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Identification of network cities in South Africa

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Abstract Settlements, cities and regions function as integrated systems. This resulted in the creation of functional connections and when linked, networks within which trade occurred. This played an important role in the creation of scope economies. This is based on the notion that various networks formed a unique exchange environment from which economic development benefitted. Furthermore, networks evolve and grow when independent cities or regions strive to co-operate and in the process created higher and lower-order settlements which support the outcomes of economic space development and cities as sites of renewed economic dynamism. Networks consist of two important elements: (1) nodes, denoting location and size and (2) links, denoting distance and capacity that display the forces of interaction. These forces of interaction are the underlying principles of the complex relationships that exist between different urban centres (gravitational properties) due to the agglomeration of economic activities. Applying a regional network model, considering gravitational properties provides a solution, whereby a city's functionality within a network is established. The model provides a framework denoting a city's rise in performance as either mega, primary, secondary or intermediate which ultimately measures a city's role and 'place' within economic space development. The framework allows cities to realise their 'place' of potential allowing them to respond proactively and innovatively to develop and promote economic development.

Keywords Networks · Economic space development · Regional network model · Regional and urban systems · Agglomeration · Economic stages · Urbanisation · Cities · Regions

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Introduction

Cities and regions in the view of scholars such as Jacobs (1984), Dewar (1988) and Drewes (2015), play a key role in the economic development of a country. This according to Van Huyssteen (2013, 2014) provides opportunities for creativity and innovation, resulting in certain cities or regions being selected as preferred locations for economic development. Furthermore, economic spaces are shaped by events creating different stages of economic development. These stages of economic development create a shift in economic activities, moving from the one economic

sector to the next (Mallick 2005). This shift is considered essentially positive because it increases quality of life, i.e. a highly developed economy presents societies and cities with more choices and opportunities. Presenting societies and cities with a multiplicity of choices and opportunities ultimately helps to generate conditions that transform economic and social conditions (Higgings 2017).

Mallick (2005), Gildenhuys (1994), and Watts (1993) stated that, internationally, there was consensus that economic development in a country could hardly take off successfully if specific attention were not paid to the development of the urban environment. In their view, economic space development is a normative expression i.e. economic space development is subjectively constructed. Subjectively can include keeping with tradition and customs or relations and functions that link distant localities in such a way that economic space development is shaped by events and interactions. This supports the notion of economic development as a result of interactions between cities. This basically means that interactions between cities or regions are considered a key ingredient of what is defined by functional networks.

The aim of the paper is to via the application of a regional network model; elevate cities and towns to find their *'place'* in a functional network of cities supporting the notion of what is considered *'good spatial and settlement planning'*. The structure of the paper is based on the following key concepts: (1) urban networks and regional growth arguing the evolutionary explanation of economic change i.e. moving from the one economic sector to the next; (2) urbanisation and agglomeration economies arguing the transformation of economic conditions on an urban and regional scale; (3) regional policies in South Africa that foster the vision of spatially and economically integrate centres and regions that will provide economic opportunities; and (4) the application of a regional network model to identify an interactive functional network of cities and regions that presents a renewed economic spatial framework for South Africa. Evident from the paper is that a city or region can only be understood if the context of its *'place'* of functionality (performance) within a network is understood.

Urban networks and regional growth

In basic terms, networks mean the interactive linking of cities or regions. These networks may be of a different nature and of different importance. In the modern conception of cities, networks play an important role in understanding city functionalities and development. Networks are not only physical connections such as roads, railroads, ship routes or airways, but also non-physical connections such as trade, finance, markets, migration, culture and shared social spaces.

As early as 1850, Köhl (Haggett 1983) created a series of networks that served regions. His ideas were adopted by Christaller to explain the development of urban systems. Both Köhl and Christaller (1933) identified two important features relating to networks: (1) that networks are hierarchical; and (2) that networks have a structure that relates to flows. This means that the linkages within a network should affect the accessibility of cities and regions connected to it. This supports the notion of economic growth and development that results from interactions between dominant urban centres. Furthermore, according to Haggett (1983), as illustrated in Fig. 1, networks consist of two important elements: (1) nodes, denoting location and size, which are the intersection points and (2) links, denoting distance and capacity that display the forces of interaction. The city itself is considered the node connecting different networks. According to Batten (1994), networks evolve and grow when independent cities or regions that are complementary in function, strive to co-operate and achieve significant scope economies aided by fast and reliable

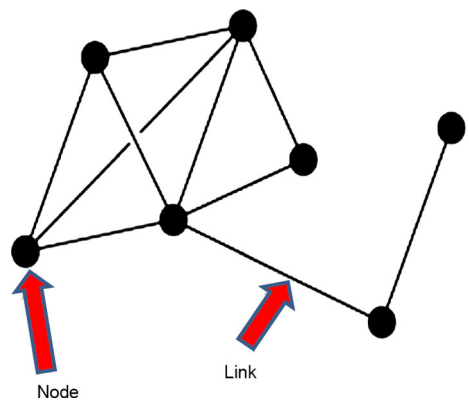

Fig. 1 Networks. *Source*: Brand (2017)

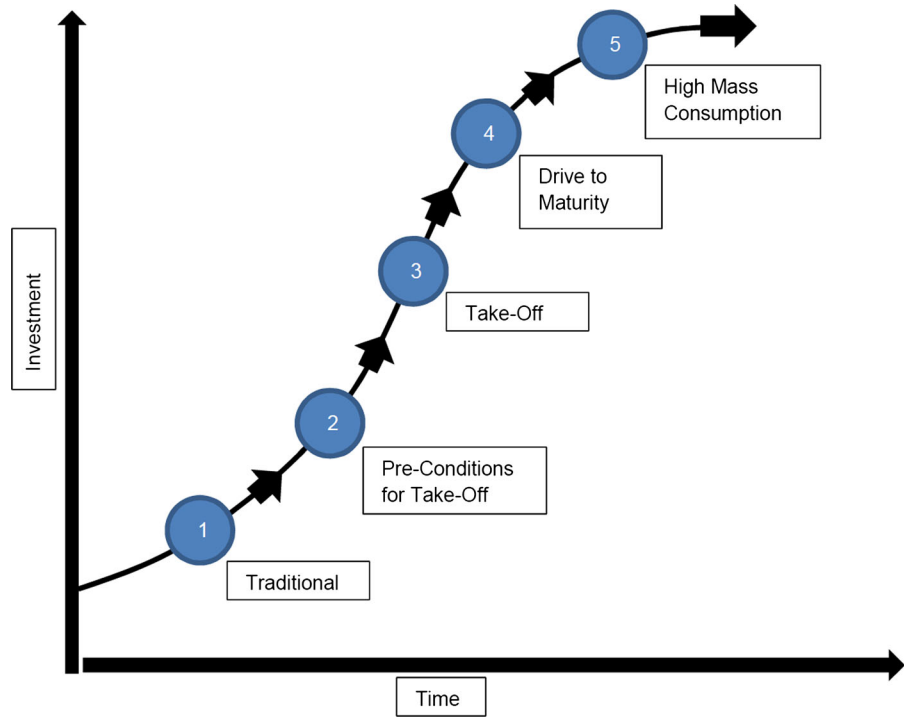

Fig. 2 Rostow's model of economic development. *Source*: Potter et al. (1999)

infrastructure. When considering the principles of locational theories (central place, diffusion, new economic geography and core-periphery), some of these networks are more powerful than others, creating higher and lower-order settlements which support the outcomes of economic space development and cities as sites of renewed economic dynamism. It has also been argued that networks are a key ingredient of what defines economic space development. Cities and regions, in the view of the South African Cities Network (SACN) (2016), are complex, dynamic and constantly evolving environments, with new technologies rapidly shifting the context in which they operate. Networks provide for a sophisticated polycentric urban landscape that supports a diversified economic environment (the whole paragraph underpins the regional network model as a potential unobstructed approach to support the notion of what constitute as *'good spatial and settlement planning'*).

According to Giddens (1991), although scholars such as Durkheim, Marx and Weber theorised economic transformation, it was Rostow's (1960) concept of economic growth that postulated the evolution of economic stages. Rostow (1960) argued that each stage as illustrated in Fig. 2 evolved towards a higher state of economic development over time. He identified five stages of economic growth, namely (1) traditional; (2) preconditions for take-off; (3) take-off; (4) drive to maturity; and (5) age of high mass consumption. Mallick (2005) further argued that the aim of economic stages is that, within the economic history, each stage contributes at different levels towards the main economic sectors which based on the sector theory (see Fig. 3) is accompanied by a shift in economic activities from the primary to the secondary and, later, to the tertiary sector.

Figure 3 illustrates that economies with a low per capita income are placed in an early stage of development (traditional and pre-condition for take-off), i.e. the main portion of income is achieved through production in the primary sector. The diagram further illustrates that economies in a more advanced state of development (take-off and drive to maturity), with a medium income, generate their income mostly from the secondary sector, and a highly developed economy (high mass consumption) with a high income is where the tertiary sector dominates the total output of the economy, ultimately presenting societies and cities with a multiplicity of choices, which results in the creation of prosperity.

