing firms, the majority (55%) indicated that they did not have a multi-office structure, whilst 46% reported that they had a multi-office structure, showing that manufacturing firms on and around CTIA were mainly small or micro stand-alone firms. The majority (70%) of the firms with multi-office structures were branches, 20% were subsidiary firms, and 10% were head offices. It was discovered that 31% of the headquarters of the branch firms located in the vicinity of the airport were located across different areas of South Africa, and only 9.1% of the firms were subsidiaries whose parent firms were situated beyond the borders of South Africa, reflecting that the presence of multinational manufacturing firms was minimal in the vicinity of CTIA.

Contact between the branches and their headquarters and subsidiaries with their parent firms was analysed to discern the prevalence of intra-firm linkages crucial for the generation of internal economies described in the Literature Overview section. Showing the presence of dense intra-firm linkages within the economic space that is not restrained by geographical space or physical distance between head offices and (other) branches, the findings revealed that, on the one hand, 41% of the branch or subsidiary firms communicated with their headquarters daily and on the other, 32% made contact with other branches daily.

5.2 Linkages, agglomeration economies and clustering

5.2.1 Linkages with the airport

The linkages between manufacturing firms and CTIA establish, at least in part, the importance of the airport on the location and operations of the firms and the existence of urbanisation economies. More than half (57%) of the firms used CTIA for airfreight (shipping) purposes, i.e., to receive raw materials/ input for manufacturing activities and/or ship manufactured products. It was essential to analyse the frequency of the utilisation of CTIA to establish the level of the airport's importance on the activities of the manufacturing firms. Most firms (31%) received raw materials and/ or shipped their products through the airport at least every three months, while a smaller number (representing 15%) used the airport on daily, weekly and yearly, respectively. A much smaller number (constituting 8%) of the firms seldom used the airport, only once per month. The findings depict that the majority of the manufacturing firms did not use CTIA frequently, suggesting that the firms possibly used other modes of transport to interact with suppliers, distributors and/ or buyers frequently.

5.2.2 Linkages with firms in the vicinity of CTIA and elsewhere

As agglomeration economies rely on linkages, it was essential to analyse the inter- and intra-industry linkages of the manufacturing firms located in the vicinity of CTIA. The interaction between firms in the economy reflects a peculiar relationship, involving a balance of competition and cooperation (Belussi & Caldari, 2009). The findings revealed that more than three-quarters (78%) of the manufacturing firms had business interactions with other firms in the study area, i.e., the neighbouring firms. These geographically proximate linkages within the study area reflect signs of a possible spatial cluster/ industrial district of manufacturing firms.

Despite the aforementioned dense business linkages within the study area, the findings revealed that face-to-face engagements were not necessarily a precondition for business interactions, as less than half of the firms (42%) relied on face-to-face engagement with neighbouring establishments. The findings bring into question, at least in part, scholars who assert that face-to-face interactions are a prerequisite for the effective coordination of economic activities (Storper & Venables, 2004).

The manufacturing firms confirmed they had business relationships with the neighbouring involved in a several sectors, including manufacturing, transportation storage and logistics, and wholesale and retail. More than half (54%) of the manufacturing firms had business interactions with the neighbouring transport, storage and logistics firms, possibly for transporting the input and/ or finished products. 14% of the firms indicated that the business interactions were with the manufacturing firms near the airport, depicting the existence of intra-industry linkages, which could potentially result in localisation economies. As discussed in the Literature Overview section, drawing from the seminal work of Marshall (1920), localisation economies are benefits that result from the co-location of businesses in the same industry or economic sector. In this regard, the interactions of manufacturing firms in the vicinity of CTIA reflect the possibilities of localisation economies that stem from intra-industry linkages.

Intra-industry and inter-industry interactions of the manufacturing firms in the vicinity of CTIA included sales, marketing, procurement, transport and logistics, and repairs and services. The majority (56%) of the interactions involved activities related to transport and logistics. Services and repair constituted 13% of the interactions between manufacturing and neighbouring firms. Sales, marketing, and procurement constituted a small percentage (6.3%) of the interactions between the manufacturing firms and the neighbouring firms in the vicinity of CTIA.

