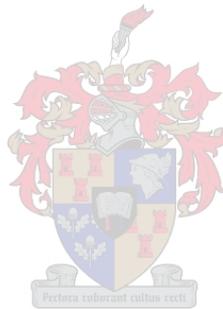


**THE IMPACT OF SPATIAL PLANNING ON THE STRUCTURE OF SOUTH
AFRICAN CITIES SINCE 1994**

By

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SUMMARY

South African cities have been shaped by colonial and post-1948 apartheid city policies resulting in what is commonly referred to as ‘apartheid cities’. The vision of urban spatial transformation supported by goals such as compact urban form, increased population densities, and a greater mix of land uses hence emerged as key elements of the spatial planning doctrine after the transition into democracy in 1994. The aim of this research is to establish the influence of spatial planning and spatial plans on urban structure in South Africa since 1994 through empirical analysis across a range of metropolitan and intermediate sized cities. A comprehensive methodology for evaluating the influence of spatial planning processes and spatial plans is developed based on an analysis of alternative paradigms of procedural planning theory. A framework to incorporate the spatial planning evaluation methodology into the existing prescribed SDF preparation process is provided. Elements of this methodology are applied to evaluate the evolving spatial structure of eight South African cities since 1994. The results established modest increases in net population densities since 1994, and only marginal changes in the overall levels of land-use mix. The density increases occurred mostly at decentralised suburban locations but, in the case of the four largest metropolitan cities analysed, also in and around the traditional CBD areas. The results also led to the identification of five different variants of the double-linear density model to describe urban built-up space of cities. The influence of spatial plans on population density and land use mix was found to be limited, but the influence on the location of new economic activities over the study period was significant. The results of the plan quality assessment indicated that spatial plans require substantial improvement in the areas of spatial analysis of the urban economic space, quantifying infrastructure and capital investment, translating broad sustainability principles into quantifiable sustainability indicators and targets, focusing more specific attention on the informal sector, and applying innovative spatial statistical analysis techniques in the preparation and evaluation of spatial plans. Spatial plans to drive ‘reconfiguration’ will require consistent intervention at various scales and across different timeframes. Spatial plans and policies based on a limited number of principles, rather than complicated ‘integrated’ plans, are most likely to produce persistent and systematic outcomes aligned with the spatial planning vision. The precondition for such a planning approach is a rigorous process of ongoing evaluation and feedback to assess the effect of the established planning principles. Improving the influence of urban spatial planning will require a shift in focus from planning activities primarily aimed at the plan preparation phase to spatial plan evaluation during the implementation phase.

KEY WORDS

Spatial Development Frameworks, urban spatial planning, plan evaluation, densification, spatial restructuring, South African cities.

OPSOMMING

Die struktuur van Suid-Afrikaanse stede is deur beide koloniale en apartheidsbeleid in die periode na 1948 beïnvloed en word dikwels beskryf as ‘apartheidstede’. Kompakte stedelike vorm, verhoogde bevolkingsdigtheid, en ‘n groter vermenging van grondgebruike het na 1994 ontwikkel as sleutel elemente van die Suid-Afrikaanse ruimtelike beplanningsraamwerk. Die doel van hierdie navorsing is om die invloed van ruimtelike beplanning op stedelike vorm in Suid-Afrika te bepaal deur middel van empiriese navorsing in ‘n aantal metropolitaanse en intermediëre stede. ‘n Omvattende metodologie, gebaseer op die ontleding van verskeie benaderings tot prosedurele beplanningsteorie, is ontwikkel om die invloed van ruimtelike beplanningsprosesse en planne te evalueer. ‘n Raamwerk word ook voorgestel vir die insluiting van hierdie metodologie binne die bestaande voorgeskrewe prosesse vir die voorbereiding van ruimtelike ontwikkelingsraamwerke. Elemente van hierdie metodologie word toegepas om die veranderinge in stedelike vorm in agt Suid-Afrikaanse stede sedert 1994 te bepaal. Die resultate toon matige toenames in bevolkingsdigtheid, maar slegs geringe veranderinge in die vlakke van vermenging van grondgebruike. Die toenames in bevolkingsdigtheid vind hoofsaaklik plaas in gedentraliseerde voorstedelike gebiede, en in die geval van die vier grootste metropolitaanse stede, ook op die randgebiede van die historiese stadskerne. Die resultate het vyf variante van die dubbele-liniëre digtheidsmodel om stedelike voetspore te beskryf geïdentifiseer. Die invloed van ruimtelike planne op toenames in bevolkingsdigtheid en vlakke van grondgebruiksvermenging sedert 1994 was beperk, maar dit het wel ‘n noemenswaardige invloed gehad op die ligging van nuwe ekonomiese aktiwiteite oor die tydspanne wat ontleed is. Die evaluering van ‘n aantal ruimtelike ontwikkelingsraamwerke het aangetoon dat die gehalte van sekere aspekte van hierdie planne verbeter moet word. Dit sluit in die ontleding van ruimtelike ekonomiese patrone, die bepaling van die infrastruktuur en finansiële implikasies van ruimtelike voorstelle, die identifisering van kwantifiseerbare teikens vir volhoubare ontwikkeling, verskerpte fokus op die ruimtelike aspekte van die informele sektor, en die toepassing van ruimtelike statistiese metodes in die evaluering van die uitkomst van ruimtelike beplanning. Om noemenswaardige veranderinge in stedelike ruimtelike patrone te weeg te bring sal die konsekwente toepassing van voorstelle op verskillende ruimtelike vlakke en oor verskeie tydspannes vereis. Ruimtelike planne wat gebaseer is op ‘n beperkte aantal beginsels wat konsekwent toegepas word het ‘n groter waarskynlikheid op sukses as ingewikkelde ‘geïntegreerde’ planne. ‘n Goed deurdagte proses vir die volgehoue evaluering van die vasgestelde ruimtelike beplanningsbeginsels is ‘n voorvereiste vir so ‘n beplanningsproses. ‘n Verskuiwing in die fokus van stedelike ruimtelike beplanning vanaf die voorbereiding van planne na die evaluering en monitering daarvan gedurende die implementeringsfase is nodig om die invloed van ruimtelike beplanning op stadstruktuur in Suid-Afrika te verhoog.

TREFWOORDE

Ruimtelike Ontwikkelingsraamwerke, stedelike ruimtelike beplanning, plan evaluering, stedelike verdigting, ruimtelike herstrukturering, Suid-Afrikaanse stede.

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Soli Deo Gloria

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ACRONYMS AND ABBREVIATIONS

ASGISA	Accelerated and Shared Growth Initiative for South Africa
CAS	Complex Adaptive Systems
CBD	Central Business District
CPT	Communicative Planning Theory
CSIR	Council for Scientific and Industrial Research
DCOGTA	Department of Cooperative Governance and Traditional Affairs
DFA	Development Facilitation Act
DPME	Department: Performance Monitoring and Evaluation
DRDLR	Department of Rural Development and Land Reform
EA	Enumerator Area
EMF	Environmental Management Framework
FAR	Floor Area Ratio
GEAR	Growth, Employment and Redistribution
GIS	Geographic Information Systems
HEM	Human Ecosystem Model
HHI	Herfindahl-Hirschman Index
ICT	Information and Communication Technology
IDP	Integrated Development Plan
ISO	International Organization for Standardization
IUDF	Integrated Urban Development Framework
LUMI	Land-use Mix Index
MSDF	Municipal Spatial Development Framework
NEG	New Economic Geography
NEPF	National Evaluation Policy Framework
NDP	National Development Plan
NPC	National Planning Commission
NSDP	National Spatial Development Perspective
NUDF	National Urban Development Framework
OECD	Organisation for Economic Co-operation and Development
RDP	Reconstruction and Development Programme
SACN	South African Cities Network
SAL	Small Area Layers
SCODA	State of Cities Open Data Almanac
SDF	Spatial Development Framework

SEA	Strategic Environmental Assessment
SMME	Small, Medium and Micro Enterprises
SPLUMA	Spatial Planning and Land Use Management Act
SPO	Spatial Planning Outcomes
TOD	Transit-oriented Development
URP	Urban Renewal Programme

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 CONTEXTUAL SETTING AND BACKGROUND

South Africa's urban areas are the drivers of economic and population growth and locations where many social, economic and ecological challenges are concentrated. United Nations estimates indicate that the proportion of the South African population living in urban areas will increase from 71% in 2030 to 80% in 2050 (DCOGTA 2016). The urban system is dominated by four city regions (Gauteng, Cape Town, eThekweni and Nelson Mandela Bay) and five secondary cities (Mangaung, Buffalo City, Pietermaritzburg, Mbombela and Polokwane) that together account for 65.3% of South Africa's formal national economic activity and 49.7% of the population. Other major and small towns jointly account for a further 28.1% of the national population and 21.2% of economic activity (Van Huysteen et al. 2015). Despite the importance of the country's urban areas, it is characterised by a number of spatial characteristics generally attributed to historically contingent factors. These characteristics include unequal access to economic and social opportunities, fragmented spatial form and high levels of separation between home and workplace, inefficient public transport systems, poorly located low income settlements at peripheral locations, and low density profiles compared with cities in other countries with similar incomes (Simon 1989; Drakakis-Smith 1992; Maylam 1995; Boraine et al. 2006; Donaldson 2006; Turok 2011; Bertaud & Malpezzi 2014; SACN, 2016). These characteristics are not very different from conditions experienced in many other cities of the Global South but in the South African context are mainly ascribed to colonial and apartheid urban policies. The notion of 'spatial transformation of cities' hence emerged as a key element of evolving spatial planning and policy in South Africa subsequent to 1994. After the transition into democracy in 1994, many of the then existing spatial planning approaches and tools were viewed as inappropriate and requiring a complete overhaul. The initial idealistic approach of 'Reconstruction and Development' originally enjoyed widespread support and the Development Facilitation Act of 1995 (South Africa 1995) represented the first tentative steps of instituting a new planning system. It introduced important principles for spatial planning such as discouraging urban sprawl, promoting densification and mixed-use development, and promoting the integration of residential and employment areas. After the disbanding of the RDP office in 1996 the focus shifted towards economic development as a prerequisite for redistribution but the spatial planning system remained largely intact with many of the pre-1994 planning procedures and legislation remaining on the statute books. It was only with the promulgation of the Municipal Planning and Performance Management Regulations (South Africa 2001) introducing the system of Integrated Development Planning (IDP) that an important era of so-called 'joined-up' governance was ushered in. The primary focus was to ensure focused delivery through the temporal and spatial coordination of development and investment initiatives of all three spheres of governance. This system also required the preparation of Spatial Development Frameworks (SDFs) as an instrument for giving spatial expression to the

developmental vision and priorities of municipalities as an integral part of the preparation and approval of IDPs. The SDF concept largely replaced the traditional guide plans and structure plans that for many decades formed the backbone of the forward planning process and functioned as the primary tool for guiding the spatial development patterns of South African cities and towns.