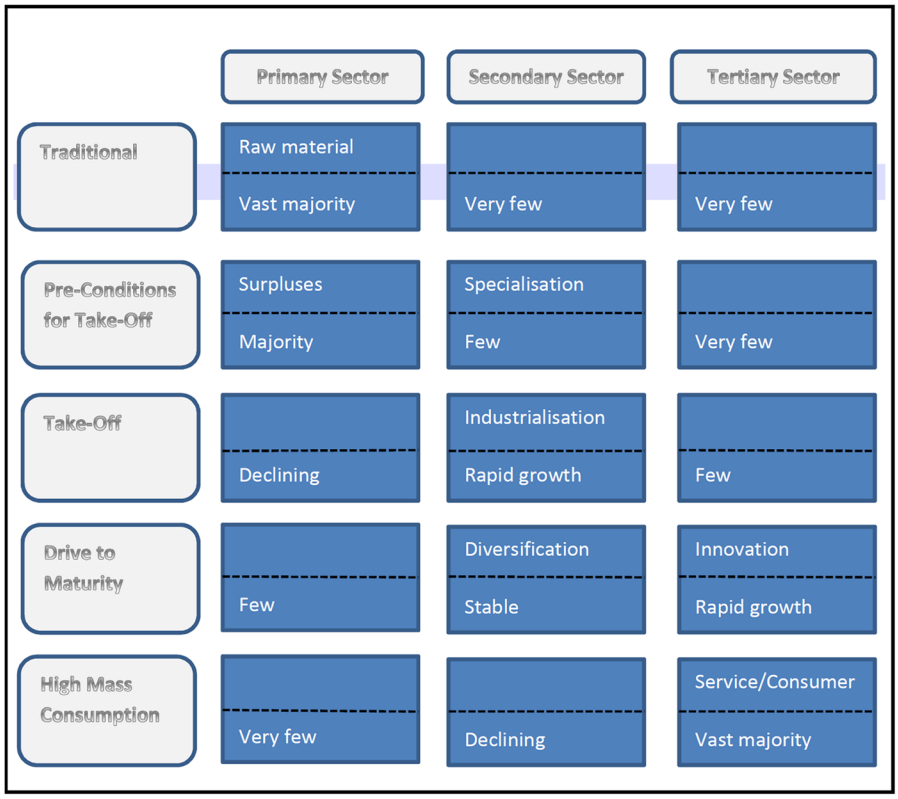

Fig. 3 Sector shift in economic activities. *Source*: Potter et al. (1999) and Clarke (1991)

Urbanisation and agglomeration economies

The most common and probably the most prominent concept in an urban and regional system, which ultimately shapes economic space development, is the process of urbanisation (Bakker et al. 2016; Burgess et al. 2004). However, according to Cohen and Cohen (2015) urbanisation is not a modern phenomenon, but a specific condition at a set time. This condition is evident when considering Rostow's stages of economic development, especially the Take-Off stage, which characterises industrialisation as the leading condition in economic development.

Urbanisation tends to evolve through different phases of urban development. This is when people settle in various parts of a region in a country to establish the initial settlements. During this initial phase, most of the urban centres are central places that support a widely distributed population. However, due to the uneven distribution of natural resources, certain urban centres tend to develop faster than others, thereby attracting more people (Geyer and Geyer 2015a, b; Geyer 2002). Geyer and Kontuly (1993, 1996) took the concept and incorporated it into a theory of differential urbanisation, which postulates that large, intermediate-sized and small cities evolve through successive periods of fast and slow growth in a cycle of development as illustrated by Fig. 4. According to them, the differential urbanisation theory is subdivided into three main phases:

1. *Urbanisation phase*—This is the phase when the process of the initial urban establishment cycle comes to an end and an urban hierarchy is formed.
2. *Polarisation reversal*—Over time, urban centres enter what has been termed the turnaround phase, called 'polarisation reversal'. It's a phase associated with population and industrial re-concentration to intermediate-sized cities closer to the large urban agglomerations i.e. deeper into the periphery.
3. *Counter urbanisation*—Finally, counter-urbanisation kicks in when not only intermediate-sized cities, but also smaller centres in the deeper periphery start gaining migrants and growing

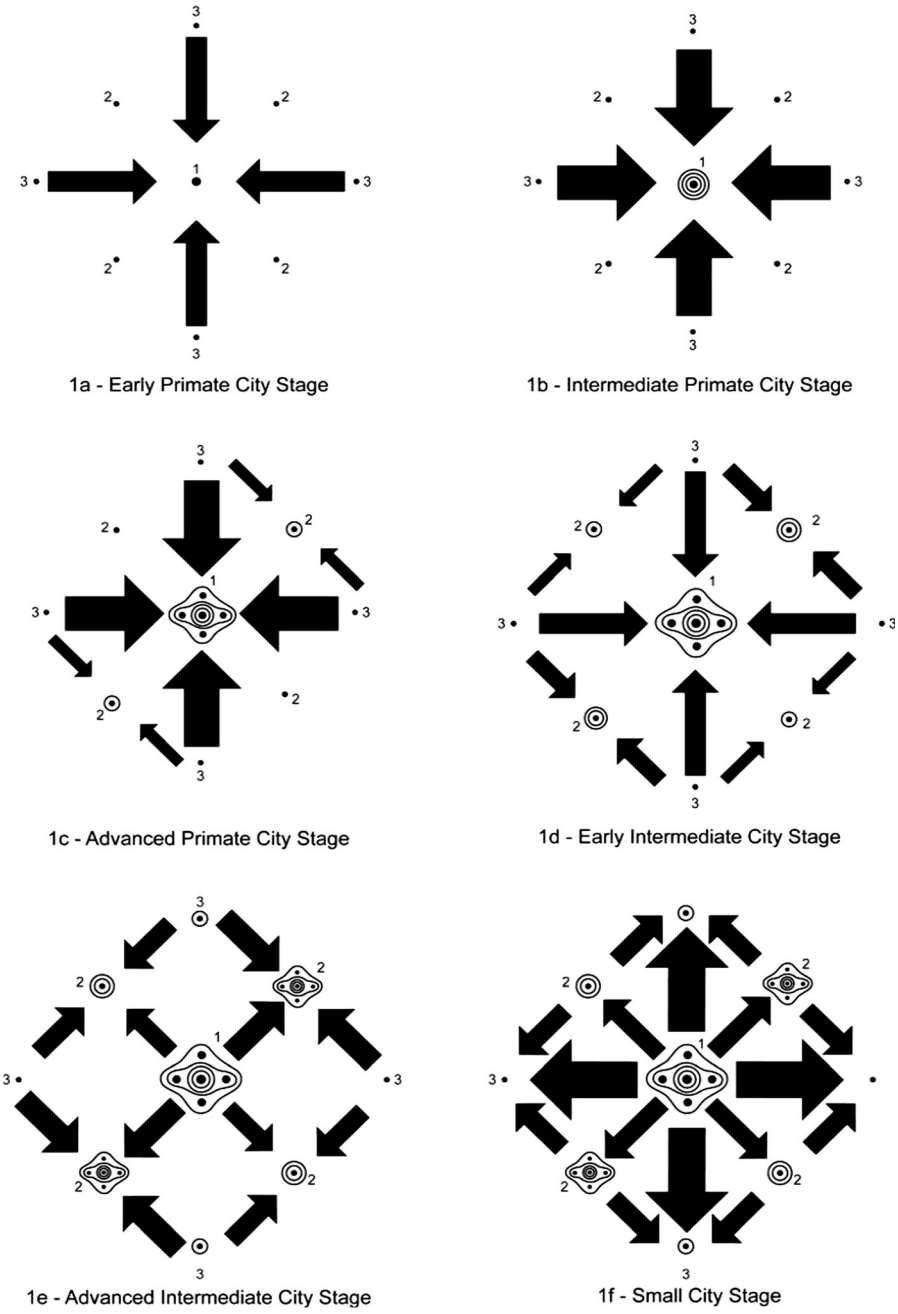

Fig. 4 Urbanisation process. *Source*: Geyer (2006) and Geyer et al. (2012)

economically. At the end of this phase, the urban system has reached a 'saturation point', where rural–urban migration ceases to be a major contributory factor in the urbanisation cycle.

Davis and Henderson (2003), in their assessment of the urbanisation process, concluded that urbanisation and economic development went hand-in-hand. In their view, urban concentration, the extent to which urban resources are concentrated in one or more larger cities, is directly affected by economic development. This view supports Richardson's (1980) earlier notion that the locational advantages created by the establishment of core regional and urban systems, ultimately result in strong interactions of spatial economic

networks, thereby supporting the arguments put forward by Van Huyssteen (2009, 2013, 2014) and Geyer (2003) that, over time, resulted in the development of a *hierarchy of urban centres* (alludes to step one of the regional network model focussing on the Urban Function Index (UFI) and Settlement typology) and Drewes (2015) that cities and regions are the engines driving economic development.

Agglomeration refers to the benefits businesses obtain when locating near each other. The concept relates to the notion of economies of scale and network effects, i.e. if industries agglomerate together, production costs will reduce. Therefore, the formation and growth of cities are directly linked to exploiting economies of agglomeration to create opportunities for investment.

In the view of Parr (2002), the benefits created by agglomeration economies are based on production costs being reduced. As a result, other industries which can take advantage of these economies are established, causing sustained cumulative growth in preferred localities. This process, in the view of Krugman (1991), Fujita and Thisse (1996), Mayer (1996) and Nafziger (2006), is one of the key underlying principles of urbanisation. In simple terms, the basic principle behind agglomeration economies is that production is regulated when there is an agglomeration of economic activities, which initiates economic growth. The existence of agglomeration economies, highlighted by Howitt (2004), Mayer (1996), McCann (2004) and Nafziger (2006), is how cities increase in size and population. According to Drewes (2015), agglomeration economies lead to a greater concentration of people, economic entities, infrastructure and institutions, which means that resources are used more efficiently. Nicholson (2003) noted that these principles of agglomeration were linked through integrated connectivity networks, which supported the idea of creating better opportunities in the restructuring of economic spaces. Furthermore, core-periphery conditions, as illustrated in Fig. 5, tend to lead to the gravitation of economic activities to core areas.