It was also essential to analyse the existence of subcontracting to, at least in part, further discern the extent of inter-firm linkages of the manufacturing firms across different geographical scales. Subcontracting is a contractual relationship in which one firm conducts commissioned work on behalf of another firm (Kimura, 2002). Subcontracting benefits the involved firms through, among others, wage and cost savings (Holl, 2008). By nature, subcontracting between firms enhances inter-firm linkages that could lead establishing industrial clusters/ districts if the linkages occur within the same geographical area. Approximately 61% of the manufacturing firms subcontracted the services of other firms, while 52% of the firms subcontracted their services to other firms.

The literature argues that firms, which are located in industry agglomerations, are inclined to utilise subcontracting (Holl, 2008), hence it was essential to ascertain the geographical location of the firms that subcontracted their services to the manufacturing firms located in the vicinity of CTIA and vice-versa. The manufacturing firms noted that the majority of the firms (47%) that were subcontracted were located elsewhere in the City of Cape Town municipality, and 21% of the firms were located in the vicinity of CTIA, in part showing signs of spatial clustering. About 5% of the subcontracted firms were situated beyond the borders of South Africa. It is noted that the manufacturing firms located in the vicinity of CTIA were more related (i.e. from a subcontracting perspective) to those located elsewhere in Cape Town and thus utilised geographical proximity more at a metropolitan level as opposed to the vicinity of CTIA.

Most (38%) of the establishments that utilised the services of manufacturing firms were located elsewhere in the City of Cape Town municipality, and 24% of the firms were in other provinces of the country. A small number (about 10%) of the firms that subcontracted the services were located within the environs of CTIA, while 14% of the firms that subcontracted the services of the manufacturing firms were located outside South Africa. Like the previous discussion, the findings reflect the possibility of subcontracting-related agglomeration at a metropolitan/ municipal scale.

It was also essential to analyse the backward and forward linkages of the manufacturing firms. It was uncovered that the majority (33%) of the firms sourced their inputs largely outside South Africa, and around a quarter (26%) of the firms obtained their input from areas within the City of Cape Town municipal area, 21% sourced their inputs from other provinces, and a smaller number of the firms (comprising 7%) obtained their input from the neighbouring firms located in the vicinity of CTIA. The findings show that geographical proximity was not a determinant, as most inputs were received from firms located beyond the borders of South Africa. This could explain, at least in part, the linkages between the manufacturing firms and the airport while acknowledging that the input from (or output to) other countries could be transported through road and sea-based modes of transport.

Concerning the destination of the output of the manufacturing firms, close to a quarter of the firms (24%) sent their output to other South African provinces of Gauteng and KwaZulu-Natal, and 23% of the firms located in the vicinity of the CTIA sent their products to other areas in the Western Cape province. This shows that geographical proximity was not a significant factor, as only 11% of the firms indicated that their products were delivered within the environs of CTIA. The findings on the source of input and destination of products nullify, at least in part, the argument that with respect to industries that are vertically connected through an input-output arrangement, the upstream industry is attracted to locations with a concentration of downstream firms (Venables, 1996).

5.3 Locational behaviour

More than half (55%) of the respondents of the manufacturing firms indicated that before occupying the premises used at the time of the survey, their firms were located elsewhere, implying that 45% of the firms had always been located in the vicinity of CTIA. Among the firms that were previously located elsewhere, three-quarters (75%) were once situated in other industrial sites/ business premises within the City of Cape Town municipal area, while 25% were previously located at other premises within the study area, reflecting stickiness of the environs of the airport and/ or the municipal area. The so-called stickiness denotes the ability of an area to attract and retain businesses (Markusen, 1996).