Although other related legal and policy reforms such as National Spatial Development Perspective (South Africa 2006a) and the first attempts at a National Urban Development Framework (South Africa 2009) were initiated after the introduction of IDPs in 2001, the most significant further development from a planning perspective has been the establishment of the National Planning Commission (NPC) in April 2010. This commission is an advisory body tasked with preparing recommendations to the cabinet on issues affecting South Africa's long-term development and one of its tasks was the preparation of a National Development Plan (NDP) for the country. The NDP was finalized and officially approved in 2012 and identified the transformation of human settlements as one of the key elements of the plan. The plan recognises that many of the elements of its spatial vision were known and accepted in 1994, but that the challenge has been "to translate the vision into implementation and meaningful spatial outcomes" (NPC 2012:286). The NDP offers a range of recommendations seen as appropriate measures to reconfigure towns and cities into more efficient and equitable urban forms. It includes aspects such as the need for explicit spatial restructuring strategies in each municipality, and the creation of a robust set of indicators as part of a spatial governance evaluation framework. The finalised Integrated Urban Development Framework (IUDF) further built on various chapters in the NDP and specifically extended Chapter 8 of the NDP dealing with the transformation of human settlements and the national space economy (DCOGTA 2016). The IUDF describes spatial transformation as changing existing city footprints to produce compact, coordinated and connected cities, using transit-oriented development (TOD) and other urban planning strategies (DCOGTA 2016). From an urban spatial planning perspective the most profound post-1994 policy development has been the promulgation of the Spatial Planning and Land Use Management Act (SPLUMA, Act 16 of 2013) in 2013. Of specific relevance to spatial planning are the provisions of the act that require the preparation of SDFs at various levels of spatial aggregation ranging from a national level, down to a municipal level, and precinct level within an individual municipality. Section 21 of this act requires the SDF to include an implementation plan containing the specification of implementation targets, including dates and monitoring indicators. Central to these policies is the concept of urban spatial transformation based on the principles of a compact city form and increased densities, the multifunctional use of space and facilities, and the integration of urban activities and land uses.¹ Despite the merit of these and other arguments in the NDP, IUDF and SPLUMA it implicitly assumes that cities and towns can be 'reconfigured' through a number of policies and interventions that can be controlled and implemented by a public sector institutional

¹ The goals and concepts of the South African urban spatial planning policy framework is analysed in detail in Chapter 3.

structure. It however fails to adequately recognise the complex system of interacting driving forces and diversity of role players determining urban form and structure.

1.2 CLARIFYING CONCEPTS AND DEFINITIONS

The primary object of this research is concerned with the activity and process of ‘spatial planning’ resulting in a product in the form of a ‘spatial plan’. As a point of departure it is thus imperative to clarify and define the terms ‘plan’ and ‘planning’ as understood and applied in the remainder of this document. One of the problematic concepts of mainstream planning theory is the wide and generic use of the concept ‘planning’ with some definitions giving planning an unlimited domain (Alexander 2015). The evolution of the term ‘urban planning’ is well encapsulated by Wildavsky’s (1973) understanding of the various dimensions of what could be understood as planning: (1) a rational and adaptive process, (2) aimed at achieving specified future objectives through a series of related actions, (3) resulting from the ability to influence people to act in accordance with these objectives, and (4) guiding decisions on the allocation of public sector resource over time. During the early stages of planning as a distinct profession it was primarily viewed as a process of rational choice and defined as “a process for determining appropriate future action through a sequence of choices” (Davidoff & Reiner 1962:103). All forms of ‘planning’ by the very nature of the activity also include an element of resource allocation (such as money, land, time, or physical resources). This important element of resource allocation is thus included in many definitions of planning such as that of Roberts (1974:4), defining it as “making choices among the options that appear open for the future and then securing the implementation which depends on the allocation of the necessary resources”.

The growing importance of the concepts of power and ideology in planning theory since the 1980s is also reflected in the definitions and understanding of the term planning originating from this era. Examples of definitions reflecting these concepts are those of Alexander (1981:137) defining planning as “the deliberate social or organisational activity of developing an optimal strategy of future action to achieve a desired set of goals, for solving novel problems in complex contexts, and attended by the power and intention to commit resources and to act as necessary to implement the chosen strategy”. Another example is the definition of Watson (2002a:28) describing planning as “those intentional public actions which impact on the built and natural environment, and which are frequently accompanied by political processes of some kind.” Another important view that emerged during the 1970s and 1980s is the communicative turn in planning and is aptly reflected in Friedmann’s definition of planning as “a negotiated process among affected parties who have different values, concerns and interests at stake” (Friedmann, 1989:129). This shift in focus to communicative planning was further accompanied by an increasing awareness of the concept of quality of life as an overarching goal in urban planning. This is reflected in definitions that view urban planning as an activity aimed at changing living areas to improve conditions from what it would have been without planning (Taylor 1998). The spatial element of urban

planning is often overlooked in more general definitions of urban planning but is clearly reflected in the definitions of Healy (1998:1) describing the activity and philosophy of spatial planning as “the ideal of improving quality of life through promoting, managing and regulating place making” and Hillier (2010:3) defining the term spatial planning as “deliberate attempts to influence the spatial distributions of humans and non-humans and of various land-using activities.”

Despite attempts to provide a comprehensive description of the term ‘planning’, a commonly agreed definition clearly remains elusive. One element of wide agreement is the multidimensional nature of the concept that includes elements from different disciplines such as urban geography, economics, and architecture and its application at very different scales ranging from urban systems at a global level to individual neighbourhoods. Alexander fittingly identifies these different understandings of the term ‘planning’ (2016:91-92) in terms of four substantive descriptors:

- disciplinary or professional: such as city and regional (also referred to as town and country planning), economic planning or transportation planning
- object of practice: such as spatial or territorial planning, urban planning, land use planning, social planning
- planning domain: such as regional planning, state planning, corporate planning
- form of practice: such as strategic planning, advocacy planning, e-planning.

Taking these four substantive descriptors as point of departure the term ‘planning’ as used in this research refers to the **discipline** of city and regional planning, the **object of practice** as spatial and land use planning, the **planning domain** as city and municipal level planning, and the **form of practice** as strategic planning. It is further also necessary to distinguish between the terms ‘spatial planning’ and ‘spatial plans’. The term ‘spatial planning’ refers to spatial planning processes and activities leading to insights shared between the various parties and that result in the adoption of a ‘spatial plan’. It also refers to activities forming part of the implementation process subsequent to adoption of the ‘spatial plan’. The term ‘spatial plan’ refers to the plan as a package including the document that communicates goals and objectives, that identifies and prioritizes problems or needs, specifies proposals, and formulate implementation instruments (Baer 1997). In the South African context the term ‘spatial plan’ specifically refers to SDFs as applied within the substantive descriptors outlined above.

1.3 PROBLEM STATEMENT

The key instrument embedded in South African spatial planning policy is Spatial Development Frameworks (SDFs) at various scales. As a result, a multitude of SDFs and related policies and plans were prepared and revised at municipal level since 1994 to ensure compliance with policy and legal requirements. The quality and influence of these plans were however never adequately monitored and evaluated and their influence remains unclear. This has led to claims that South African cities are

continuing to reflect the spatial legacies of the past (Robins 2002; Pieterse 2004) and that SDFs, as the principal policy instrument to guide urban spatial development, are not sufficiently effective to pursue the overall spatial planning goals as outlined in the NDP, SPLUMA and the IUDF. Official policy documents also reflect these sentiments. The National Planning Commission (NPC) identified urban spatial challenges as one of the critical crosscutting issues that will influence South Africa's long-term development, and expressed the opinion that although the spatial legacy of apartheid was identified as a particular focus area for attention since 1994, the situation has probably been aggravated since then (Republic of South Africa 2011a). It recognises that densities have increased in some urban areas and that partial regeneration of inner cities have been achieved, but that little progress has been made in reversing apartheid geography (National Planning Commission 2012). The IUDF also states that apartheid spatial patterns have largely not been reversed since 1994 and argues that most of the infrastructure investments after 1994 have unintentionally reinforced some apartheid spatial patterns with the cumulative effect that "... it is harder to reverse apartheid geographies today than in 1994" (DCOGTA 2016:22). The official stance on this matter is probably best articulated in Chapter eight of the NDP that categorically states that a "fundamental reshaping of the colonial and apartheid geography may take decades, but by 2030 South Africa should observe meaningful and measurable progress in reviving rural areas and in creating more functionally integrated, balanced and vibrant urban settlements" (NPC 2012:260).

In response to this growing opinion that SDFs and related policies seemingly did not achieve the desired results and that the pace of change is inadequate, the Department of Rural Development and Land Reform (DRDLR) in 2008 initiated a study to investigate the quality and status of SDFs throughout the country. One of the primary deficiencies identified in this study was the inability to formulate practical and implementable SDFs with measurable targets that will allow for assessing the success of a SDF. This led to the development of a first guideline document for the preparation of Spatial Development Frameworks (South Africa 2011b). These official guidelines for the preparation of SDFs included important principles such as functional and socio-economic integration, efficient urban structure, and compaction and densification, but stopped short of providing incisive measures for physical and economic transformation of cities and towns. Despite the fact that the concepts such as compaction, densification and integration have been part of the South African spatial planning nomenclature since 1994, the actual implementation of these concepts in a quantifiable sense thus still remained rather vague. Although these SDF guidelines also identified the monitoring of spatial form through the application of key performance indicators as an important element of SDFs, it did not provide any clear guidelines or relevant spatial statistical indicators (apart from illustrative density factors and their potential application). The finalisation of SPLUMA in August 2013 further entrenched the requirement of monitoring indicators for spatial development by making provision for the establishment of specific norms and standards and providing detailed prescriptions for the preparation and content of municipal Spatial Development Frameworks. Section 21 of SPLUMA specifically requires SDFs to include an

implementation plan containing the specification of implementation targets and timeframes, and monitoring indicators. No details regarding the required monitoring system and indicators are however provided. Subsequent to the promulgation of SPLUMA, a revised and updated set of guidelines for the preparation of SDFs were also released by the Department of Rural Development and Land Reform in 2014 (DRDLR 2014). Although these guidelines make specific provision for an elaborate monitoring and evaluation component during the preparation of municipal SDFs, no details are provided regarding the monitoring and evaluation procedures, techniques and indicators to be applied.

Despite these process and content requirements and guidelines for the preparation of SDFs there remained a surprising paucity of comprehensive cross-city comparative empirical evidence to evaluate the extent of changes to South African city structure since 1994, and to objectively review the influence of the new generation of spatial policy and planning instruments. More importantly, the absence of this information negates the possibility to determine the extent and nature of the influence of various forces influencing urban form and how policy instruments can influence these forces. Available quantitative studies generally focused on individual cities (or pairs of cities) or single time periods and did not include comprehensive cross-city temporal comparisons of structural and spatial changes (e.g. Kotze & Donaldson 1998; Turok 2001; Horn 2005; Donaldson & Kotze 2006; Lemanski 2006; Sinclair-Smith & Turok, 2012). This absence of reliable information resulted in the effectiveness and influence of urban spatial planning in the post 1994-era and its impact on restructuring South African cities being questioned, often as the result of relying on anecdotal evidence and speculation rather than rigorous empirical research. Although the latest State of the Cities Report of the South African Cities Network (SACN 2016) includes a wide range of statistical data and a suggested standardised set of indicators², it does not provide a methodological framework for the systematic assessment of the impact of spatial policies and plans. These challenges are not unique to South Africa and the lack of consensus on the exact interpretation of concepts such as compact cities and the selection of quantitative indicators for measuring these aspects have also been identified elsewhere. Burton (2002) identified one of the key challenges in research on the structure and the compactness of cities as the lack of consensus on the meaning of the term ‘compact city’ and the absence of recognized indicators for measuring it. Pratt & Larkham (2010) recognized considerable differences in opinion regarding the desirability of a ‘compact city’ approach, the extent and rate at which it should be encouraged, appropriate policies to enforce compactness, and empirically testing the sustainability thereof.