Graham and Dender (2010) took the concept further, referring to agglomeration as the scale of location accessibility. According to them, accessibility may be direct continuity within urban areas or between different main urban areas linked by transportation routes, emphasising the notion of a network. The network concept is considered to mean the

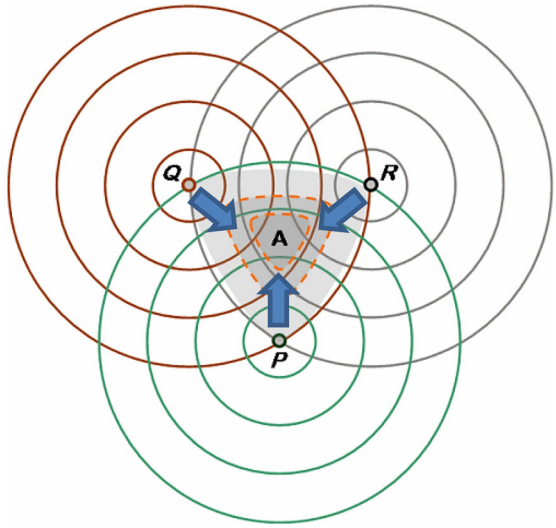

Fig. 5 Agglomeration economies. *Source*: Brand (2017)

underlying principles of the complex relationships that exist between different urban centres, due to the agglomeration of economic activities. Graham and Dender (2010) and Rosenburg (2014) referred to accessibility as the modified law of gravitation, taking into account the population size of places, the distances between them and the size of their economies. In the view of Rosenburg (2014), larger places attract more people, ideas and commodities than smaller places, resulting in *different degrees of attraction between places* (alludes to step three and four of the regional network model focussing on the degree of economic attraction that exist between cities (step three) and classifying the degree of economic attraction as a ranking score (step four)).

Agglomeration is also associated with synergy. The assumption is that cities in close proximity to one another, relate to each other in a synergetic way, making the whole network of cities more than the sum of its parts (Meijers 2005). Synergy expresses the rise in the performance of a network through effective and efficient interactions. Capello et al. (1998) analysed the concept of synergy and arrived at two distinct meanings, namely synergy is positive when two or more cities interact, or synergy is external caused by individual cities which voluntarily or non-voluntarily *form part of a group of cities or regions* (alludes to step two of the regional network model focussing on synergy that exists between cities). However, the concept of synergy is not new; it was introduced by

Doxiadis (1968) more than four decades ago. In Friedmann's (1966) view, there is a direct relationship between the interaction of cities and the distance separating them meaning, the locality of a settlement in relation to a dominating core city would co-determine its level of interaction with the core city. This direct relationship has recently been linked to the *daily* and *weekly urban system* concept advanced by Geyer and Geyer (2015a). The daily urban system includes all settlements located within 1 h travel time from one of the core city centres which, according to Newman (2004), remains a fairly constant commuting distance. Closely associated with the daily urban system is the concept of the weekly urban system (Hall and Hay 1980), which includes all settlements (higher and lower order) located within 2 h commuting distance from one of the core city centres. According to Geyer and Geyer (2015a), the hinterlands created by the daily (direct relationship) and weekly (indirect relationship) urban systems are regarded as a fair representation of the economic and social sphere of influence that exists between cities i.e. the synergy that exists between cities.

Regional policy in South Africa

Since 1994, South Africa adopted various policy frameworks in an effort to rebuild and transform the economy of the country after years of economic isolation and financial sanctions. Policies that played a major role were the Reconstruction and Development Programme (RDP) adopted in 1995 which was considered the cornerstone of government development; the Growth, Employment and Redistribution (GEAR) strategy adopted in 1996 to stimulate faster economic growth; the Accelerated and Shared Growth Initiative for South Africa (ASGISA) adopted in 2005 as a further development on the first two developmental strategies; the New Growth Path (GNP) adopted in 2010 to accelerate economic growth to rapidly reduce poverty, unemployment and inequality; and the National Development Plan (NDP)-2030 introduced in 2013 as South Africa's long-term socio-economic development roadmap i.e. emphasises the beginning of a new focus on strategic planning for South Africa. Brand (2017) when considering Schoeman's (2015) classification of the current and most important policy frameworks, argued that although many of these policies are standing on the periphery of planning systems, only a few are at the core when considering strategies about how to best manage the country's future. In his view policy frameworks that strongly interface with the NDP are (1) the National Infrastructure Plan (NIP), which envisions a long-term planning framework for investment in major strategic infrastructure projects; (2) the Industrial Policy Action Plan (IPAD), which introduces Specific Economic Zones (SEZs) as a tool to assist in the economic development of regions; (3) the National Transport Master Plan (NATMAP), which envisions a dynamic, long-term, sustainable land-use and multimodal (road, rail, air and sea) transportation systems framework for the development of network infrastructure facilities; (4) the Integrated Urban Development Framework (IUDF), which unlocks development synergies that emanate from coordinated investments in cities, thereby ensuring a new approach for South African cities and towns; and (5) the Spatial Planning and Land Use Management (SPLUMA), which brings together through the development of Spatial Development Frameworks (SDFs) promoted at a national, provincial, local and district level, the collective vision of government, businesses, and civil society to promote social and economic inclusion.

Brand (2017) in his assessment of the above policies concluded that the IUDF and SDFs foster the vision of spatially and economically integrate centres that will provide economic opportunities. Drewes and Van Aswegen (2013) argued that the development of SDFs is to ensure that all plans and programmes are coordinated, consistent and in harmony with each other, i.e. SDFs will give specific and definite geographical expression to influence the space economy of South Africa. On the other hand, the IUDF provides for a new approach to urban investment by recognising that the country has different types of cities and towns, which have different roles and requirements. Therefore, to achieve the transformative vision of spatial transformation as a strategic approach, the IUDF advocates cities to be the country's economic driver through improved spatial transformation and inclusion (South Africa 2014). Another initiative although not directly linked with the above policy frameworks but worth including, the South African Treasury in collaboration with various organisations launched the Southern Africa–Towards Inclusive Economic Development (SA-TIED) programme

that looks at ways to support policy-making for inclusive growth and economic transformation in the southern Africa region. According to Treasury, the southern African region has great potential for economic transformation and inclusive growth. However, constrains at the regional level, including a divergence between national policies and regional integration have hampered this potential (South Africa 2019).

Although there is no agreed definition for spatial transformation, it is often referred to as 'major urban change or restructuring'. Therefore, urban restructuring implies that cities are being tasked with driving spatial transformation (Turok 2014). This transformation should meet the need for inclusivity, mobility and access to economic development investments which will drive local and national growth prospects, transforming space in a manner that is economically sustainable (SACN 2016). This aligns with the aim of the NDP, which is to break down the legacy of spatial divergence through a coherent approach to spatial development backed by strong investment, and the identification of viable and sustainable opportunities.

Towards a regional network model

As far back as the 1930s, Wright (1934) made the statement that there are different approaches to specifying a model of interest. He was the first to suggest that the most intuitive way to specify a model is to describe one's model by means of a path diagram. In this regard, a detailed illustration of what the regional network model entails is shown in Fig. 6. A diagram provides a useful guide to clarifying ideas about the relationships that exist among variables, which could be directly translated into corresponding equations for modelling (Wang and Wang 2012). Models refer to the imitation of real-world processes or systems and are generally used to illustrate the eventual real effects of specific conditions, as well as required courses of action, i.e. the creation of a model represents the key characteristics, behaviours and functions of the selected system or process.

The aim of the regional network model in the context of this research is to establish an interactive functional network when focussing on cities and regions as renewed economic dynamism. Furthermore, to foster and understand the phenomena networks provide as a sophisticated polycentric structure, the outcome of the model is contextualised against South Africa as a real-life event.

South Africa has a long-standing network of cities and towns which have developed and become hierarchized over the course of a history during which their locality, distribution and growth have been influenced by colonisation, segregation, industrialisation and globalisation (Giraut and Vacchiani-Marcuzzo 2012). The discovery of minerals has seen the pastoral and agricultural economy of South Africa change into a mining and industrial economy which resulted in a market shift of population. This process of urban evolution resulted in nested patterns of higher and lower-order centres. This allowed for the delimitation of functional areas in national space, based on economic catchment areas of higher-order centres, which, in turn, determined the outcomes of agglomeration economies in the form of *city regions, cities* and *large towns*.

Almost 68% of South Africa's population reside within *city regions, cities* and large *towns*. The spatial distribution of cities, towns and settlements, is set to represent the functional role that cities and towns play in their regional contexts. Findings illustrate the important role that these populated places, and especially *city regions* and *city* areas play as economic engines and job baskets within South Africa. An estimated 57% of the formal economy alone is being generated in the *city regions* and when adding the network of *cities* and major *towns,* more than 80% (see Table 1). These cities function as highly concentrated command points, i.e. key locations for economic activities and specialised services, sites for production and innovation; and as markets for products and innovation produced.