The majority (55%) of the manufacturing firms moved from their previous locations because of the inadequate space to efficiently run their business operations. For instance, some respondents noted that they did not have adequate storage facilities at their previous premises. Additionally, 10% of the representatives of the firms pointed out that they moved from the previous locations as they had secured land to develop their premises. The other 10% moved from their previous premises because they wanted their firms closer to freight distribution firms near CTIA. Another 10% of the firms explicitly indicated that they relocated to the current premises because they preferred to be close to CTIA while the remaining 10% decided on the current premises because of other factors.

Further to the centrifugal factors from the previous premises discussed above, it was important to analyse the centripetal factors that influenced the location of the manufacturing firms in the vicinity of CTIA. The majority (53%) of the firms were attracted to their premises by the centrality of the study area, and 21% of the firms highlighted the advantages of being close to the airport. About 16% of the firms reported that the study area was beneficial due to the proximity to significant transport infrastructure in terms of local, regional and national road networks. A smaller number (5%) of the firms noted that their locations were ideal as freight distribution establishments neighboured their firms. Also, the current premises had adequate space required for their daily operations. It can be commented that most of the firms decided on their locations not necessarily because of airport-related factors, but because they were primarily influenced by the centrality and accessibility of the CTIA's environs. On the background of the advantages that influenced the location of the manufacturing firms, it was also important to identify the problems in the environs of CTIA. 36% of the respondents noted that they were negatively affected by the gridlock and high rentals in the study area. 7% of the respondents indicated that the aircraft noise impacted their firms, and 7% emphasised security problems in the study area. 14% of the respondents had no disadvantages, showing contentment with the environs of CTIA.

To indirectly ascertain the extent of the reported problems of the study area, it was crucial to analyse the locations the manufacturing firms would relocate if they had to move from their premises. The majority (40%) of the firms preferred to relocate to other industrial precincts within the municipality, and 13% preferred to relocate to the neighbouring premises in the vicinity of CTIA. A staggering 33% of the firms

were completely satisfied with their locations and had no intention of relocating. 6.7% of the manufacturing firms preferred to relocate to other provinces in South Africa, and the remaining 6.7% preferred to relocate to other countries. The findings again show the stickiness of the environs of CTIA and/ or the metropolitan area as the firms preferred to move to areas within the municipality, the study area or not move at all.

6 FOUNDATION FOR A THEORETICAL FRAMEWORK

Informed by the empirical findings summarised in the previous section, the foundation for a theoretical framework analysing the spatial economic factors that influence the location of manufacturing firms in the vicinity of airports is based upon the interconnections between the concepts of space, linkages, agglomeration economies, proximity and pattern discussed in the Literature Overview section. The contribution is graphically displayed in Fig. 2 and unpacked in the following discussion. The discussion hereunder uses the term 'manufacturing airport-centric firms' to refer to manufacturing firms located near the airport.