Apart from the specific circumstances influencing the spatial development of cities in South Africa, there is also the broader and more general problem associated with the inadequate theoretical and

² The State of Cities Open Data Almanac (SCODA) is aimed at addressing the planning, monitoring and reporting needs of cities. Its aim is to lead to more efficient and effective data systems and processes and data and indicators becoming more readily and consistently available. It consists of a list of 217 potential indicators covering various thematic areas.

methodological underpinning of processes to evaluate the influence of spatial plans (Faludi 2000). Despite fields such as public administration and management sciences focusing increasing research attention on policy and plan implementation, little enquiry has been directed at the evaluation of implementation processes in the field of spatial planning. Internationally planners generally also have inadequate knowledge about the implementation of spatial plans and their effects on spatial development (Talen 1996; Seasons 2003). The challenge of limited assessment techniques and data is also not unique to South Africa and internationally the assessment of the success or failure of spatial plans often rely on anecdotal evidence and assumptions rather than empirical assessments. This results in a limited understanding of decision makers regarding present and future problems they face (Alterman & Hill 1978; Faludi 2000; Laurian et al. 2004). The complexity of urban development processes also imply that it is difficult to establish causal links between spatial plans and its eventual outcomes (Laurian et al 2004). The physical change and spatial structure of a specific area which is the subject of a spatial plan or policy can be the result of various factors, and can not only be attributed to planning alone. It is thus difficult to isolate the effects of spatial planning policies from other activities and policy streams (Talen 1996). From a methodological perspective, it is imperative to understand how spatial policies and plans interact with the triggers and forces affecting urban spatial changes.

The issues and challenges outlined in this section can be summarised in terms of four key elements of a problem statement. Problems one to three are applicable to South African circumstances as well as international experience, while problem four is more specific to the South African urban context:

- Problem 1: The theoretical and methodological underpinnings of evaluation methodologies and procedures that are required to evaluate the influence of spatial plans are still inadequate.
- Problem 2: There is a paucity of empirical evidence (including spatial and temporal coverage) and hence a reliance on assumptions and anecdotal evidence to review the successes and failures of spatial plans.
- Problem 3: There is no consensus on the detailed interpretation and the selection of appropriate quantitative indicators for the measuring of widely used spatial concepts such as compactness, densification and land use integration.
- Problem 4: In the South African context, there is a growing perception that spatial planning processes and plans are ineffective to pursue the overall spatial planning goals as outlined in the NDP, SPLUMA and the IUDF. This has led to claims that South African cities are continuing to reflect the spatial legacies of the past.

These challenges make it very difficult for planners and decision makers to determine if the alleged lack of impact of spatial planning and plans are the result of inappropriate processes and methods, pursuing the wrong goals and concepts, inadequate plan quality, or in fact failed implementation of the plan itself. In view of these challenges, and the growing international trend of introducing evidence-based planning (Alexander 2009; Wong & Watkins 2009), it is imperative to reflect critically upon the influence of urban spatial planning policy on the physical and morphological development of South African cities since 1994. This also suggests the need for a much stronger methodological and analytical basis for spatial planning than what has generally been the case until now.

1.4 RESEARCH QUESTIONS

The general question underlying this research is whether urban spatial plans (with a specific focus on SDFs as the key instrument in a broader range of planning and policy tools) had a meaningful influence on the evolution of the spatial structure and morphology of South African cities since 1994 and if not, why not? Based on the key elements identified in the problem statement the specific research questions are defined as follows:

- **Research Question 1:** What are the forces shaping the evolution of urban form and morphology and how is urban spatial planning influencing or influenced by these forces?
- **Research Question 2:** What are the overall principles and concepts of urban spatial organization in South Africa?
- **Research Question 3:** What is an appropriate theoretical grounding and suitable methodological approach for evaluating the influence of spatial plans and policies on urban development processes and outcomes?
- **Research question 4:** What are the key trends and changes in the urban structure of South African cities since 1994, and to what extent have SDFs, as the primary instrument within a broader range of policy and planning tools, influenced these changes?
- **Research Question 5:** Are the goals of increased densities, compact city form, and increased land use mix embedded in the South African spatial planning doctrine relevant, and what are the implications for future urban spatial planning processes and practices in South Africa?

1.5 RESEARCH AIM AND OBJECTIVES

The overall aim of this research is to establish the influence of spatial planning (based on the prevailing spatial planning doctrine) on key elements of city structure in South Africa through empirical comparative and temporal analysis across a range of metropolitan areas and intermediate sized cities in South Africa. The specific research objectives are defined as follows:

- **Objective 1:** To identify the forces shaping the development of urban form and morphology and establish how these forces interact with urban spatial planning.
- **Objective 2:** To analyse the evolution of the overarching spatial planning doctrine in South Africa since 1994 and determine how this doctrine has influenced spatial planning and spatial plans in South Africa.
- **Objective 3:** To develop a methodological framework for evaluating the influence of spatial planning and spatial plans.
- **Objective 4:** To undertake an empirical analysis with sufficient spatial and temporal coverage to assess the quality of SDFs and evaluate the influence of these SDFs on the urban structure of South African cities since 1994.
- **Objective 5:** To determine the implications of the research results for future urban spatial planning processes and practices and provide recommendations for improving and refining the evaluation of spatial plans.

1.6 RESEARCH DESIGN AND METHODOLOGY

1.6.1 Research design and method

The nature of the research objectives outlined in Section 1.5 necessitates a mixed method approach including the application of both quantitative and qualitative techniques. The overall research design consists of three interrelated components as illustrated in Figure 1.1. The first component entails a literature review and analysis of a number of interrelated elements. It firstly provides an overview of the main triggers and forces influencing the evolution of urban spatial structure and how these forces potentially influence urban spatial planning processes and plans, or alternatively how these forces may be influenced by spatial planning policy. The second element of the literature review considers the evolution of the key elements of the South African spatial planning policy since 1994 and identify the key challenges influencing spatial plan and spatial planning quality in South Africa. It considers the

urban spatial planning history in South Africa pre-1994, the South African urban structure legacies resulting from this history, and then traces the transformation of the spatial planning system post-1994 and the emergence of a new spatial planning doctrine. The third element of the literature review considers the theoretical grounding of spatial planning and spatial plan evaluation within the broader framing paradigms of procedural theory in urban planning.

The second component of the research design involves the development of a methodological framework for evaluating the outcomes of spatial planning and spatial plans. It uses the insights acquired in the literature review to develop a proposed comprehensive methodology for spatial plan and spatial planning evaluation. Elements of this methodology, focussing specifically on the 'product' elements of the evaluation methodology, are then applied in the subsequent empirical analysis components of the research design.

The third component of the research represents the empirical analysis component of the study and includes both qualitative and quantitative elements. The purpose of the qualitative analysis is to identify the spatial planning responses to the challenges identified in the literature review as reflected in SDFs of a range of case study cities. It includes a detailed content analysis of a cross-section of municipal SDFs focusing on two interrelated strands of arguments. Firstly, it provides a summary of the key elements of the debates inherent to each of the identified challenges based on the literature that was reviewed. Secondly, the critical elements of these debates then provide the reference framework for analysing the content of a cross-section of urban spatial plans in South Africa to establish how municipalities have responded to these identified challenges in their SDFs. The content analysis of these plans considered both the narrative content and the spatial proposals.

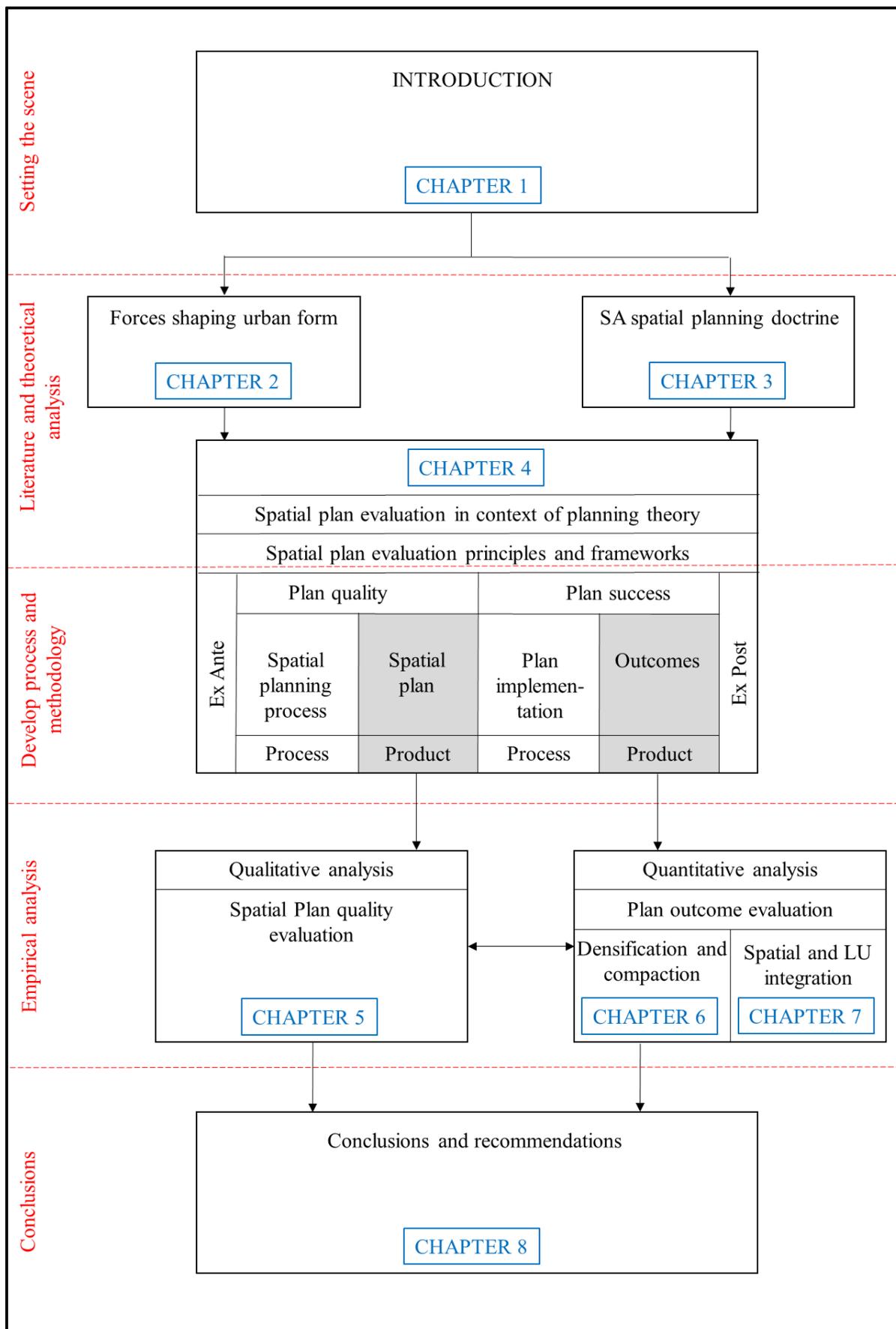


Figure 1.1: Research design and method

The quantitative analysis component of the research design entails an empirical analysis of changes and trends of key elements of urban structure in South African cities through the application of a range of spatial analysis and spatial statistical techniques. This analysis considers the product element of the plan success component of the evaluation methodology (see Figure 1.1) to assess the level of influence of municipal spatial planning and spatial plans on evolving urban structure using a range of South African case study cities.

The outcomes and results of these various components form the basis for synthesising the implications for future urban spatial planning processes and practices and provide recommendations for improving and refining the evaluation of spatial plans and spatial planning processes and practice.

1.6.2 Data sources and analysis

The details of the data sources and analysis techniques applied in the empirical analysis components of the research are described in detail in Chapters five, six and seven individually. As an introduction, this section provides a broad overview of the primary demographic and land use data sources utilised as input to the data analysis process.

The qualitative analysis of Chapter 5 is based on a combination of a literature review and content analysis of the SDFs of 15 different case studies. These case study SDFs are from ten different cities, representing the four largest metropolitan municipalities (Johannesburg, Cape Town, Tshwane and eThekweni), two municipalities that more recently obtained metropolitan status (Mangaung and Buffalo City) and four intermediate sized cities (Msunduzi, Emalahleni, Mbombela and Rustenburg). Many of the larger metropolitan municipalities have introduced a hierarchy of plans dealing with more detailed proposals at lower levels of spatial aggregation and hence in the case of Johannesburg, Cape Town, eThekweni, Tshwane and Buffalo City, both the overall metropolitan level SDF, as well as one of the sub-regional spatial plans were evaluated. In the other five municipalities only the municipal level SDFs were used. The selected cities are representative of different sizes, different geographical regions in South Africa, and different institutional histories. From a practical point of view their selection was also influenced by the availability of comparative detailed land use and socio-economic data required for the purposes of the parallel quantitative spatial and statistical analysis conducted in Chapters 6 and 7.