Establishing the primary networks of functional urban and regional centres for South Africa as illustrated in Fig. 6, is based on four key steps. The first step is to establish the broader or general functional network of cities. For this purpose the UIF and settlement typology were considered. The purpose of the UFI is twofold: (1) to determine the economic weight of urban settlements relative to one another; and (2) to distinguish between the sizes of the commercial, service and industrial components of urban economies. The settlement typology was primarily developed to describe the role and character of

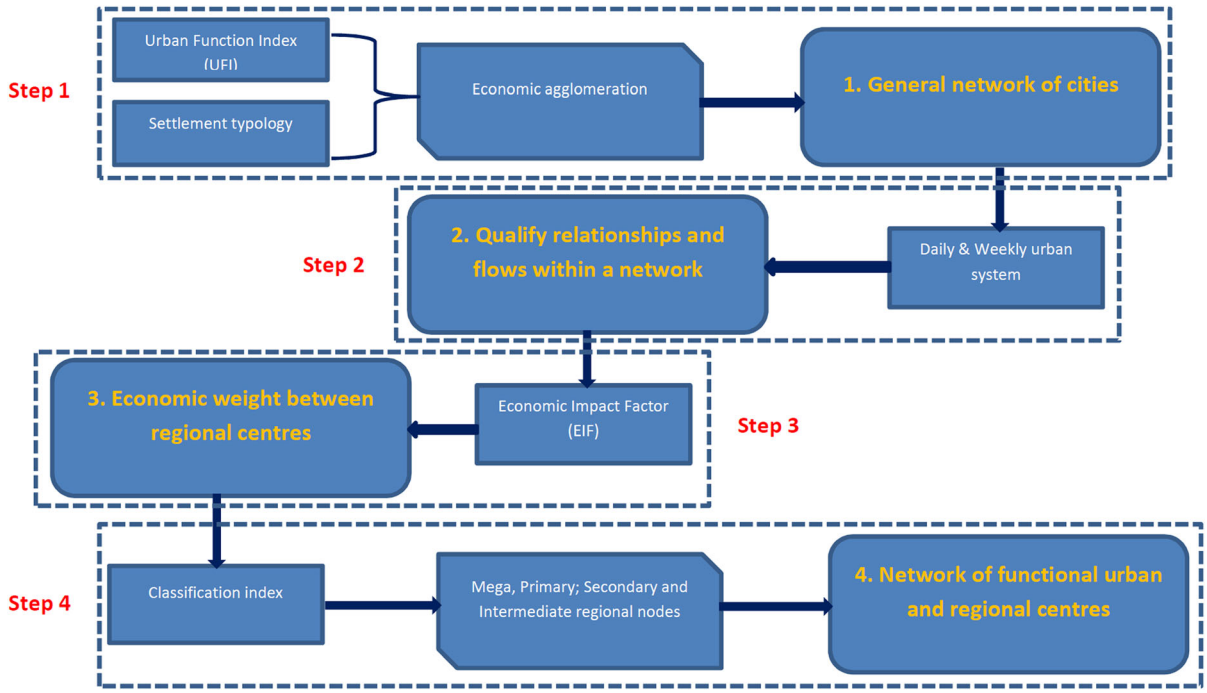

Fig. 6 Regional network model. *Source*: Brand (2017)

the different settlement types, and to illustrate the relationships and flows between the different spaces, as well as the relationships between urban centres and their hinterlands and the broader global economy. Therefore, both the UFI and the settlement typology were subsequently used to measure economic agglomeration, i.e. the relative strength of commercial and industrial clustering as a means of determining the potential strength of economic space development within the country. However, it is important to note that the places of the biggest and most well-known cities, towns and settlements (see Table 1) include their functional surroundings to enable understanding of formal economic activities and the extent of population in the area. This also refers to the functional role of cities, towns and settlements in providing access to services and opportunities.

Table 1 and Fig. 7 illustrate the network of cities generating more than 80% of the country's formal economy. These places are primarily classified as *primary cities, intermediate cities* or *small cities* and *large towns*, and are divided into three functional typologies: (1) cities with a UFI value of 20 and above, considered *primary cities*, contributing more than 50% towards the economy, as well as accommodating close to 40% of the total population and close to 50% of the total economically active population; (2) cities with a UFI value of between 5 and 20, considered *intermediate cities* or *small cities*, contributing more than 15% towards the national economy, as well as accommodating close to 15% of the total population and close to 15% of the total economically active population; and (3) cities with a UFI value of between 2 and 5, considered *large towns*, contributing close to 10% towards the national economy, as well as accommodating close to 10% of the total population and close to 10% of the total economically active population. This classification, based on UFI values, defines the relative economic dominance of the cities in a general network.

Although it is clear that the general network of cities, based on functional typology, represent the most dominant agglomeration of economic activities in South Africa, the clustering of this network of cities in proximity to one another creates the opportunity to establish the sphere of synergy (step two) that exists between the cities. This allows for considering a daily and weekly urban system (explained under urbanisation and agglomeration economies) to establish the sphere of synergy that exists between the general

Table 1 General functional networks of cities. *Source*: South Africa (2011)

UFI	Municipality				Population		Economic active		GVA	
100	WC	CPT	City of Cape Town	Cape Town	37,40,025	7.22%	17,00,229	9.06%	1,86,199	10.93%
94.51	GT	JHB	Johannesburg	Johannesburg	44,34,828	8.57%	22,61,487	12.05%	2,33,761	13.72%
76.05	KN	ETH	eThekwini	Durban	34,42,362	6.65%	14,22,879	7.58%	1,48,555	8.72%
51.7	GT	TSH	City of Tshwane	Tshwane	29,21,490	5.64%	14,24,601	7.59%	1,56,169	9.17%
38.49	GT	EKU	Ekurhuleni	Ekurhuleni	31,78,470	6.14%	15,82,452	8.43%	1,49,601	8.78%
34.93	EC	NMA	Nelson Mandela Bay	Port Elizabeth	11,52,117	2.23%	4,57,386	2.44%	42,415	2.49%
25.91	FS	MAN	Mangaung	Bloemfontein	7,47,429	1.44%	2,92,971	1.56%	30,394	1.78%
Total					1,96,16,721	37.89%	91,42,005	48.69%	9,47,094	55.59%
19.26	EC	BUF	Buffalo City	East London	7,55,202	1.46%	2,85,225	1.52%	28,005	1.64%
18.97	KN	KZN225	The Msunduzi	Pietermaritzburg	6,18,537	1.19%	2,29,674	1.22%	23,152	1.36%
16.65	GT	GT481	Mogale City	Krugersdorp	3,62,421	0.70%	1,78,479	0.95%	16,342	0.96%
12.21	MP	MP322	Mbombela	Nelspruit	5,88,792	1.14%	2,28,237	1.22%	17,226	1.01%
11.82	LIM	LIM354	Polokwane	Polokwane	6,28,998	1.21%	2,30,475	1.23%	17,177	1.01%
11.23	WC	WC044	George	George	1,93,671	0.37%	79,545	0.42%	5,866	0.34%
9.12	NC	NC091	Sol Plaatjie	Kimberley	2,48,040	0.48%	92,562	0.49%	8,834	0.52%
9.02	NW	NW403	City of Matlosana	Klerksdorp	3,98,676	0.77%	1,58,895	0.85%	11,799	0.69%
8.32	NW	NW373	Rustenburg	Rustenburg	5,49,576	1.06%	2,66,472	1.42%	26,313	1.54%
8.24	WC	WC024	Stellenbosch	Stellenbosch	1,55,733	0.30%	67,134	0.36%	9,501	0.56%
7.83	GT	GT421	Emfuleni	Vereeniging/ Vanderbijlpark	7,21,665	1.39%	3,10,095	1.65%	21,797	1.28%
7.43	FS	FS184	Matjhabeng	Welkom	4,06,461	0.79%	1,58,175	0.84%	13,027	0.76%
7.15	WC	WC023	Drakenstein	Drakenstein	2,51,262	0.49%	1,06,029	0.56%	8,959	0.53%
6.8	MP	MP312	Emalahleni	Witbank	3,95,463	0.76%	1,90,662	1.02%	21,456	1.26%
5.88	KN	KZN282	uMhlathuze	Richardsbay	3,34,458	0.65%	1,24,410	0.66%	13,865	0.81%
5.55	WC	WC043	Mossel Bay	Mossel Bay	89,427	0.17%	34,899	0.19%	5,069	0.30%
5.39	NW	NW402	Tlokwe City Council	Potchefstroom	1,62,759	0.31%	65,913	0.35%	6,161	0.36%
5.14	MP	MP313	Steve Tshwete	Middelburg	2,29,833	0.44%	1,07,067	0.57%	9,490	0.56%
5.05	WC	WC048	Knysna	Knysna	68,658	0.13%	29,187	0.16%	2,355	0.14%
Total					71,59,632	13.83%	29,43,135	15.68%	2,66,394	15.64%
4.97	KN	KZN252	Newcastle	Newcastle	3,63,237	0.70%	1,00,653	0.54%	7,430	0.44%
4.92	KN	KZN283	Ntambanana	Empangeni	74,337	0.14%	13,074	0.07%	1,027	0.06%
4.6	NW	NW372	Madibeng	Brits-Hartbeespoort	4,77,378	0.92%	2,15,214	1.15%	14,302	0.84%
4.45	LIM	LIM333	Greater Tzaneen	Tzaneen	3,90,093	0.75%	1,16,019	0.62%	5,683	0.33%
4.12	WC	WC025	Breede Valley	Worcester	1,66,824	0.32%	68,607	0.37%	4,305	0.25%
3.94	FS	FS201	Moqhaka	Kroonstad	1,60,536	0.31%	55,593	0.30%	5,529	0.32%
3.92	FS	FS192	Dihlabeng	Bethlehem	1,28,703	0.25%	47,496	0.25%	3,288	0.19%
3.74	EC	EC157	King Sabata Dalindyebo	Mthatha	4,51,713	0.87%	95,577	0.51%	7,997	0.47%
3.74	KN	KZN232	Emnambithi/ Ladysmith	Ladysmith	2,37,435	0.46%	72,252	0.38%	5,677	0.33%
3.74	WC	WC032	Overstrand	Hermanus	80,433	0.16%	35,553	0.19%	2,578	0.15%
3.69	WC	WC045	Oudtshoorn	Oudtshoorn	95,934	0.19%	31,167	0.17%	2,212	0.13%
3.68	NC	NC083	//Khara Hais	Upington	93,495	0.18%	32,232	0.17%	3,040	0.18%
3.68	NW	NW383	Mafikeng	Mafikeng	2,91,528	0.56%	92,895	0.49%	8,619	0.51%