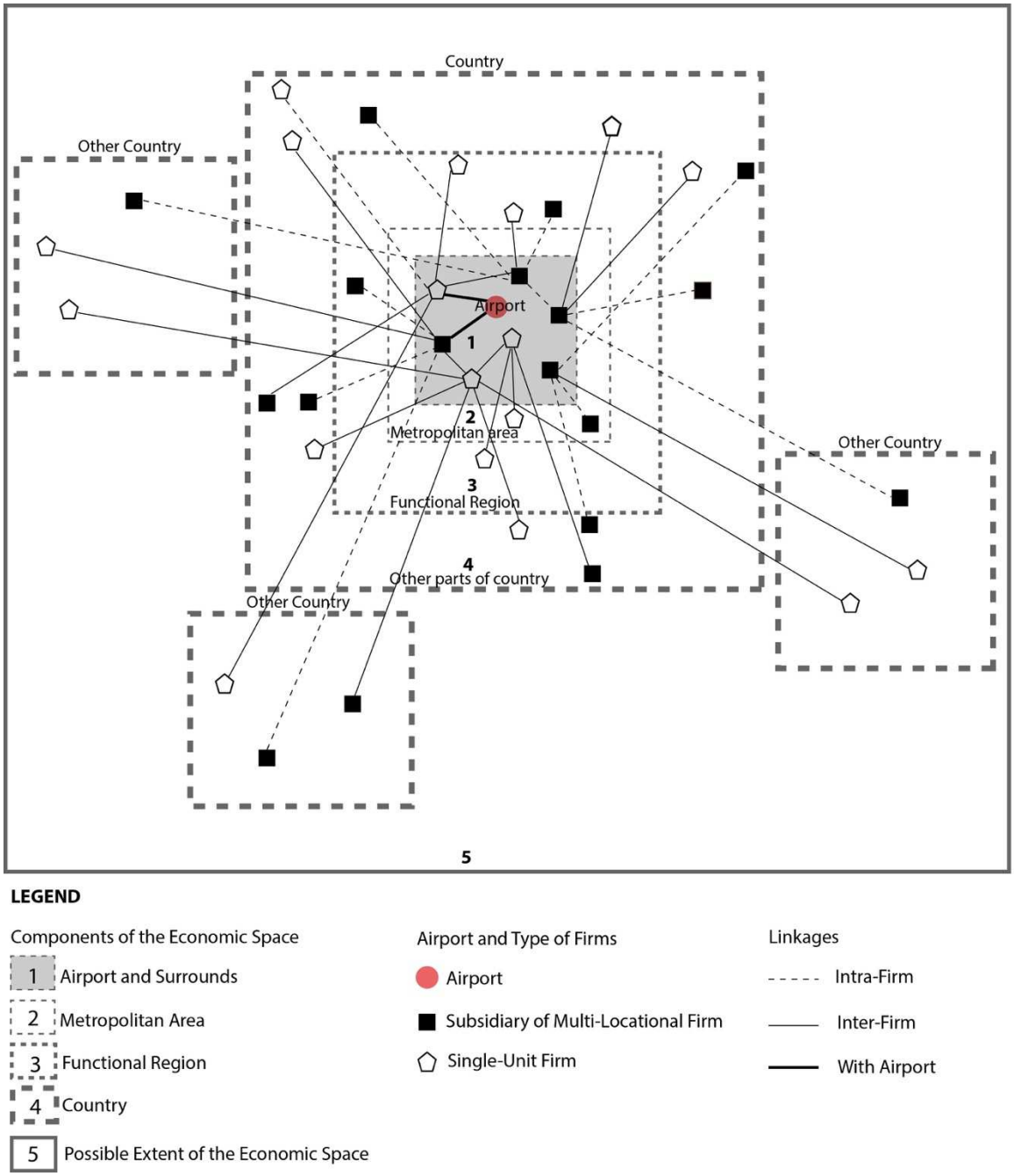

Fig. 2: A framework for manufacturing firms located in the vicinity of airports.

6.1 Immediate environs of the airport

The first component of the economic space (in Fig. 2) represents the airport and the associated manufacturing airport-centric firms, which are predominantly small establishments involved in a range of manufacturing activities. The firms choose their location for three main reasons. Firstly, the majority decide on the location because of the centrality/ accessibility of the airport and its environs. Secondly, some choose their premises to be geographically close to the airport or vie to be close to airport-related freight companies. Thirdly, some firms select their location due to the proximity to essential transport infrastructure in the form of local, regional and national road networks. These location-choice reasons show that the airport is one of the factors that directly or indirectly attract manufacturing firms. A few firms relocate from within the airport and surrounding areas over time, influenced by the search for premises that are more suitable for their particular business needs. This trend shows that the environs of the airport (as well as the broader municipal area) are sticky in attracting and retaining manufacturing firms.