One of the main reasons for the paucity of comprehensive multi-year and cross-city spatial and statistical analysis of changing urban form and land use is the lack of a common set of detailed land-use data for different cities at a similar level of detail and for the same multiple time periods. Quantitative urban form studies have generally focused on individual cities (or pairs of cities) for single time periods and used different data sources (e.g. Kotze & Donaldson 1998; Turok 2001; Horn 2005; Donaldson & Kotze 2006; Lemanski 2006; Sinclair-Smith & Turok 2012) and thus do not allow for comprehensive cross-city comparisons. The criteria of comparability, spatial flexibility and robustness of available data were key considerations in the selection of case study cities to form part of the quantitative analysis

component of the study. Information required for the detailed spatial analysis of the selected dimensions of urban form thus had to be available for multiple periods for all cities forming part of the analysis. Data satisfying these criteria could be sourced for eight of the ten cities used in the parallel qualitative analysis of Chapter 5. These eight cities include the five metropolitan areas of Johannesburg, Cape Town, Durban (eThekweni), Pretoria (Tshwane), and Bloemfontein (Mangaung), as well as three intermediate sized cities of, Pietermaritzburg (Msunduzi), Nelspruit (Mbombela), and Witbank (eMalahleni).

All analysis requiring population related information used the 1996 and 2011 census population figures at Enumerator Area (EA) level. EAs are the smallest unit of spatial analysis used for census purposes, and were deemed an appropriate unit of spatial analysis for both population and land use data. It is also suitable for summarising data to higher levels of spatial aggregation. In the metropolitan areas of Johannesburg, Cape Town, eThekweni and Tshwane the urban footprint data covers the entire 2011 municipal area of demarcation, focussing on the areas within the identified urban edges or urban growth boundaries where appropriate. The total municipal population was used for municipal wide calculations in these areas. In the case of Bloemfontein, Pietermaritzburg, Nelspruit and Witbank the municipal area consist of a main core urban centre, as well as a number of smaller towns and/or dense traditional settlement areas scattered across the area of jurisdiction of the municipality. In this instance, the urban built-up footprint and population figures of the main central core urban area was used, and the analysis excluded the outlying and scattered settlements in the remainder of these municipalities. In these cases, the population figures are based on the enumerator areas and wards falling within the urban core areas only.

One of the biggest challenges in the quantitative data analysis component was the need for accurate land use data at the scale of individual cadastral entities (the spatial units according to which SDF proposals are generally organized) for the selected case study cities. The land use data also had to reflect time periods as close as possible to the two census periods (1996 and 2011) for which the detailed demographic data was available. The obvious choice for this purpose would have been the use of available land cover data derived from satellite imagery. There is however a difference between land cover data and land use data. Land cover describes the biophysical coverage of an area resulting from human and natural processes, whereas land use data describes the human activity that occurs on the land and that defines how it is used (Stephenson et al. 2015). Although land cover can be used to infer land use, the two concepts are not interchangeable. Despite significant progress in the field of satellite imagery and remote sensing, land cover information derived from medium-resolution satellite images (such as Landsat images on which the South African land-cover datasets area based) cannot provide sufficient separation among urban functional zones (Hu et al. 2016). An assessment of the land cover data available at the time of the analysis (2013/14) confirmed this aspect and alternative data sources and methods thus had to be explored.

The commercially available Building Based Land Use^{©™} dataset of GeoTerraImage (2012) is widely used in industry (e.g. ESKOM, Telkom, City of Johannesburg, Gauteng City Region Observatory, CSIR) and has been applied in research and academic work (e.g. Geyer et al 2012, OECD, 2012). The Building Based Land Use^{©™} dataset contains buildings, structures and other area specific land uses as identified and mapped from high resolution orthophotos as point data. The land uses are mapped using manual image interpretation techniques and classified into a standardised 70-class land use classification using supplementary datasets and fieldwork. This data undergoes extensive quality control and validation to provide accurate and detailed land use for selected urban areas within South Africa. The point data format is however not suitable for application to the selected analysis techniques and variables of interest to this research and thus had to be integrated with the latest available cadastral data for each city to produce a set of land use data at the level of individual stands or land parcels as spatial unit of analysis. A Python script was developed in ArcMap 10 to integrate the land use points and the erf boundaries and to consolidate the 70 land use classes to 13 main classes (see Appendix A for main classes and sub-classes). These main classes include multiple residential, single residential, informal residential, mixed residential, commercial, industrial, transport and utilities, institutions, sport and recreation, mining, mixed land use, parks and conservation, and agriculture and forestry. The two classes of parks and conservation, and agriculture and forestry were not considered as forming part of the urban built-up footprint in those components of the analysis referring to built-up footprint. Two data sets were used in each city: one as close as possible to 1994 as the base year of the study (and 1996 as the base year for population data) and one for the time period as close as possible to 2011 to enable the use and application of detailed 2011 census data at disaggregated levels such as Small Area Layers (SALs) and Enumerator Areas in conjunction with the land use data. The results of this analysis reflecting the changing land use patterns in each of the eight cities are provided in Appendix A. These maps represent an important research contribution in its own right and are used as one of the primary data sources for the empirical analysis conducted in Chapters 6 and 7.

1.7 STRUCTURE OF DOCUMENT

The remainder of the document is structured according to seven individual chapters that document the results of the research objectives as described in Section 1.5 and outlined on Figure 1.1.

The evolution of urban form and character throughout the world can be viewed as the result of the interaction of a range of physical, social, economic and technological forces influenced by the institutional and governance framework within which cities function. These interactions are diverse and complex and requires an understanding of the concepts of space, scale, and time appropriate to spatial planning contexts. A number of key questions have to be considered in this regard. What are the forces and triggers driving land use and spatial changes in cities? How do these forces interact with one

another? How does the spatial planning and policy framework influence these forces or how do these forces affect the spatial planning framework? **Chapter 2** provides an overview of these forces and how it interact with the urban spatial planning and policy framework.

The operation and impact of the forces described in Chapter 2 in the South African context have been substantially influenced by historical Colonial, and political ideologies. This resulted in spatial patterns and urban structures that became widely associated with South African urban areas and the almost default use of the term ‘apartheid city’ that often forms the bases for ideological rhetoric rather than a critical engagement with the true meaning and implications of the concept. It is hence not possible to critically evaluate the influence of contemporary post-1994 spatial plans without considering the historical context of South African urban spatial planning. **Chapter 3** starts by providing a description of the South African urban spatial planning history pre-1994 and considers the role and influence of both Colonial and Nationalist ideologies. It then proceeds to describe the urban spatial structure legacies of contemporary South African cities that emanated from this historical context. Building on this background it then proceeds to review the transformation of the South African urban spatial planning system post-1994 and the emergence of a new spatial planning doctrine. This spatial planning doctrine provides a reference framework for the qualitative and quantitative analysis provided later on in Chapters 5 to 7.

As indicated in the problem statement, the theoretical and methodological underpinnings of spatial plan and spatial planning evaluation methodologies and procedures are inadequate. Although plan evaluation have a long standing history as an element of urban planning practice, little attention has been directed to the theory and practice of evaluating the achievement of plan objectives and policies. The first part of **Chapter 4** hence contextualises the concept of spatial plan and spatial planning evaluation against the background of the changing paradigms prevalent in the broader field of procedural urban planning theory. It starts by identifying the important overall paradigm shifts that occurred in urban planning theory and aims to help map the landscape of ideas that are influencing the study field of spatial plan and spatial planning evaluation within the broader epistemological debates in urban planning theory. The limited research and enquiry that has been directed at the evaluation of implementation processes and outcomes in the field of urban planning (Talen, 1996) creates conditions where it is difficult for planners and decision makers to determine if the alleged lack of impact of spatial planning is the result of inadequate plan quality, or pursuing the wrong goals and concepts, or in fact failed implementation of the plan. The second part of Chapter 4 utilises the key findings of the preceding chapters and sections to develop a methodological framework for evaluating spatial planning processes and spatial plans. This framework includes elements of contextual evaluation, operational environment quality evaluation, plan quality evaluation and plan success evaluation. Components of this evaluation methodology focussing

specifically on the ‘product’³ elements of the evaluation methodology are then applied in the empirical analysis described in Chapters 5 to 7.

Chapter 5 applies the ‘product’ element of the plan quality evaluation component of the framework developed in Chapter 4 and is presented in the form of an article published in the journal *Urban Forum* titled ‘*A critical reflection on spatial planning practices and outcomes in post-apartheid South Africa*’ (Volume 25, pages 69-88, 2014) (Appendix D). This article examines the issues relating to urban spatial plan quality in South Africa. It synthesises the key challenges in urban spatial planning in South Africa and analyses the responses of contemporary urban spatial plans to these identified challenges, through a review of the spatial plans of a cross-section of South African case study cities. In conclusion, it offers a number of suggestions to address these challenges and pave the way for some practical solutions.

The ‘product’ element of the plan success evaluation component of the methodology developed in Chapter 4 is applied in Chapters 6 and 7. It aims to determine the influence of SDFs as the key instrument of spatial planning policy on guiding the spatial transformation of a sample of South African cities since 1994 in terms of two of the most prominent goals of the post-1994 spatial planning doctrine: (1) compaction and densification and (2) spatial and land use integration.

Chapter 6 provides the results of an analysis of the extent to which the goal of compaction and densification have been achieved. It is presented in the form of an article published in the journal *International Planning Studies* titled ‘*The evolving spatial structure of South African cities: A reflection on the influence of spatial planning policies*’ (Volume 20(1-2), pages 87-111, 2015) (Appendix E). This article analyses changes to the urban form and density of South African cities since 1994 against the background of spatial plans influencing these aspects. The fundamental aspects in the measurement of urban form and density are firstly described as a basis for identifying and selecting appropriate techniques and spatial indicators. These indicators are then applied to a cross section of eight South African cities with the aim to answer four questions:

- Does the range of basic population density indicators reflect an increase in density since 1994?
- Is the double density gradient model applicable to South African city structure and are there specific variations between larger metropolitan areas and smaller intermediate cities?
- Are the changes in the double density gradient model parameters since 1994 indicative of compact growth and densification?
- Does the evolution of urban spread over time since 1994 provide any indication of densification or compaction of the urban structure in relation to the city centre?

³ The details of the spatial plan and planning evaluation methodology, and the distinction between ‘product’ and ‘process’ elements of this framework are described in detail in Chapter 4.

Chapter 7 describes the results of the analysis to determine the extent to which the overall spatial goal of functional and land use integration and the role of the identified spatial planning concepts in achieving this goal have been achieved over the study period. It is presented in the form of an article published in the South African Geographical Journal titled '*Land use mix in South African cities and the influence of spatial planning: Innovation or following the trend?*' (Volume 97(3), pages 217-242, 2015) (Appendix F). It describes the various approaches and indicators to analyse land-use mix. It firstly provides a multi-year and cross-city analysis of a range of land use mix indicators for eight different cities in South Africa since 1994. Secondly, it attempts to provide a comprehensive view of land-use diversity in South African cities through the application of a range of indicators reflecting both intensity and pattern-based land-use mix measures. It then compares the land-use mix patterns and trends with the main spatial principles and structuring elements contained in the SDFs of the eight cities, to review the appropriateness and effectiveness of these measures.