Table 1 continued

UFI	Municipality				Population		Economic active		GVA	
3.56	WC	WC047	Bitou	Plettenberg Bay	49,161	0.09%	23,598	0.13%	1,524	0.09%
3.46	GT	GT422	Midvaal	Meyerton	95,301	0.18%	45,954	0.24%	4,275	0.25%
3.16	MP	MP307	Govan Mbeki	Secunda	2,94,537	0.57%	1,34,385	0.72%	16,166	0.95%
3.08	KN	KZN292	KwaDukuza	Stanger	2,31,189	0.45%	91,176	0.49%	5,159	0.30%
3.04	KN	KZN212	Umdoni	Scottburgh-Umkomaas	78,876	0.15%	25,035	0.13%	2,215	0.13%
3.03	FS	FS204	Metsimaholo	Sasolburg	1,49,109	0.29%	65,205	0.35%	6,171	0.36%
2.89	LIM	LIM344	Makhado	Makhado	5,16,030	1.00%	1,24,473	0.66%	8,165	0.48%
2.79	EC	EC134	Lukanji	Queenstown	1,90,725	0.37%	53,262	0.28%	3,948	0.23%
2.77	WC	WC014	Saldanha Bay	Saldanha Bay	99,192	0.19%	44,829	0.24%	3,406	0.20%
2.74	GT	GT484	Merafong	Carletonville	1,97,520	0.38%	91,524	0.49%	6,586	0.39%
2.63	MP	MP302	Msukaligwa	Ermelo	1,49,376	0.29%	56,964	0.30%	3,913	0.23%
2.6	KN	KZN263	Abaqulusi	Vryheid	2,11,062	0.41%	42,699	0.23%	4,253	0.25%
2.59	LIM	LIM367	Mogalakwena	Mokopane	3,07,683	0.59%	78,645	0.42%	6,531	0.38%
2.32	EC	EC104	Makana	Grahamstown	80,391	0.16%	28,491	0.15%	2,143	0.13%
2.1	FS	FS194	Maluti a Phofung	Harrismith	3,35,784	0.65%	90,870	0.48%	6,891	0.40%
2.03	FS	FS203	Ngwathe	Parys	1,20,519	0.23%	39,555	0.21%	2,240	0.13%
2.02	NC	NC062	Nama Khoi	Springbok	47,040	0.09%	16,014	0.09%	2,507	0.15%
2.02	NW	NW384	Ditsobotla	Mmabatho	1,68,900	0.33%	52,434	0.28%	4,397	0.26%
Total					63,34,041	12.23%	20,81,445	11.09%	1,62,177	9.52%
Total					33,110,314	63.96%	1,41,66,585	75.46%	13,75,665	80.74%

Total population count: 51,770,654; Total economically active population: 18,774,132; and Total GVA: 1,703,801 billion. Note: (1) Total population count is defined as all usual residents, generally referred to as the *de jure* population, and the total of all persons present, referred to as the de facto population; (2) Economically active population is defined as the fraction of a population that is either employed, or actively seeking employment; (3) Gross value added (GVA) at basic prices is defined as output valued at basic prices less intermediate consumption valued at purchaser's prices. Therefore, the GVA is known by the price at which the output is valued. GVA is a useful way of comparing regions of different sizes of economies

functional networks of cities. The purpose is to quantify the relationships and flows between different settlements within a network, and to distinguish between nodes within the daily and weekly commuting areas of core cities.

With the assumption that a travel distance at a speed of 80 km an hour is considered a fair commuting distance (Hall and Hay 1980; Newman 2004), converts a 1 and 2-h commuting time into an 80 and 160-km distance, respectively, whereby the synergy created by the daily and weekly urban systems are established. For the purpose of the model, an 80-km buffer representing a direct relationship is placed around each larger urban centre, as illustrated in Fig. 8, whereby all settlements, including primary towns, intermediate towns and towns, are collapsed into broader economic regional nodes, as illustrated in Table 2 and Fig. 9. This allows for the creation of a more refined classification of functional networks of economic regions.

Refining the functional network of cities into a broader network of regional nodes not only provides a more practical approach to analysing the dominant distribution of economic activities within the country, but also creates the opportunity to establish the degree of economic attraction or economic output levels exerted (step three) by each regional node relative to one another.

Establishing the degree of economic attraction or economic output levels exerted by each regional node is based on the economic weight, which is referred to as Economic Impact Factors (EIFs). According to Brand et al. (2015), the economic output exerted refers to the total population, in relation to economically active populations, as well as the value of all goods and services produced in an economy based on Gross

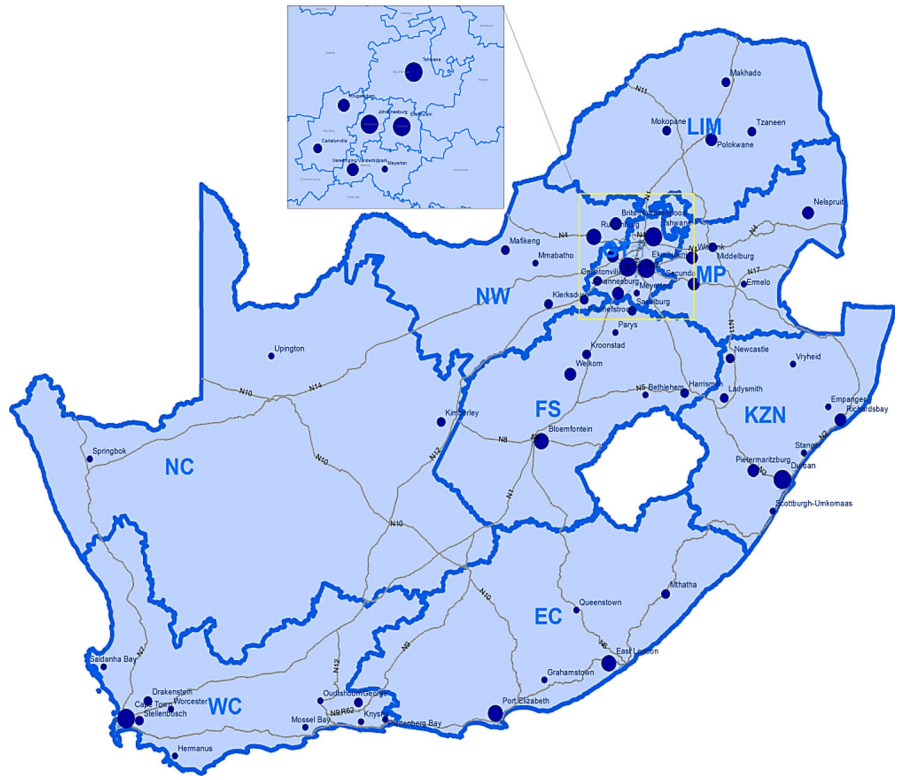

Fig. 7 General functional networks of cities. *Source*: Brand (2017)

Value Added (GVA), and is primarily used to compare the relative economic output that exists between cities and regions i.e. quantifies the level of interaction that exists between each regional node.