Manufacturing airport-centric firms have the following attributes: one, manufacturing firms with inter-firm linkages with other firms in the geographical surrounds and/ or elsewhere; two, manufacturing firms with intra-firm linkages with units of the same firm located in the vicinity of the airport and/ or elsewhere; three, manufacturing firms that utilise a combination of intra-firm and inter-firm linkages. Although face-to-face interactions are not dominant in facilitating business, manufacturing firms have business interactions with other firms near the airport, which points to a potential spatial cluster. Most linkages are with the neighbouring transport and logistics firms, which are essential for transporting the input to the manufacturing processes and/ or shipping the finished products to markets in different economic space layers. A sizeable number of the firms also have linkages with the neighbouring manufacturing firms, pointing to the possibility of localisation economies arising from the intra-industry linkages within the airport's environs. However, regarding vertical linkages, a negligible number of manufacturing firms source their manufacturing input and/ or send their products to the neighbouring firms.

Most manufacturing airport-centric firms have linkages with the airport, utilising it for airfreight to receive raw materials/ input to the manufacturing processes and/ or shipping the finished products to the suppliers/ market. With different frequencies of utilisation, the majority of those firms use the airport at least every three weeks. The manufacturing firms that use the airport benefit from urbanisation economies by being geographically proximate to the airport and the associated airfreight services.

6.2 Municipal area

The linkages (and agglomeration economies) of manufacturing airport-centric firms are not restrained by geographical proximity to each other and the airport. The second component of the economic space (refer to Fig. 2) represents a municipal area in which the airport is situated. Relative to manufacturing airport-centric firms, firms in the broader municipal area have the following characteristics. Firstly, some firms have intra-firm linkages with manufacturing airport-centric firms, i.e. interactions between units of the same firm. Secondly, firms in the broader municipal area have inter-firm linkages with manufacturing airport-centric firms. These two categories are not mutually exclusive; hence, some of the firms near the airport have a combination of inter- and intra-firm linkages with firms located in the broader municipal area. Lastly, other firms in the municipal area do not have significant linkages with manufacturing firms in the vicinity of the airport and are, therefore, not in the same economic space.

Through vertical (buyer and seller) arrangements, airport-centric manufacturing firms source some of their manufacturing input from within the municipality and similarly send some manufactured products to areas in other parts of the municipality. Subcontracting is one of the business arrangements used to realise the inter-firm linkages between firms in the municipal area and manufacturing airport-centric firms in the following manner: firstly, manufacturing airport-centric firms use the services of firms in the broader municipal area through subcontracting; and secondly, firms in the municipal area utilise the services of manufacturing firms through subcontracting. Manufacturing airport-centric firms use these two arrangements simultaneously.

The linkages of manufacturing airport-centric firms and firms elsewhere in the metropolitan area are based on geographical proximity and organisational proximity. However, the relevance of the former is declining due to the increasing geographical distances from the airport. Manufacturing airport-centric firms' linkages (internal and external to the firm) and agglomeration include firms positioned elsewhere in the metropolitan area.

6.3 Functional region

The intra-firm and inter-firm linkages involving manufacturing airport-centric firms do not cease within the bounds of the municipal area as defined by the administrative boundaries. The third component of the economic space relates to a functional region. The distinction between the municipal area and region is not clear-cut. Because distinctive administrative boundaries do not define the region, it can be referred to as a functional region. Similar to the attributes of the metropolitan area, the region accommodates firms with the following characteristics: firstly, firms with intra-firm linkages with manufacturing airport-centric firms; and secondly, units with inter-firm linkages with manufacturing airport-centric firms. Other firms in the region do not have significant linkages with firms around the airport and, therefore, do not form a significant part of the manufacturing airport-centric firms' economic space. At this level of the economic space, subcontracting is one of the business arrangements used to achieve the inter-firm linkages between firms in the region and the manufacturing airport-centric firms. The manufacturing firms also source some of the input from the region and/ or deliver some manufactured products to parts of the region.

The influence of geographical proximity is diminishing, and the linkages are mainly based on organisational proximity. However, it should be acknowledged that because the airport is not situated at the geographical midpoint of the municipal area, there are instances where it could be geographically closer to some parts of the region than certain parts of the municipality. In this regard, geographical proximity still has a role in the operations of the manufacturing airport-centric firms' economic space with firms in the region.