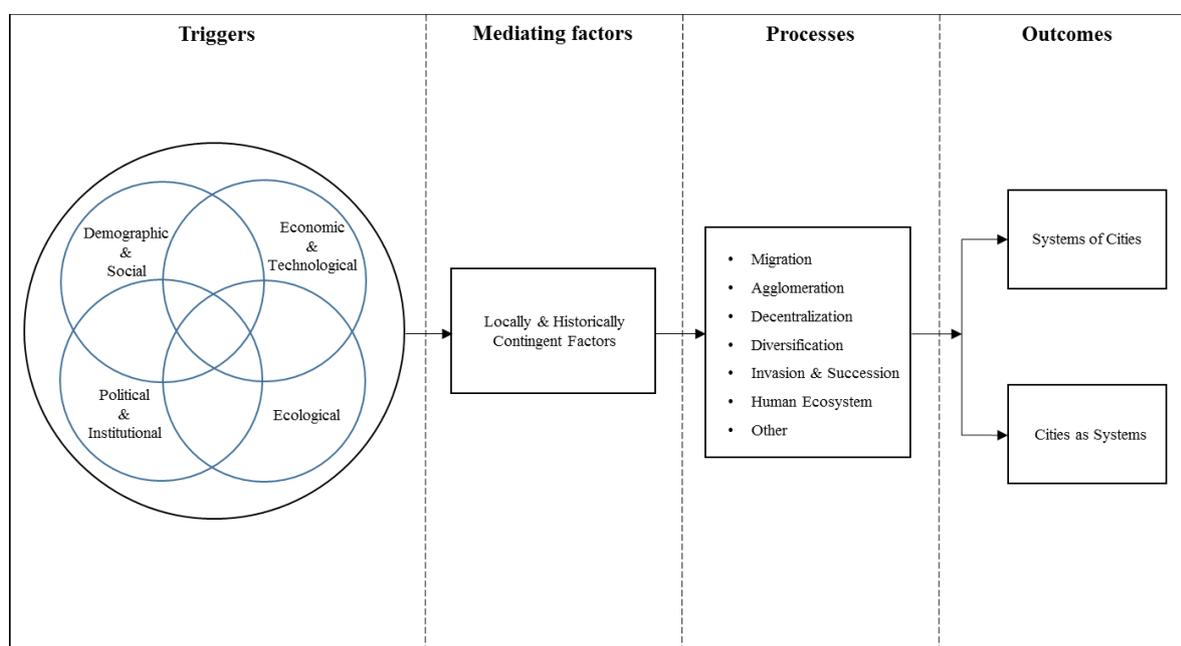
Chapters 5, 6, and 7 of this document are presented in the format as it was published in the peer-reviewed journals referred to in the preceding paragraphs. This has three implications for the structure and content of this document. Firstly, there are some overlaps and duplication in the introductions of Chapters 5 to 7 due to the fact that the articles were published in three different journals, each article requiring some introduction and background information related to the research project. Secondly, additional information at a more detailed level of spatial aggregation became available subsequent to the publishing of the articles (such as more detailed and spatially disaggregated results of the 2011 census data), thus necessitating some elaboration on the findings presented in these articles. Thirdly, some theoretical aspects and terminology used in these three chapters could not always be discussed in detail in the published articles due to publisher limitations on the length of the articles. In some instances further explanation and interpretation was deemed necessary for the purposes of this dissertation. Where required this supplementary information was added as **footnotes and endnotes** in Chapters 5 to 7 (these footnotes and endnotes do not appear in the original published articles).

Chapter 8 summarises the implications of the research results for future urban spatial planning processes and practices and provide recommendations for improving the overall spatial planning process by being more attuned to the various forces influencing the spatial development of cities. It suggests a refined methodology for the comprehensive evaluation of the influence of spatial plans and spatial planning processes aimed at improving the success of spatial plans in meaningfully contributing to appropriate forms of urban structure and land use configuration in South African cities. It provides a summary of spatial planning policy and process implications and recommendations for implementation. The conclusions also provides a critical self-reflection on the research process and results and offer some suggestions for further future research.

2 CHAPTER 2: TRIGGERS AND PROCESSES INFLUENCING EVOLVING URBAN FORM

2.1 INTRODUCTION

The form and character of urban environments throughout the world is the result of the interaction of a range of interconnected forces (Simmel 2002) influenced by the institutional and governance framework within which it functions, and involving various resources such as land, natural resources, finance, and human capacity. These complex interactions are diverse and differ across time and at different spatial scales. A factor often not recognised by urban planners is that the planning and control of discrete land uses without adequately considering the inter-relationships between spatial development and these interacting forces and resources will not be capable to result in planned urban changes (Lichfield 2006). An understanding of what these forces are and how they interact to shape evolving urban form is thus an indispensable point of departure for a research project where the overall aim is to establish the influence of spatial planning and spatial plans on key elements of city structure. A framework consisting of major trigger factors, mediated through locally and historically contingent factors, and leading to processes underlying urban change provides an ordering structure for these interactive processes (Figure 2.1).



Source: Adapted from Pacione (2009a) and concepts of Berry (1964)

Figure 2.1: Triggers and processes influencing urban form

As indicated on Figure 2.1 the demographic and social, economic and technological, institutional, and ecological triggers are interacting in various combinations to influence the spatial outcomes of settlements and cities. These triggers are mediated through locally and historically contingent factors

and result in various processes driving the evolving structure of ‘systems of cities’ and ‘cities as systems’ (Berry 1964). Berry was one of the pioneers to describe cities as systems (entities comprising of interacting and interdependent parts) that can be analysed at a various levels and be partitioned into a variety of subsystems. ‘Cities as systems’ can thus be understood as consisting of a variety of subsystems, each comprising interacting and interdependent parts. Cities forming part of an environment together with other cities also constitute systems, and can be referred to as ‘systems of cities’.

The remainder of this chapter focusses on the functioning and impact of these triggers, contingent factors, and processes on ‘cities as systems’. Each of these individual aspects can potentially represent a whole field of study in urban geography or urban planning and this chapter thus provides a summary of these aspects as a reference framework for the subsequent components of the research. The structure outlined in Figure 2.1 does not imply a simple linear process and implied causal links. For example, an aspect such as globalisation can be considered as both a ‘trigger’ and a ‘process’, depending on the scale and focus under consideration. At one level, globalisation can be viewed as a trigger influencing international, regional and urban level migration processes. At a different level globalisation can however also be considered as a process resulting from triggers such as political, institutional and social factors. The framework outlined in Figure 2.1 thus merely provides an ordering structure for the discussion of a diverse and complex subject.

2.2 TRIGGERS

2.2.1 Demographic and social forces influencing urban change

2.2.1.1 Demographic structure

The demographic structure and changes of an urban population influence the overall spatial patterns of cities and that of individual elements or sub-systems such as residential, commercial and industrial components. Aspects such as age structure (influencing residential life cycle events such as completion of education, birth of first child, retirement), marital status, household size and employment status are all factors that influence residential adjustment and relocation decisions. Many of these trends are also clearly visible in South African cities where, for example, the average size of households decreased between 1996 and 2011⁴ in most of the larger cities. Specific individual land uses such as the retail component are also influenced by demographic factors such as household income and purchasing power (impacting on aspects such as car ownership), levels of employment, and female participation in the labour force. These demographic changes not only trigger higher-level processes such as urbanization

⁴ The decrease in household sizes between 1996 and 2011 in some of the case study cities analysed in Chapters 5, 6, and 7 area as follows: From 3.5 to 3.1 persons per household in Johannesburg, from 3.9 to 3.5 in Cape Town, from 4.2 to 3.6 in eThekweni, from 3.9 to 3.2 in both Tshwane and Mangaung, and from 4.4 to 3.8 in Msunduzi (SACN, 2016).

and migration but also interact with local processes related to neighbourhood changes and local socio-economic conditions.

The theory of demographic transition is particularly relevant to urban development processes and postulates a process of declining fertility and mortality occurring in western countries from the eighteenth and nineteenth centuries onwards. In most parts of the rest of the world it occurred from the second half of the twentieth century. The completion of this demographic transition results in an older stationary population with no population growth and little need for immigrants (Letshaeghe 2010). The concept of a second demographic transition (particularly applicable to developed countries and some cities in the developing world) however rejects the idea of a stationary equilibrium. Instead, it postulates a second transition characterised by sub-replacement fertility caused by substantial postponement of marriage and parenthood, and a variety of living arrangements other than marriage. This second transition results from attempts to achieve personal goals such as improved education, employment, and income (an idea very similar to the concept of productionism within the framework of differential urbanization). In this second transition the role of the nuclear family is significantly reduced while the prevalence of single households and single parent households increases (Lesthaeghe & Neidert 2006). According to this theory of a second demographic transition, migration flows become increasingly important determinants of urban growth in most cities of the Global North. This migration of people impacts on the size, physical configuration and social composition of receiving cities and in many of these cities the culture of immigrant populations are distinct from the historical parts of the city. These higher-level demographic processes of urbanization and migration also intersect with local processes related to urban and neighbourhood changes. Lewis Mumford predicted this phenomenon in the 1925 and described it as the 'fourth migration' where the rest of the 20th century would be dominated by people migrating from the central cities to the suburbs. This idea of the 'fourth migration' was further advanced by Fishman (2005) who argued that some cities are at the onset of a 'fifth migration' during which inner-city districts that were previously depopulated will reurbanise and factors such as immigrant reurbanism will play an important role.

Early signs of this fifth migration have been identified in US cities. Kotkin (2014) found that, after an era of population decline, the downtown cores of the 51 metropolitan areas in the US with populations over a million, gained just over 200 000 residents over the period 2000 to 2010. Although representing only 1.3% of all growth in the major metropolitan areas of the US, it is indicative of at least some upswing in the attractiveness of city centres. Elements of this 'fifth migration' are also prevalent in some of South Africa's largest cities with Johannesburg the destination of most internal and cross-border migrants, and the inner city acting as an arrival area for migrants from foreign countries. An estimated 50% of residents in the urban core areas of Gauteng have moved to the inner city in the last 15 years (SACN 2016). The results outlined in Chapter 6 and reflected in Appendix B indicates that in three of the four metropolitan cities analysed (Johannesburg, Tshwane and eThekweni) there is clear evidence of

increases in population density in and around the traditional CBD areas together with widespread increases in decentralised suburban locations. There are thus clear (and statistically significant) results confirming elements of both Mumford's fourth migration, as well as Fishman's concept of a 'fifth migration' in some of the cities analysed in this study.

2.2.1.2 Social organization

The integrity and coherence of social institutions and their maintenance are fundamental to understanding social organization processes in cities. A critical element is the understanding that demographic characteristics such as population size, growth, movement, and concentration are the causal triggers influencing social organization processes such as rates of interaction amongst individuals, levels of conflict, degrees of social differentiation, and levels of subgroup formation (Turner 1990). Divisions in cities have always existed and are the result of power relationships, economic functionality, cultural characteristics, or a combination of these factors (Marcuse & Van Kempen 2000). Four factors largely determine the way in which people live together in a society (Geyer 2007a) and provide an informative point of departure to explain the interaction between human nature and space. The first factor is the basic human instinct of self-survival in societies that are inherently self-centred and where the differentiated physical and intellectual abilities of individuals result in characteristics such as competitiveness and domination⁵. The second factor is the tendency of people to classify everything they perceive (partially because of their mental insecurity). This qualitative classification is often dichotomous in nature (e.g. familiar-strange; good-bad) and related to self-preservation. Thirdly, people have a natural desire to finding safety in a familiar environment ('belong') based on aspects such as stage in lifecycle, common interests, beliefs and other factors. The fourth aspect is that most people prefer to interact on a small scale preferably on one-to-one bases. In a larger group, this interaction will normally be with individuals whom they feel intuitively most comfortable with. The interaction of these factors (especially the third and fourth aspects) causes social organization where people prefer to live in small and identifiable places such as specific neighbourhoods or urban precincts.