Furthermore, strong emphasis is also placed on a well-developed, multimodal transportation network system (connectivity) as an essential ingredient in contributing towards the nature and extent of economic development. The World Bank (2012) augmented sea and air transportation as the primary key gateways when unlocking a country's economic development opportunities. The main reason is based on the fact that the advancement in sea and air transportation resulted in lowering trade barriers, allowing for deeper integration of market access across the globe. Mitchell (2014) noted that a multimodal transport system was capable of joining together various networks that used different protocols. He also postulated that these different protocols had different impacts and played different roles in economic development. However, for the purpose of the model, only sea and airports are considered. The reasons are that, except for the fact that sea and airports lower trade barriers globally, sea and airports also represent a nodal locality which is an important consideration in the ranking of urban and regional centres (Geyer 1988). In this regard, a Multimodal Impact Factor (MmIF) is considered with the focus on the principal sea and airports. The MmIF refers to the total value of volume and movement of goods and people passing through sea and airports, and is primarily used to compare the relative output levels that exist between the various ports. For the purpose of the model, both the MmIFs of each sea and airport are calculated as a mean. The reason is based on the fact that the mean is the most popular and well-known measure of central tendency, and can be used with both discrete and continuous data. The MmIFs of each sea and airport are calculated as z-values, which indicate the comparative output weight according to which the spatial dominance of each sea and airport is determined. The Multimodal Port Impact Factor (MmPIF) as well as the Multimodal Air Impact Factor (MmAIF), is calculated using the following algorithms:

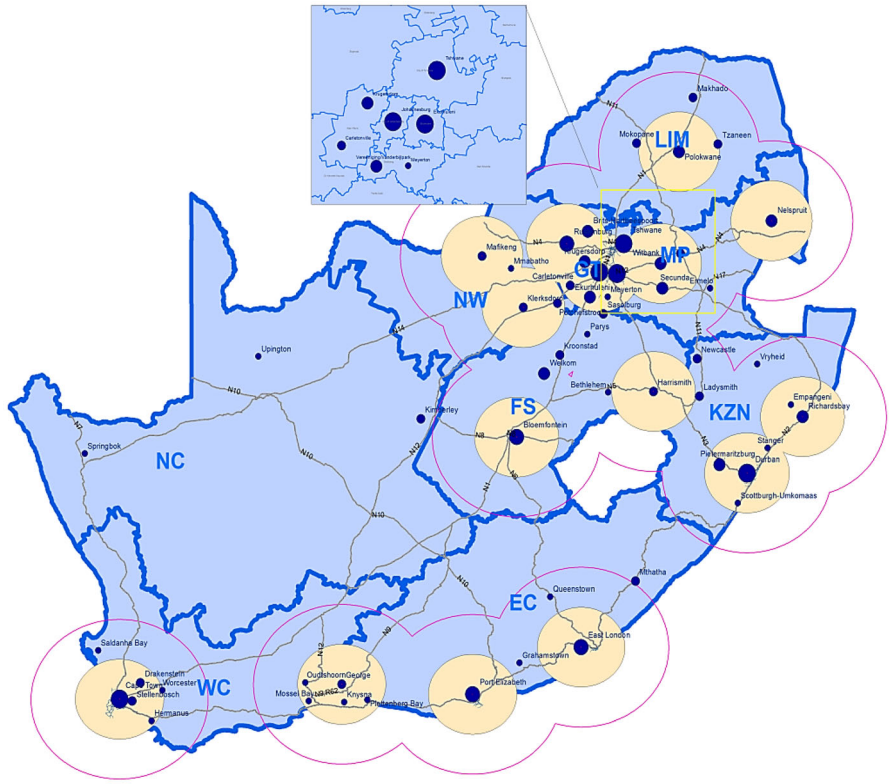

Fig. 8 Daily and weekly urban systems. *Source*: Brand (2017)

$$MmPIFi = \left(\frac{\sum_{n}^{Ci}}{\sum CTi\ldots n}\right) + \left(\frac{\sum_{n}^{COi}}{\sum COTi\ldots n}\right) + \left(\frac{\sum_{n}^{Vi}}{\sum VTi\ldots n}\right)$$

where *MmPIF* is the MmPIF for city i (i = 1…n); $\sum_{n}^{Ci}$ is the mean average for cargo in metric tonnes for city i; $\sum CTi\ldots n$ is the sum of the total cargo in metric tonnes for all the cities; $\sum_{n}^{COi}$ is the mean average for container volume for city i; $\sum COTi\ldots n$ is the sum of the total container volume for all the cities; $\sum_{n}^{Vi}$ is the mean average for vessel movement for city i; and $\sum VTi\ldots n$ is the sum of the total vessel movement for all the cities.

$$MmAIFi = \left(\frac{\sum_{n}^{Pi}}{\sum PTi\ldots n}\right) + \left(\frac{\sum_{n}^{Ai}}{\sum ATi\ldots n}\right) + \left(\frac{\sum_{n}^{Ci}}{\sum CTi\ldots n}\right)$$

where *MmAIFi* is the MmAIFi for city i (i = 1…n); $\sum_{n}^{Pi}$ is the mean average for passenger movement for city i; $\sum_{PTi\ldots n}$ is the sum of the total passenger movement for all the cities; $\sum_{n}^{Ai}$ is the mean average for aircraft movement for city i; $\sum ATi\ldots n$ is the sum of the total aircraft movement for all the cities; $\sum_{n}^{Ci}$ is the mean average for cargo in metric tonnes for city i; and $\sum_{CTi\ldots n}$ is the sum of the total cargo in metric tonnes for all the cities.

Having established the dominance of the principal sea and airports relative to one another, the following step is to determine the EIFs for each regional node, which establishes the economic weight of each economic region relative to one another. Table 3 illustrate the EIFs for each regional node and are calculated using the following algorithm:

$$EIFi = \left(\left(\frac{PEi}{PTi}\right) / \left(\frac{\sum PEi\ldots n}{\sum PTi\ldots n}\right)\right) + (MmPIFi + MmAIFi)x\left(\frac{GVAi}{\sum GVAi\ldots n}\right)$$

where *EIFi* is the EIF for city i (i = 1…n); *PEi* is the economically active population of city i; *PTi* is the total population of city i; $\sum PEi\ldots n$ is the sum of the economically active population of all the cities;

Table 2 General functional networks of economic regions. *Source*: Brand (2017)

Regional nodes	Municipality				UFI	Population		Economic active		GVA	
1	EC	NMA	Nelson Mandela Bay	Port Elizabeth	34.93	11,52,117	2.23%	4,57,386	2.44%	42,415	2.49%
2	EC	BUF	Buffalo City	East London	19.26	7,55,202	1.46%	2,85,225	1.52%	28,005	1.64%
3	EC	EC157	King Sabata Dalindyebo	Mthatha	3.74	4,51,713	0.87%	95,577	0.51%	7,997	0.47%
4	EC	EC134	Lukanji	Queenstown	2.79	1,90,725	0.37%	53,262	0.28%	3,948	0.23%
5	EC	EC104	Makana	Grahamstown	2.32	80,391	0.16%	28,491	0.15%	2,143	0.13%
6	FS	MAN	Mangaung	Bloemfontein	25.91	7,47,429	1.44%	2,92,971	1.56%	30,394	1.78%
7	FS	FS184	Matjhabeng	Welkom	7.43	4,06,461	0.79%	1,58,175	0.84%	13,027	0.76%
8	FS	FS201	Moqhaka	Kroonstad	3.94	1,60,536	0.31%	55,593	0.30%	5,529	0.32%
9	FS	FS192	Dihlabeng	Bethlehem	3.92	1,28,703	0.25%	47,496	0.25%	3,288	0.19%
10	FS	FS194	Maluti a Phofung	Harrismith	2.10	3,35,784	0.65%	90,870	0.48%	6,891	0.40%
11	FS	FS203	Ngwathe	Parys	2.03	1,20,519	0.23%	39,555	0.21%	2,240	0.13%
12	GT	JHB	Johannesburg	Johannesburg	94.51	1,25,38,182	24.22%	61,75,011	32.89%	6,09,004	35.74%
	GT	TSH	City of Tshwane	Tshwane	51.70						
	NW	NW372	Madibeng	Brits-Hartbeespoort	4.60						
	GT	EKU	Ekurhuleni	Ekurhuleni	38.49						
	GT	GT481	Mogale City	Krugersdorp	16.65						
	GT	GT421	Emfuleni	Vereeniging/Vanderbijlpark	7.83						
	FS	FS204	Metsimaholo	Sasolburg	3.03						
	GT	GT422	Midvaal	Meyerton	3.46						
	GT	GT484	Merafong	Carletonville	2.74						
13	KN	ETH	eThekwini	Durban	76.05	43,70,964	8.44%	17,68,764	9.42%	1,79,081	10.51%
	KN	KZN212	Umdoni	Scottburgh-Umkomaas	3.04						
	KN	KZN292	KwaDukuza	Stanger	3.08						
	KN	KZN225	The Msunduzi	Pietermaritzburg	18.97						
14	KN	KZN282	uMhlathuze	Richardsbay	5.88	4,08,795	0.79%	1,37,484	0.73%	14,892	0.87%
	KN	KZN283	Ntambanana	Empangeni	4.92						
15	KN	KZN252	Newcastle	Newcastle	4.97	3,63,237	0.70%	1,00,653	0.54%	7,430	0.44%
16	KN	KZN232	Emnambithi/Ladysmith	Ladysmith	3.74	2,37,435	0.46%	72,252	0.38%	5,677	0.33%
17	KN	KZN263	Abaqulusi	Vryheid	2.60	2,11,062	0.41%	42,699	0.23%	4,253	0.25%
18	LIM	LIM354	Polokwane	Polokwane	11.82	6,28,998	1.21%	2,30,475	1.23%	17,177	1.01%
19	LIM	LIM333	Greater Tzaneen	Tzaneen	4.45	3,90,093	0.75%	1,16,019	0.62%	5,683	0.33%
20	LIM	LIM344	Makhado	Makhado	2.89	5,16,030	1.00%	1,24,473	0.66%	8,165	0.48%