Although the magnitude of linkages is declining, some firms in the region are still part of the same economic space as the manufacturing airport-centric firms regardless of the increasing geographical distance and changes in administrative boundaries.

6.4 Other parts of a country

The linkages and organisational of manufacturing airport-centric firms extend beyond the functional region. The fourth component of the economic space relates to other parts of a country. Manufacturing airport-centric firms, therefore, have linkages with firms (or units of the same firm) located in other parts of the country. Similar to firms in other components of the economic space, firms elsewhere in the country have the following linkages: one, firms that have intra-firm linkages with manufacturing airport-centric firms; two, firms with inter-firm linkages with manufacturing airport-centric firms. The inter-firm linkages are realised through, inter alia, the framework of subcontracting wherein manufacturing firms around the airport use the services of firms elsewhere in the country and/ or offer their services to firms in other parts of the country, beyond the region and province. Three, there are firms with a combination of intra-firm and inter-firm linkages with manufacturing airport-centric firms. Other firms do not have direct linkages with airport-centric firms and are, therefore, not part of the same economic space.

Specifically, manufacturing firms source their manufacturing input from other parts of the country and/ or send their finished products to markets elsewhere in the country, which could be facilitated through the airport as well as other modes of transport. At this level of the economic space, geographical proximity has no role in the operations of airport-centric manufacturing airport-centric firms. The economic space's inter-firm and intra-firm linkages and operations are based entirely on organisational proximity. Manufacturing firms around the airport are, therefore, part of the same economic space as firms in other parts of the country, regardless of the great physical distances and administrative boundaries that separate them.

6.5 Multi-country activities

Although the presence of multinational firms may be limited in the environs of the airport, the linkages of manufacturing airport-centric firms extend beyond the borders of a country, leading up to the last component of the economic space (Fig. 2). While acknowledging the relevance of other modes of transport given the diversity of the activities of the manufacturing firms; the firms utilise the airport's airfreight services to source the input (to the manufacturing processes) from other countries and to a smaller extent ship their products to markets elsewhere in the world. These vertical arrangements (to transport low-weight, high-value items) utilise organisational proximity in light of the great distances between the airport and other parts of the world.

Therefore, manufacturing firms near the airport have intra-firm and inter-firm linkages with firms in other countries. Similar to other levels of the economic space, subcontracting is one of the business arrangements

used to achieve the inter-firm linkages across national borders. The subcontracting arrangements and backward and forward linkages with firms in different parts of the world show that in the style of Perroux (1950), operations of the economic space of manufacturing firms located in the vicinity of airports can be global.

7 CONCLUSION

To extend the literature on the geographical positioning of economic activities in the vicinity of airports, the paper aimed to formulate the foundation for a theoretical framework for analysing the spatial economic factors that influence the placement of manufacturing firms in the vicinity of airports. The following closely intertwined concepts were used as building blocks: space, proximity, linkages, agglomeration economies, clustering and pattern. The resultant foundation for the empirically-informed theoretical foundation is based on five layers of the economic space: environs of the airport, broader municipal area, functional region, other parts of a country, and multi-country. Within the first (core) layer, the airport is, among others, understood to be a centre of a spatial cluster of manufacturing firms, characterised by dense intra-firm and inter-firm linkages. There are also strong linkages between the manufacturing firms and the airport, wherein the airfreight services are used to source input to the manufacturing processes and/ or transport the finished products to the markets/ buyers in different layers of the economic system. The linkages of manufacturing airport-centric firms, therefore, extend to other layers of the economic space and essentially occur within the framework of vertical (buyer and seller) arrangement and manufacturing firms that engage in subcontracting activities that are not restrained by geographical space. It is hoped that the elementary contribution would sensitise policymakers, planners and authorities to the spatial economic dynamics of manufacturing firms positioned in the vicinity of airports. Furthermore, it is intended that the contribution be improved upon and be employed to conceptually guide future research on the spatial economic factors that influence the location of manufacturing firms in the environs of airports.

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