On a broader scale these social organization processes have been approached from a number of alternative viewpoints such as the outcome of struggles in the economic domain, the interplay of income and power of individual and groups (also referred to as 'class'), and the recognition of cultural and other forms of diversity in cities. In all these approaches, the four factors outlined above also play a role to varying degrees. The Marxist school of thought considers social organization processes informing urban structure as the result of tensions between ownership of the means of production and the individuals

⁵ As discussed in Section 2.4 the two related principles of dominance and succession operating in natural habitats have a long history of application to human communities in a process of invasion and succession. It is based on the original work 'The City' (published in 1925) that developed a comprehensive urban ecology of the city strongly influenced by biological and ecological concepts and evolutionary processes such as invasion and succession (Dear 2002).

who supply labour. They view comprehensive-rational planning as flawed because planners have to operate within the political limitations imposed on them by their position. The influence of Marxism on urban structure is most clearly manifested in historical communist cities that were primarily structured to support industrial production (Paden 2003). Marcuse & Van Kempen (2000) moved beyond the principle of a specific political ideology as the primary trigger for social organization processes and argued that the concept of 'class', based on the two key characteristics of income and power, is the main force of social organization in cities. Based on this argument the allocation of land for different uses is determined through the market with higher income individuals that will be able to pay higher prices and hence their choices prevailing over lower income individuals. The part of land allocation not governed by the market is determined by the relationships of power in the state and the economy and is for example controlled by aspects such as zoning conditions. This combination of income and power can result in different forms of social classification. Fainstein, Gordon & Harloe (1992) for example identified three classes: the upper class (mostly white and male), middle and lower levels of the service class (including many women and from ethnic minorities) and the unskilled working class (mostly consisting of women, immigrants, elderly and young unqualified men). These forms of divisions result in the creation of separate enclaves within cities.

Duncan (1978) also recognised the role of these inequalities in power, but added the further dimension of differential mobility and access to space as determining interrelationships between social groups in a city and influencing their use of space. Duncan argued that the solution to understanding the use of space by peripheral groups lies beyond a simple dualistic classification of urban space into public and private space. Instead, he suggested a system based on an unstated scale of social value applied to different spaces in the city by different groups ranging from 'prime' space to 'marginal' space. Marginal space is defined as areas such as alleys and space under bridges. Minority groups such as the homeless spend as much as time as possible in these marginal spaces, which then in turn becomes their prime space. The value of specific spaces in a city thus depends on the perspective from which the situation is viewed and the context of that group's relation to other groups.

The subcultural school also accepts social and cultural differences as the main driver of social organization process. The subcultural perspective views the city as the product of meaningful actions of individuals and argues that cities can be differentiated into distinct sub-communities. These sub-communities are spatially segregated and develop their own unique culture with the source of social action lying in the "small milieus of personal life" (Fischer 1975:1323). Postmodernism⁶ also embraces social differences and a diversity of lifestyles expressed in a variation of urban settings. They argue that popular societal attitudes towards minority groups (such as ethnic or lifestyle, single parent households,

⁶ Postmodernism in a general sense refers to a broad-based movement in social science (and other disciplines) critical to the grand theory of modernism.

unemployed, disabled) can influence underlying patterns of residential segregation in cities (Pacione, 2009a).

From a spatial planning perspective the ordering of urban structure based on economic function (for example based on zoning) is a widely accepted principle, but other forms of division based on class, race, lifestyle or ethnicity is regarded as more problematic (Marcuse & Van Kempen 2000). Of specific relevance is the general fear amongst urban governments that socially homogenous clusters in urban and suburban settings can be perceived as fragmented cities (Boterman & Musterd 2017). This discourse is particularly prevalent in the South African planning context against the background of demographic spatial patterns in South Africa historically influenced by race-based legislation that controlled migration to and settlement in urban areas. The concept of integration has hence been part of the South African spatial planning doctrine (described in detail in Chapter 3) since the early 1990s. These spatial planning efforts have however been hampered by a limited understanding of the influence of social organising processes on ethnic and cultural integration. The general understanding of the concept of 'integration' in South African spatial planning is mainly based on the notion of 'undoing' the effects of the ideological apartheid system but fails to recognise and critically engage with the social and cultural structuring processes at play in all cities across the globe.

2.2.2 Economic and technological forces influencing urban change

Economic forces are often regarded as the dominant influence on urban morphology and change. A combination of factors operating at a macro level (such as globalisation and technological innovation) together with locational factors at a micro level (such as available land, availability of infrastructure, client base) results in different types of economic activities clustering together at specific locations (Geyer 2009). This combination of factors influences urban form at both an urban systems level and at the level of individual cities. This section firstly considers the macro level factors such as globalisation and technological innovation before turning attention to local (urban) level factors such as land values and friction costs influencing the overall structure and composition of cities. The final section deals with factors more specifically influencing individual subsystems forming part of the city as a system.

2.2.2.1 Economic and political paradigms

The prevailing dominant economic and political paradigm of countries at a national level such as capitalism, socialism, and communism have a profound impact on the structure and functioning of cities because they influence what is produced, how it is produced, and where it is produced (Pacione, 2004). The governing national or regional economic paradigm also acts as an external factor influencing the degree to which individuals within a particular community can think and respond creatively and determine the level of freedom or flexibility to respond to these ideas (Geyer 2011).

Capitalism is the dominant economic order in most cities across the world and its influence on urban development is widespread. Capitalistic systems are generally characterised by free-market competition between businesses and urban development that are largely unconstrained by government regulation. The spatial impact of capitalism (globally and locally) is the tendency of capital to flow to and accumulate at locations that will yield the biggest potential return. This differential use of space in pursuit of profit creates what Pacione (2009b:4) refers to as “a mosaic of inequality at all geographic scales from global to local” and the resulting power relationships between polity and capital that can be described in terms of four different ideological regimes:

- Market capitalist with a low degree of state penetration in the means of production (e.g. interventions such as subsidies and tax benefits).
- Corporate fascist characterised by more direct involvement by the state in the form of control over aspects such as investment decisions and wage structures.
- Liberal democratic/welfare state liberalism is accommodative to the working class interests through conservative leftist governments
- Social democratic where income benefits are channelled to labour rather than capital by a leftist working class government through more direct control of the means of production.

Communism at the other end of the spectrum was the dominant political and economic order in regions such as Eastern Europe, the former Soviet Union, and China. Government control rather than market forces determined the spatial patterns of investment and urban growth in these cities. The transformation from communist to post-communist cities since the 1980s however not only resulted in changes in the distribution of economic activities, but also institutional transformations, transformations of social practices, and transformations in urban space (Sykora & Bouzarovski 2010).

These power relationships are particularly intricate in the South African urban context with especially the metropolitan cities influenced by different elements of these alternative ideological regimes. As will be indicated in Chapters three and five, different functions of cities are the responsibility of different spheres of government. In some instances, such as housing, the function is distributed between all three spheres of government (e.g. funding provided by national department, project implementation and management resorting under provincial government, and spatial planning for housing the responsibility of local government). Depending on the circumstances of individual cities, the combination of the three spheres of government influencing the development of cities may represent a combination of different ideological regimes as outlined above with the permutations different from city to city.

2.2.2.2 Globalisation

The emerging concept of globalisation (especially since the 1980s) fundamentally altered the understanding of cities from the traditional view of cities as a central point linked to a distinct market of a hinterland, to one also recognising its role and function in wider economic processes. Globalisation is the increased interdependence of economies across the world and is manifested by the ease with which money, people, cultures, information and goods can circulate across national boundaries and the increasing role of transnational corporations in the world economy (Allen & Thompson 1997; Gottdiener & Budd 2005). Although the concept of globalisation became particularly prominent since the 1980s, it has a much longer history (Geyer 2006). It can be traced back to period of 'global pioneerism' resulting from long distance trading, followed by an era of colonization driven by the desire for global economic domination and political control. The third phase commenced after the Second World War accompanied by the popularization of specific economic systems and social norms. It gained momentum with the advent of the rapid advances in Information and Computer Technology since the 1980s (Geyer 2006). This increasing international mobility of capital, labour, and goods created opportunities for industries and businesses to relocate production processes to countries with the most favourable set of production conditions. This process also gained momentum as a result of neo-Marxist inspired industrial action in Western Europe and the United States that contributed to increased production costs. These increases contributed to a process of industrial restructuring with many labour-intensive production processes relocating to lower wage countries with the ability to provide the required quality of labour and infrastructure (O'Loughlin 1989). This is evidenced by the relocation of many manufacturing industries from Western Europe and the United States, especially to countries in Central and Southeast Asia. This relocation of production processes to lower wage countries however largely bypassed African cities. Apart from the challenges associated with political instability, African cities in general could not provide the required quality of labour or reliable infrastructure required for this purpose. In the South African context the highly unionised form of labour and the effect of negotiated minimum wages further impacted negatively on the perception of the country's ability to benefit from these global production relocation process. The global process of industrial restructuring is also influenced by the process of 'endogenous differentiation' (Geyer 2006) through changes in organisational functioning and strategic outsourcing. This resulted in a global differentiation process where production processes increasingly located in newly industrialised countries, with many of the multi-national command and control functions and associated advanced producer services retained in the industrialized countries (Geyer 2006). These emerging global cities act as important centres for the accumulation of advanced producer services leading to the increased international prominence of cities such as New York, London and Tokyo. These cities are experiencing significant demographic and social changes resulting from large groups of upwardly mobile immigrants and high numbers of middle-level white collar workers (Fainstein & Campbell 2012).

Although often viewed as a separate and distinct process, the transition from a focus on mass production to specialized and differentiated markets as espoused in the concept of 'Post-Fordism' is inextricably linked to the growing dominance of capitalism as the dominant world order and the emergence of globalisation. The term post-Fordist in its simplest form generally refers to a transition from one distinct phase of capitalist development to a next that occurred since the mid-1970s (Amin 1994). Fordist mass production industries were the key economic drivers in most societies in the post-war decades and were supported by increasing rates of home ownership and private car ownership and higher levels of consumption. Production cost escalations related to welfare economics and the introduction of stricter environmental controls however resulted in a decline in the profit levels generated from mass production, and many businesses evolved to focus on specific services niche markets. This in turn led to the increasing role and influence of multinational corporations (Alderson, Beckfield & Sprague-Jones, 2010). This post-Fordist era is characterized by the emergence and increasing dominance of economic activities such as high technology manufacturing (e.g. Biotechnology), cultural product industries (e.g. fashion design, industry), and a range of financial and business services (Scott 2000).

The growing recognition of the command and control function of cities, the growing importance of advanced producer services, and the increasing role of multinational corporations opened up a whole new field of urban studies under the banner of 'world city networks' and 'global urban hierarchies'. This concept of world cities, or global cities, are however not entirely new and the foundations of this concept were already identified by Gottmann (1961), Hall (1966) and Doxiadis (1969). Gottmann (1961) referred to the north-eastern seaboard of the United States as a megalopolis (a description grounded in the demographic tradition of describing world cities). Early references to world cities from a functional perspective were provided by Hall (1966) describing world cities as centres of political power, trade, finance and service and advanced professional activities, and Doxiadis (1969) using the term 'ecumenopolis' for describing a universal world city.

The development of the world cities concept from a functional perspective were strongly influenced by the pioneering work of Reed (1981) using multivariate analysis of banking, financial and a range of other variables to determine rankings as international financial centres; Friedmann (1986) focussing on world cities as control centres in a new international division of labour; Sassen's (1991) views on the emergence of global cities in a globalised world economy; and the compilation of an initial roster of world cities in terms of their provision of corporate services by Beaverstock, Smith & Taylor (1999). Sassen (2012) identified the three important characteristics of contemporary global cities as command points in the organization of the world economy, key locations for the leading industries of finance and specialised services, and major sites for the production of innovation. Similar to the limited relocation of production processes to African cities, very few African cities have established themselves as global command points in the global economy. According to the most recent 2016 classification of world city

status⁷ by the authoritative Globalisation and World Cities Research Network (2018), only one of the 49 cities classified as Alpha cities were located in Africa (Johannesburg).