Table 2 continued

Regional nodes	Municipality				UFI	Population		Economic active		GVA	
21	LIM	LIM367	Mogalakwena	Mokopane	2.59	3,07,683	0.59%	78,645	0.42%	6,531	0.38%
22	MP	MP322	Mbombela	Nelspruit	12.21	5,88,792	1.14%	2,28,237	1.22%	17,226	1.01%
23	MP	MP312	Emalahleni	Witbank	6.80	9,19,833	1.78%	4,32,114	2.30%	47,112	2.77%
	MP	MP313	Steve Tshwete	Middelburg	5.14						
	MP	MP307	Govan Mbeki	Secunda	3.16						
24	MP	MP302	Msukaligwa	Ermelo	2.63	1,49,376	0.29%	56,964	0.30%	3,913	0.23%
25	NC	NC091	Sol Plaatjie	Kimberley	9.12	2,48,040	0.48%	92,562	0.49%	8,834	0.52%
26	NC	NC083	//Khara Hais	Upington	3.68	93,495	0.18%	32,232	0.17%	3,040	0.18%
27	NC	NC062	Nama Khoi	Springbok	2.02	47,040	0.09%	16,014	0.09%	2,507	0.15%
28	NW	NW403	City of Matlosana	Klerksdorp	9.02	5,61,435	1.08%	2,24,808	1.20%	17,960	1.05%
	NW	NW402	Tlokwe City Council	Potchefstroom	5.39						
29	NW	NW373	Rustenburg	Rustenburg	8.32	5,49,576	1.06%	2,66,472	1.42%	26,313	1.54%
30	NW	NW383	Mafikeng	Mafikeng	3.68	4,60,428	0.89%	1,45,329	0.77%	13,016	0.76%
	NW	NW384	Ditsobotla	Mmabatho	2.02						
31	WC	CPT	City of Cape Town	Cape Town	100.00	43,94,277	8.49%	19,77,552	10.53%	2,11,542	12.42%
	WC	WC023	Drakenstein	Drakenstein	7.15						
	WC	WC024	Stellenbosch	Stellenbosch	8.24						
	WC	WC025	Breede Valley	Worcester	4.12						
	WC	WC032	Overstrand	Hermanus	3.74						
32	WC	WC044	George	George	11.23	4,96,851	0.96%	1,98,396	1.06%	17,026	1.00%
	WC	WC043	Mossel Bay	Mossel Bay	5.55						
	WC	WC048	Knysna	Knysna	5.05						
	WC	WC045	Oudtshoorn	Oudtshoorn	3.69						
	WC	WC047	Bitou	Plettenberg Bay	3.56						
33	WC	WC014	Saldanha Bay	Saldanha Bay	2.77	99,192	0.19%	44,829	0.24%	3,406	0.20%
Total						33,110,314	63.96%	1,41,66,585	75.46%	13,75,665	80.74%

Table 3 Primary functional networks of economic regions. *Source:* Brand (2017)

Regional nodes	Municipality				UFI	Population		Economic active		Seaport	Airport	MmIF	GVA		EIF
Mega nodes															
12	GT	JHB	Johannesburg	Johannesburg	94.51	1,25,38,182	24.22%	61,75,011	32.89%	0.000	1.838	1.838	6,09,004	35.74%	1.3233
	GT	TSH	City of Tshwane	Tshwane	51.70										
	NW	NW372	Madibeng	Brits-Hartbeespoort	4.60										
	GT	EKU	Ekurhuleni	Ekurhuleni	38.49										
	GT	GT481	Mogale City	Krugersdorp	16.65										
	GT	GT421	Emfuleni	Vereeniging/ Vanderbijlpark	7.83										
	FS	FS204	Metsimaholo	Sasolburg	3.03										
	GT	GT422	Midvaal	Meyerton	3.46										
	GT	GT484	Merafong	Carletonville	2.74										
Total						1,25,38,182	24.22%	61,75,011	32.89%	0.000	1.838		6,09,004	35.74%	
Primary nodes															
13	KN	ETH	eThekwini	Durban	76.05	43,70,964	8.44%	17,68,764	9.42%	1.179	0.244	1.423	1,79,081	10.51%	0.3084
	KN	KZN212	Umdoni	Scottburgh-Umkomaas	3.04										
	KN	KZN292	KwaDukuza	Stanger	3.08										
	KN	KZN225	The Msunduzi	Pietermaritzburg	18.97										
31	WC	CPT	City of Cape Town	Cape Town	100.00	43,94,277	8.49%	19,77,552	10.53%	0.459	0.515	0.974	2,11,542	12.42%	0.3115
	WC	WC023	Drakenstein	Drakenstein	7.15										
	WC	WC024	Stellenbosch	Stellenbosch	8.24										
	WC	WC025	Breede Valley	Worcester	4.12										
	WC	WC032	Overstrand	Hermanus	3.74										
Total						87,65,241	16.93%	37,46,316	19.95%				3,90,623	22.93%	
Secondary nodes															
1	EC	NMA	Nelson Mandela Bay	Port Elizabeth	34.93	11,52,117	2.23%	4,57,386	2.44%	0.317	0.153	0.470	42,415	2.49%	0.0431
2	EC	BUF	Buffalo City	East London	19.26	7,55,202	1.46%	2,85,225	1.52%	0.043	0.077	0.120	28,005	1.64%	0.0204
6	FS	MAN	Mangaung	Bloemfontein	25.91	7,47,429	1.44%	2,92,971	1.56%	0.000	0.049	0.049	30,394	1.78%	0.0213
14	KN	KZN282	uMhlathuze	Richardsbay	5.88	4,08,795	0.79%	1,37,484	0.73%	0.616	0.000	0.616	14,892	0.87%	0.0152
	KN	KZN283	Ntambanana	Empangeni	4.92										
18	LIM	LIM354	Polokwane	Polokwane	11.82	6,28,998	1.21%	2,30,475	1.23%	0.000	0.000	0.000	17,177	1.01%	0.0107

Table 3 continued

Regional nodes	Municipality				UFI	Population		Economic active		Seaport	Airport	MmIF	GVA		EIF
22	MP	MP322	Mbombela	Nelspruit	12.21	5,88,792	1.14%	2,28,237	1.22%	0.000	0.000	0.000	17,226	1.01%	0.0113
23	MP	MP312	Emalahleni	Witbank	6.80	9,19,833	1.78%	4,32,114	2.30%	0.000	0.000	0.000	47,112	2.77%	0.0376
	MP	MP313	Steve Tshwete	Middelburg	5.14										
	MP	MP307	Govan Mbeki	Secunda	3.16										
28	NW	NW403	City of Matlosana	Klerksdorp	9.02	5,61,435	1.08%	2,24,808	1.20%	0.000	0.000	0.000	17,960	1.05%	0.0122
	NW	NW402	Tlokwe City Council	Potchefstroom	5.39										
29	NW	NW373	Rustenburg	Rustenburg	8.32	5,49,576	1.06%	2,66,472	1.42%	0.000	0.000	0.000	26,313	1.54%	0.0217
32	WC	WC044	George	George	11.23	4,96,851	0.96%	1,98,396	1.06%	0.084	0.083	0.167	17,026	1.00%	0.0136
	WC	WC043	Mossel Bay	Mossel Bay	5.55										
	WC	WC048	Knysna	Knysna	5.05										
	WC	WC045	Oudtshoorn	Oudtshoorn	3.69										
	WC	WC047	Bitou	Plettenberg Bay	3.56										
Total						68,09,028	13.15%	27,53,568	14.67%				2,58,520	15.17%	
Intermediate nodes															
7	FS	FS184	Matjhabeng	Welkom	7.43	4,06,461	0.79%	1,58,175	0.84%	0.000	0.000	0.000	13,027	0.76%	0.0086
8	FS	FS201	Moqhaka	Kroonstad	3.94	1,60,536	0.31%	55,593	0.30%	0.000	0.000	0.000	5,529	0.32%	0.0033
10	FS	FS194	Maluti a Phofung	Harrismith	2.10	3,35,784	0.65%	90,870	0.48%	0.000	0.000	0.000	6,891	0.40%	0.0032
15	KN	KZN252	Newcastle	Newcastle	4.97	3,63,237	0.70%	1,00,653	0.54%	0.000	0.000	0.000	7,430	0.44%	0.0035
20	LIM	LIM344	Makhado	Makhado	2.89	5,16,030	1.00%	1,24,473	0.66%	0.000	0.000	0.000	8,165	0.48%	0.0033
25	NC	NC091	Sol Plaatjie	Kimberley	9.12	2,48,040	0.48%	92,562	0.49%	0.000	0.026	0.026	8,834	0.52%	0.0058
30	NW	NW383	Mafikeng	Mafikeng	3.68	4,60,428	0.89%	1,45,329	0.77%	0.000	0.000	0.000	13,016	0.76%	0.0070
	NW	NW384	Ditsobotla	Mmabatho	2.02										
33	WC	WC014	Saldanha Bay	Saldanha Bay	2.77	99,192	0.19%	44,829	0.24%	0.301	0.000	0.301	3,406	0.20%	0.0034
Total						25,89,708	5.00%	8,12,484	4.33%				66,298	3.89%	
Total						3,07,02,159	59.31%	1,34,87,379	71.84%				13,24,445	77.73%	