The growing importance of globalisation, Post-Fordism, and emergence of global world cities does not necessarily imply a complete global reduction of manufacturing and industrial activities in absolute terms at the expense of advanced producer services. For example, the total world steel production continued to increase from approximately 770 million tons in 1990 (when the concept of globalisation started gaining rapid momentum) and continued to increase to as much as 1689 million tons in 2017. Even over the latest ten year period between 2007 and 2017 the production increased from 1348 million to 1689 million tons (World Steel Association 2018). The spatial global pattern of production however changed dramatically over the same period. In 1990, China only produced 8% of the total world steel production – a figure that increased dramatically to 49% by 2017 (World Steel Association 2018).

This process of globalisation implies that national and local urban economies are also increasingly influenced by international influences and trade agreements. The term glocalization as a blend of ‘global’ and ‘local’ emerged during the 1980s and refers to the adaptation of goods and services on a global basis to increasingly differentiated local markets (Robertson 1995). It also refers to the impact of globalisation mediated by local factors and influences. The recent US-China ‘trade war’ sparked by allegations of intellectual property theft by China clearly illustrates the local level impacts of global events. This trade war manifested in the imposition of a number of reciprocal tariffs on imports between the two countries (initiated by the introduction of US tariffs on all imports of steel and aluminium from China) since March 2018 (Bryan 2018). These measures could potentially result in the relocation of factories and distribution centres from China and could arguably even mean that some of the steel manufacturing activities that relocated from the US under the ‘post-Fordist’ banner may be reintroduced in the US (with the obvious economic and spatial implications at an urban scale in both countries). In addition, global companies such as Apple that invest and operate in both countries may be affected to the extent that users of their products around the world may be influenced (Yueh 2018). Countries with relatively small but open economies such as Taiwan, Singapore and Malaysia will be most affected by US tariffs on imports from China as a result of their role in global supply chains, while countries such as Chile providing most of the copper for China’s electric sector will also be negatively affected (Isa 2018). The influence of these trade agreements also have local urban level influences in South Africa. A good example is the BMW manufacturing plant in Rosslyn in the Tshwane metropolitan area. The Tshwane Metropolitan SDF identified automotives and components as one of the city’s priority investment sectors and Rosslyn as a specific spatial growth node playing an important role in the spatial

⁷ Based upon the analysis of the office networks of 175 advanced producer service firms in 707 cities worldwide. This analysis classifies these cities into four levels of world city network integration. In descending order of integration these are referred to as alpha, beta, and gamma level cities and a fourth category described as ‘cities with sufficiency of services’ (Global World Cities Research Network 2018)

development concept of the city (City of Tshwane 2012). The new tariffs introduced by the US on steel and aluminium products during 2018 significantly influenced this plant which could previously export duty free to the US under the African Growth and Opportunity Act. This plant for years exported approximately 3000 cars with smaller engines per month to the US, but this figure has reportedly in September 2018 dropped to nearly zero. BMW hence adapted this plant to export different models to the European market (van Rensburg 2018).

A further example of the impact of global markets on local spatial development is the intermediate city of Rustenburg. The increasing demand for platinum and platinum prices in international markets fuelled explosive growth in this municipality in the late 1990's and the first decade of the 21st century. The platinum price however declined from levels between \$1300 and \$1500 per ounce over the period 2009 to 2014 (after peaking at levels in excess of \$2000 during 2008), to levels generally below \$1000 since early 2016 (APMEX 2018). These declining prices, together with large scale labour unrests in the area resulted in a sharp decline in population growth rates from an annual average of 4.2% over the period 2001 to 2011 to 2.8% over the period 2011 to 2016 (Statistics SA 2011; Statistics SA 2016). The average annual economic growth rate (measured as Gross Value Added expressed in basic constant 2010 prices) also declined from an average of 3.6% per annum over the period 2001 to 2011 to a negative economic growth rate of approximately -1.6% per annum between 2011 and 2016 (Quantec 2018). This resulted in a significant review of the extent of planned spatial developments as identified in the 2010 version of the municipal SDF.

2.2.2.3 Technological changes

Technological changes are often integral to economic changes and have both global and local impacts. The impact of technological development at a global scale is most notable in the development of information and telecommunication technology (ICT) and its impact on the division of labour. Advances in ICT has made certain segments of the labour market more geographically independent. It also affects the demographic structure of urban populations with more households becoming multi-wage earners and the numbers of single-wage nuclear families are decreasing (Davidson & Rees-Mogg 1998). At a global scale, these advances in information technology opened up numerous opportunities for migrants from the Global South (Geyer 2011), especially those that established themselves as important centres for the accumulation of advanced producer services.

Technological changes also influence urban form at a local level. Examples of these include developments in transportation technology and its effect on suburbanisation and the introduction of high-speed elevators that facilitated the development of high-rise buildings (Pacione 2009a). Although the growth of ICT in most cities around the world has contributed to the large-scale decentralization of commercial land uses to less congested and lower cost areas, it has certainly not been the only factor

(also see Sections 2.4.2 and 2.4.3 dealing with agglomeration and decentralization processes). This decentralization led to a widely held view that location no longer matters. Sassen (2001) however rightly pointed out that this is only part of the argument. Parallel to these decentralization trends are the growing spatial concentration of a wide range of highly specialized professional activities and top-level management and control operations, and the growth of smaller highly specialized and high-profit firms in downtown areas. Advances in vehicle manufacturing is a technological development with significant impact on urban form that is often overlooked. The production of cheaper and more reliable cars plays a significant role in urban expansion (Glaeser & Kahn 2004). These factors result in a general willingness to live further away from work and larger commuting distances becoming more acceptable to individuals and households. National level policies such as fuel taxes and levies, and local policies such as parking costs and investment in road infrastructure will influence the attractiveness of commuting by car (OECD 2018).

2.2.2.4 Land value and bid rent

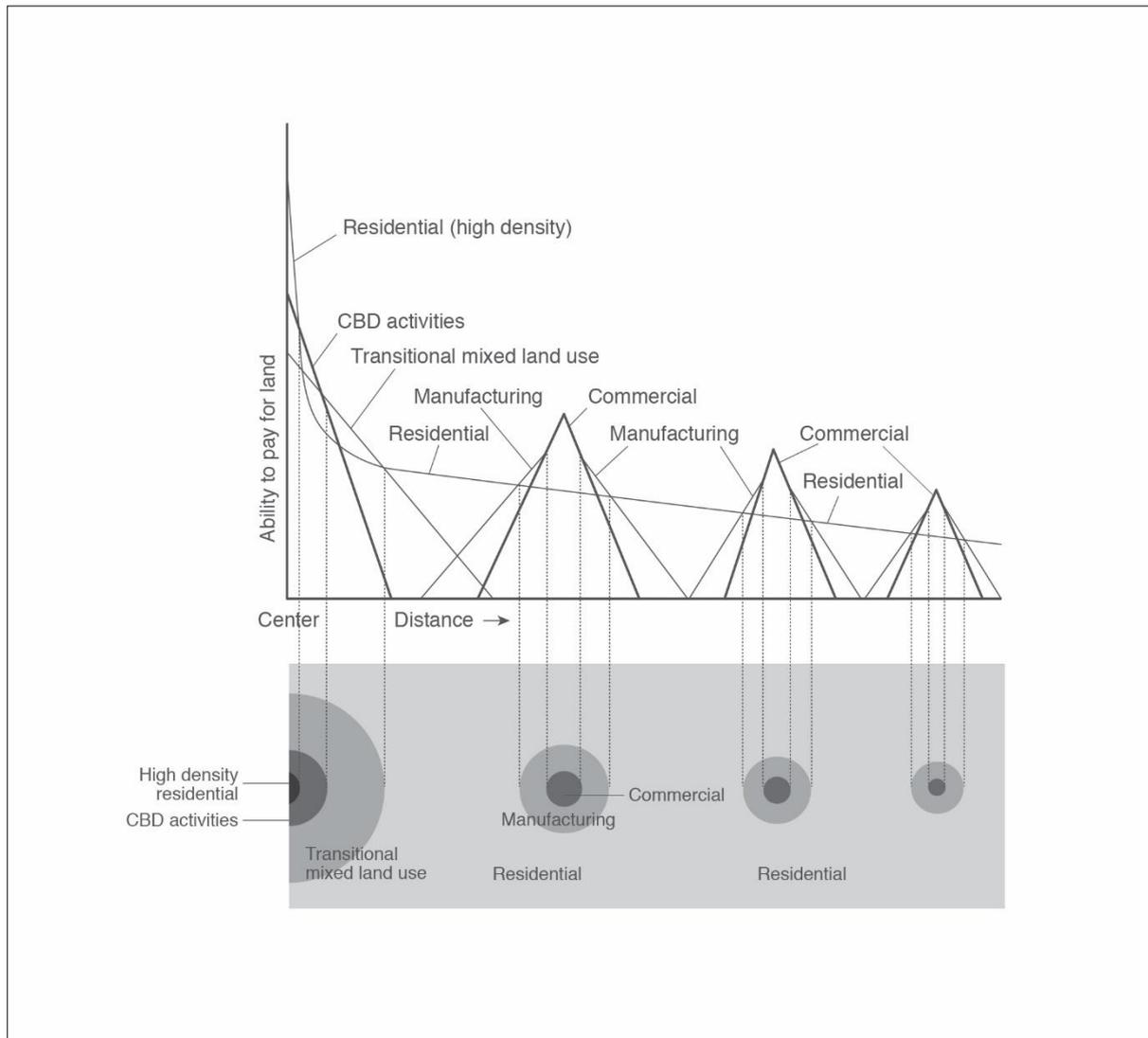
One of the most fundamental drivers of urban structure at a local level is land price or land rent relevant to location. Von Thünen introduced the original concept of the relationship between land rent and location and considered the type of development that would occur at various distances from an isolated town on a featureless plain. Haig (1926) in an attempt to establish a connection between the work of city planners and economists identified the importance of what he referred to as the ‘territorial patterns’ of economic activities in a metropolis. His point of departure was that possible sources of raw materials and the transportation problem involved in concentrating them at various points would reveal potential urban sites. He regarded transportation advantages as the main determining factor of these locations. His argument was that the spatial pattern of economic activities will be the one “...which makes maximum use of territorial specialization within the limits set by the available means of transportation. The most favoured spots are those from which the richest resources can be tapped with the lowest transportation costs. At such points would develop the great cities” (Haig 1926:186). He argued that the best location of all business functions (except the extractive and transportation functions) to be at the concentration points in urban areas, while processes of fabrication are carried out more economically outside the urban centres. The latter is influenced by the perishability and variation in bulk and weight as a result of the manufacturing process, as well as the cost of transportation.