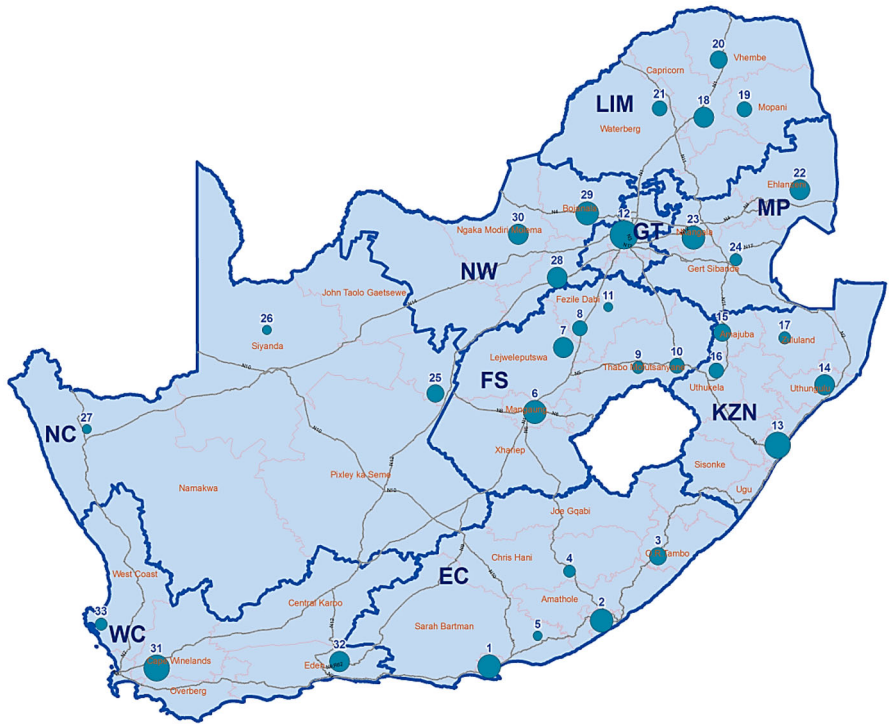

Fig. 9 General functional networks of economic regions. *Source*: Brand (2017)

$\sum_{PTi\ldots n}$ is the sum of the total population of all the cities; *MmPIFi* is the MmPIF of city i; *MmAIFi* is the MmAIF of city i; *GVAi* is the GVA of city i; and $\sum_{GVAi\ldots n}$ is the sum of the GVA of all the cities.

Establishing the degree of economic attraction exerted by each regional node, relative to one another, creates the opportunity to establish the primary networks of functional urban and regional centres (step four), which ultimately controls the most dominant agglomeration of economic activities distributed across the South African landscape.

Having established the output levels from the EIFs, each regional node is classified into four main categories: (1) mega node, if it has an EIF value of 1 and above, (2) primary node, if it has an EIF value between 1 and of 0,1; (3) secondary node, if it has an EIF value between 0,1 and 0,01; and (4) intermediate node, if it has an EIF value between 0,01 and 0,003. The reason for selecting the above four categories is based on the fact that the output levels from the EIFs provide for a natural break as illustrated in Fig. 10. Considering the EIF values, this classification provides the most relative economic dominance that exists between the networks of larger urban and regional centres, which establishes the economic output levels of each regional node, relative to one another. However, it is also clear that regional nodes with an EIF value below a certain value will provide no significant contribution towards the establishment of a primary network of urban and regional centres. In this regard, a per centile rank inclusive score (0 and 100 are included as values) was used. The per centile rank of a score is the per centage of scores in its frequency distribution that is equal to or lower than it, and this ranking is commonly used to clarify the interpretation of scores, as in this regard to establish which regional nodes will provide no significant contribution. Only the regional nodes with an EIF value of 0,003 and above are considered significant in the establishment of a primary network of economic regions for South Africa. Furthermore, applying an EIF value of 0,003 and above constitutes an economic contribution of more than 75% towards the national economy, close to 60% of the total population count and more than 70% of the total economically active population. Table 3 and Fig. 11 illustrate the primary network of economic regional nodes distributed across the South African landscape.

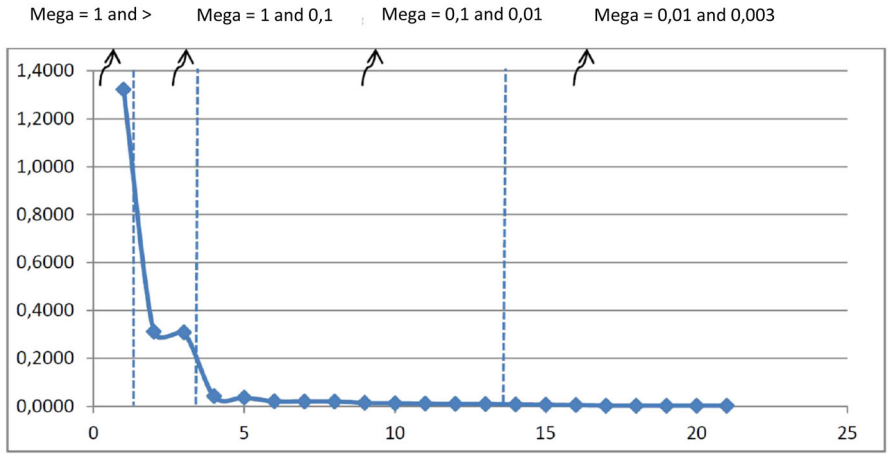

Fig. 10 Mega, primary, secondary and intermediate functional networks. *Source*: Brand (2017)

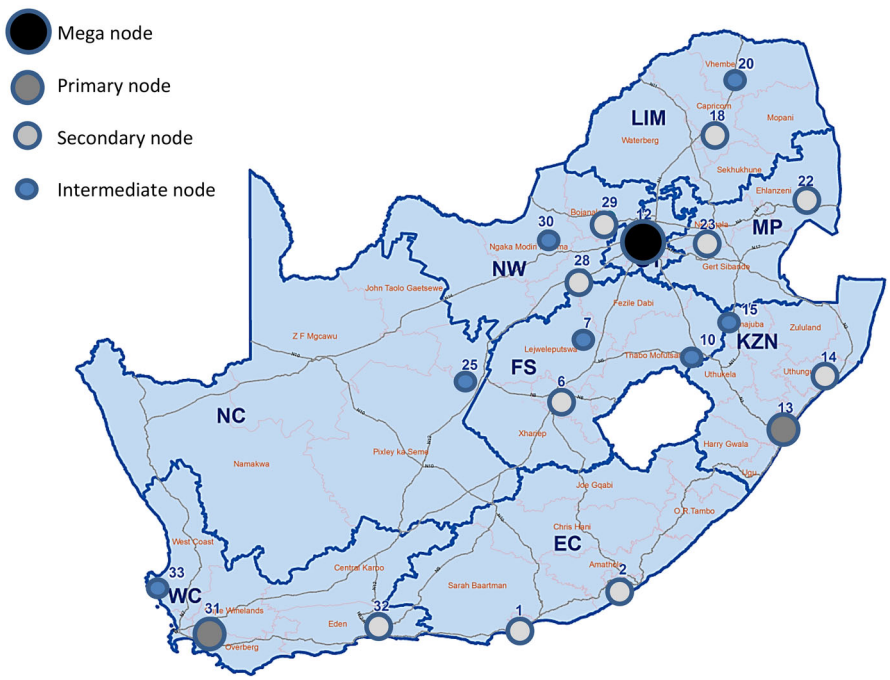

Fig. 11 Primary functional networks of economic regions. *Source*: Brand (2017)

Conclusion

Daniels (1994) made the observation that the primary role of local authorities was one of control and regulations, and was not considered appropriate agencies to effectively build economic spaces. The traditional role of local authorities was to administer and deliver services within a context of gradual change. However, cities and regions are increasingly being acknowledged as the appropriate level for more effective and efficient interventions to transform spatial legacies, and influence economic space development. This is based on the notion that cities and regions are identified as preferred locations to promote economic development i.e. preferred locations appeal as destinations for investment. These 'preferred regions' are linked to the concept of functional regions, i.e. cities and towns that demonstrate more interaction with one another than with outside areas (Hoover and Giarratani 1985). This places substantial responsibility on the local and regional authorities of the functional region to effectively plan, manage and

implement strategies and programmes to promote inclusive growth.

What makes the concept of functional networks, especially in relation to economic development, so important? Many scholars have argued that a city or region can only be understood if the context of its connections is understood. These connections revolve around the interactions between dominant urban or regional centres which establish a city's 'place' of functionality (performance) within a network. A network as mentioned before, provide for a sophisticated polycentric structure that supports a diversified economic environment. If a city or region understands its 'place' within a network can create opportunities in alignment with their circumstances, i.e. cities or regions realises their economic potential as a consumer, producer, landowner and investor which allows them to respond pro-actively and innovatively to develop and promote economy development.

The obvious key question is what opportunities or solutions can the regional network model towards economic transformation provides? Economic transformation is a complex process that requires well-timed policy interventions. The SA-TIED made reference to limited regional integration. To overcome the limitation, the SA-TIED came up with six thematic work streams of which the regional network model can offer a solution to two of the work streams, namely (1) macroeconomic modelling supporting policy formulation and (2) regional growth supporting investment potential. Furthermore, the IUDF and the SDFs advocates various themes to promote inclusive economic development as the backbone of national economic policy, emphasising the potential of new economies through innovation, investments and spatial development. The *National Spatial Development Framework (NSDF),* the first of its kind, spearheaded by National Government, is divided into four subframes of which the first a *National Urban Network* can directly be linked to the regional network model. The IUDF on the other hand promotes nine policy levers of which the regional network model can offer a solution to three, namely (1) to create cities that are well planned; (2) to create cities that grow through investments; and (3) to create cities that are dynamic, fostering entrepreneurialism and innovation. It is clear that the model potentially supports the notion of what is considered *'good spatial and settlement planning'* in local as well as international planning policy frameworks. It also supports the theoretical domains of spatial development planning, urban design, regional and rural development planning, and agglomeration economics that seeks to make a decisive contribution to bringing about a more prosperous and spatially transformed South Africa.

Compliance with ethical standards

Conflict of interest Not applicable.

Research involving human participants and/or animals Not applicable.

Informed consent Not applicable.

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