Alonso (1964) presented an alternative (but complementary) theory to the phenomenon of land values that tend to decrease with distance from the centre of the city, while household income tends to rise. The traditional concentric zone theory of Burgess (1925) (which Alonso referred to as ‘historical theory’) explains this phenomenon in terms of a filtering process or trickle-down theory in the housing market according to which new houses (mostly on the urban periphery) are built only for the higher income groups but in time through a trickle down process are occupied by lower income groups. Alonso

however provided an alternative explanation that he described as the ‘structural theory’. When simultaneously considering the value of land, the cost of commuting, and travel and space preferences he observed that there is a general preference for ample space over shorter journey-to-work in American cities. This implies that more distant but cheaper sites (in terms of cost per area) are more attractive to the wealthy than to the poor. His explanation of the more-land-but-less-accessibility phenomenon represents the interplay between personal preferences, costs, and income in the structure of the market. According to this structural theory of Alonso, cities that develop at a rate where housing structures had no time to age and evolve as postulated in the ‘historical theory’ would still show the same basic urban form: low income near the centre and high income further out. Alonso in 1964 hence formalized the earlier principles of Von Thünen of urban development and defined the concept of bid-rent. The concept of bid-rent is based on the principle that the land use that provides the highest revenue at a particular location will outbid all other uses. This generally implies that productive land uses generate greater revenue per unit of land than residential uses. The result is that central business districts hence mostly contain businesses uses and relatively fewer residential units. Bid-rent theory can however also predict settlement patterns where households can trade off location costs with transportation costs. This implies that lower income households with limited ability to spend on transportation costs will wish to be within easy access to employment and services and may consequently be willing to bid more per unit of land than richer households (Green 2012). Many cities thus have poor people living in city centres at very high densities (and often of poor quality). As illustrated on Figure 2.2 residential uses can thus also compete with commercial uses in city centres when densities are increased sufficiently, or alternatively in the form of lower densities with enhanced environmental qualities such as securitised residential developments (Geyer 2007a). The basic reasoning in bid-rent models applicable to monocentric city structures can also be extended to be applicable to polycentric city structures.

Despite the relevance and wide application of the principles of bid-rent models in urban studies it has also been criticised for its assumptions such as the CBD as the dominant employment force, equal transportation access throughout the city, and reliance on pure market conditions of supply and demand. The concept of market equilibrium implying a consensus position which conceals the reality of power relations at play in urban development has also been criticised (Ley & Mercer 1980). There are also conditions that may contribute to the postponement of development of apparent profitable vacant land as a result of land speculation in cases where three contributing factors co-exist (OECD 2018):

- where the land use type that maximise present value of profits in the short and long term are different;
- where the preferred long term land use is not profitable in the short term; and
- Where the conversion costs from development of short term profit-maximising use to another type of land use through demolishment and replacement are prohibitively high.



Source: Adapted from Clark 2000

Figure 2.2: Bid-rent model of urban land use in polycentric city structures

These conditions imply that a current fragmented urban structure may in fact represent a logical step in an economically efficient long-term process of urban land transformation (OECD 2018). It also implies that spatial planning policies resulting in the reduction of available developable land (such as policies aimed at achieving a more compact urban structure) contribute to subsequent increases in property values (Steyn & Geyer 2011). These high property values in central city locations forces higher density or higher-income housing (or both) to overcome the impact of high land prices. One of the results is that affordable housing is often developed at decentralised locations on cheaper land, which is the opposite outcome than that envisaged by many spatial development policies and plans (Geyer 2007a). The analysis of land use change since 1994 in the cities forming part of this analysis (see Appendix A) clearly indicates some manifestation of this aspect. In the four largest metropolitan cities analysed (Johannesburg, Cape Town, Tshwane & eThekweni), as well as in some of the secondary cities such as Pietermaritzburg and Bloemfontein, the development of affordable informal residential areas almost exclusively occurred at peripheral locations. Although land price clearly plays a major role when

considering these spatial patterns, it is not the only factor at play in determining these patterns. It has been found that historical path dependency is also an important factor determining the location of informal residential areas in South African cities (Geyer et al. 2014; Mohale, Geyer & Geyer Jr 2016).

2.2.2.5 Friction costs

Transport and commuting costs are one of the longest standing and important factors explaining differences in urban spatial structure. As is the case with the bid-rent theory it dates back to the work of Von Thünen in the 19th century who identified commuting cost as a reason for land prices to rise in areas located close to the centre of a city, and Haig (1926) who regarded transportation advantages as the main determining factor of the location of urban sites. This friction cost is a function of distance and is influenced by the concept of 'nearness' that is perceived and valued differently by different individuals (Geyer 2009). This could for example refer to nearness to place of work or specific types of social facilities or public transport facilities. This friction of distance is the mechanism through which the effect of nearness to an amenity of value (e.g. place of work or specific types of social facilities) is measured and operationalised (Geyer 2009). Differentiated friction costs contribute to centripetal and centrifugal forces influencing urban spatial patterns.

The concept of friction cost is also closely associated with the co-location hypothesis based on the job-housing balance according to which residents and workers will change their residence and workplace (or both) to adapt to situations of increasing congestion (Kim 2008). Some research found that the co-location of jobs and housing as part of the suburbanization process have mitigated congestion in urban areas with polycentric and dispersed structures by facilitating shorter commuting times and distances (Gordon, Kumar & Richardson 1989; Crane & Chatman 2003). Other studies also found that average automobile commute times either fell by a statistically significant amount or remained the same in the 20 largest metropolitan areas of the US in the 1980s (Gordon, Richardson & Jun 1991). A study into the job-employment imbalance and travel times in the Gauteng City Region also indicated that workers in housing-rich areas (peripheral parts of the City Region) are associated with longer average travel times than workers in job-rich areas (concentrated in the city centre) and balanced areas (Geyer & Molayi 2018). This co-location hypothesis is however not universally supported and other authors established increases in average commuting time and distance with higher levels of employment decentralization (Hamilton & Röell 1982; Cervero & Wu 1998) or stable average commute time and distance regardless of residence and workplace mobility (Kim 2008).

The co-location hypothesis is only possible in a free-market system where workers can freely choose their housing location and firms can make rational locational decisions (Zhao, Lü & De Roo 2011). However, in cities in many developing countries, workers are not able to freely choose housing locations due to affordability constraints and the co-location hypothesis will thus not be applicable in these

circumstances. There is also evidence that commuters do not always consider trip distance minimization as the primary factor in deciding their residential locations, workplaces or commuting routes (Sohn 2005). The jobs-housing balance only has a statistically significant association with the commuting time of workers when factors such as population density, transport accessibility, and socio-economic characteristics of workers are also controlled for (Zhao, Lü & De Roo 2011)

The concept of friction cost holds significant implications for urban spatial planning policies and concepts, especially those that advocates in favour of more compact urban forms and higher densities. In many monocentric cities the emergence of negative externalities resulting from the process of invasion and succession leads to increasing commuting costs to reach city centres and hence the emergence of sub-urban nodes. Some of these sub-urban nodes grow to the extent of competing with traditional city centres (a good example is the growth of Sandton City in Gauteng relative to the traditional Johannesburg central city) in becoming what Garreau (1991) referred to as edge cities⁸ (Geyer 2007b). The unit cost of infrastructure at increasing distances from the traditional city centres also represent a different form of friction cost. Decreases in the unit costs of infrastructure development closer to city centres is an argument often used in support of policies of compact urban form and higher densities. Biermann (2000) however found that only some per capita costs decrease with increasing densities and that centrally located areas can be as costly to develop as more peripheral locations due to factors such as existing spare capacities and environmental and land use characteristics.

2.2.2.6 Land-use specific intra-city locational factors

In addition to the general principles and factors outlined in the preceding sections applicable to overall urban structure, there are also distinctive factors that influence the location and development of specific individual urban land use components such as the industrial and retail components. A comprehensive review and analysis of commercial and industrial location theory falls outside the scope and objectives of this research. It is however instructive to briefly highlight a number of trigger factors influencing the location of the industrial and retail components of cities specifically.

A wide body of literature exists to explain the phenomenon of industrial location and the forces shaping the location and spread of industrial development. Many of the principles of industrial location theory are based on Weber's location production theory to maximise the profits of firms by determining the minimum transport cost location in a two-dimensional space where the market and the sites of localized resources are given (Tellier 1972). Fundamental factors influencing traditional industrial location has also been identified by Renner (1947) and Rawstron (1958). Renner (1947) identified the ingredients required to undertake any industrial activity (and thus influencing location decisions) as raw materials,

⁸ The original criteria for defining edge cities are more fully described in Section 2.4.3

market, labour, power, capital and transportation. Rawstron (1958) identified similar drivers of locational decision making but from the perspective of the types of restrictions influencing the choice of industrial location. These include physical restrictions, economic restrictions, and technical restrictions. Physical restrictions include factors such as the availability and suitability of land (e.g. topography), extraction costs and the transportability of raw materials. The economic restrictions influencing locational cost include labour requirements, material needs, the attributes of land, and marketing and capital requirements. Technical restrictions refer to the methods of production with the frequency of technical innovation influencing the importance of locational decisions. Scott (1982) identified the triggers leading to decentralisation of industries away from central urban areas as the lack of space for expansion at inner city locations, traffic congestion, high land prices and tax rates at central locations, and technological innovation leading to obsolete central plant and equipment. The pull factors resulting in the increasing attractiveness of peripheral areas for industrial decentralisation include aspects such as the increasing spatial coverage of freeway systems, more affordable land prices at suburban locations, decentralisation of the labour force, and in many instances the proximity to airports (Scott, 1982).

Based on their research on the dispersion of employment in Los Angeles, Gordon & Richardson (1996) formulated a hypothesis of a more generalized dispersion of employment in metropolitan areas. They argued that agglomeration activities are possible throughout metropolitan regions due to the levels of access provided by automobiles. The driving forces of dispersion include the mitigation of congestion costs, technical changes resulting in the emergence and growth of outsourcing, and changes in the labour market reflected by the increasing reliance on part-time and temporary workers. They found that the share of jobs in downtown areas and major sub-centres of Los Angeles were small and declining over the period 1970 to 1990. They argued that this trend may be indicative of change towards a more uniformly dispersed spatial structure rather than dispersed clustering in a limited number of major sub-centres as postulated by the concept of polycentricity (Gordon & Richardson 1996).

There is, however, also a concurrent re-emergence of spatial agglomeration of some specialised industries in districts and clusters in the post-Fordist era. The ability of industrial regions to transform themselves into these new types of industries is determined by the complex interaction of multiple regional and national forces including corporate strategies, industrial cycles, state priorities, and regional politics (Markusen, 1996). It is also determined by local factors arising from concentrations of highly specialized skills and knowledge institutions, rivals, related businesses, and sophisticated customers (Porter 1998). The focus of industrial regions is increasingly shifting towards access to specialist knowledge and learning, rather than the traditional factors such as access to raw materials, land and energy (Henry & Dawley 2011). This trend is also informed by new patterns of market demand and consumption characterised by segmented or niche markets and the shortening product life cycles. The combined impact of these factors resulted in the emergence of three new types of industrial spaces

(Henry & Dawley 2011). The first is referred to as ‘new industrial districts’ and consists of dense agglomerations of small and medium-sized firms specialising in high-quality production of particular goods or services. The second is high technology sunbelt areas characterised by a diverse range of technopoles, corridors and innovative complexes growing through the capture of the sunrise high technology industries (e.g. biotechnology and ICT). The third type is flexible production enclaves within old industrial regions consisting of a diverse set of hotspots of economic development in cities at the centre of previous geographies of economic decline, often associated with creative industries.

Similar to the industrial sector, the retail component of cities are also continuously adapting and responding to trigger factors such as changing demographic conditions, consumer behaviour, and economic conditions. On the demand side, these triggers include aspects such as suburbanisation of population, changing consumer preferences, changing levels of purchasing power, increased mobility, and behaviour and demographic transitions within the service areas of commercial centres. From a supply perspective retailers are simultaneously also responding to increasing competition and the impact of new technology such as on-line shopping (Borchert 1998). The overall decentralisation of retail and industrial location is clearly prevalent in the results of the land use change analysis in the South African cities analysed in this research. The results contained in Appendix A indicate that the main trend of commercial and industrial development since 1994 in the four metropolitan cities analysed has been towards large new decentralised commercial and industrial nodes. In the case of commercial development these new nodes also exhibit a very clear correlation with the development of new medium and higher income residential areas.

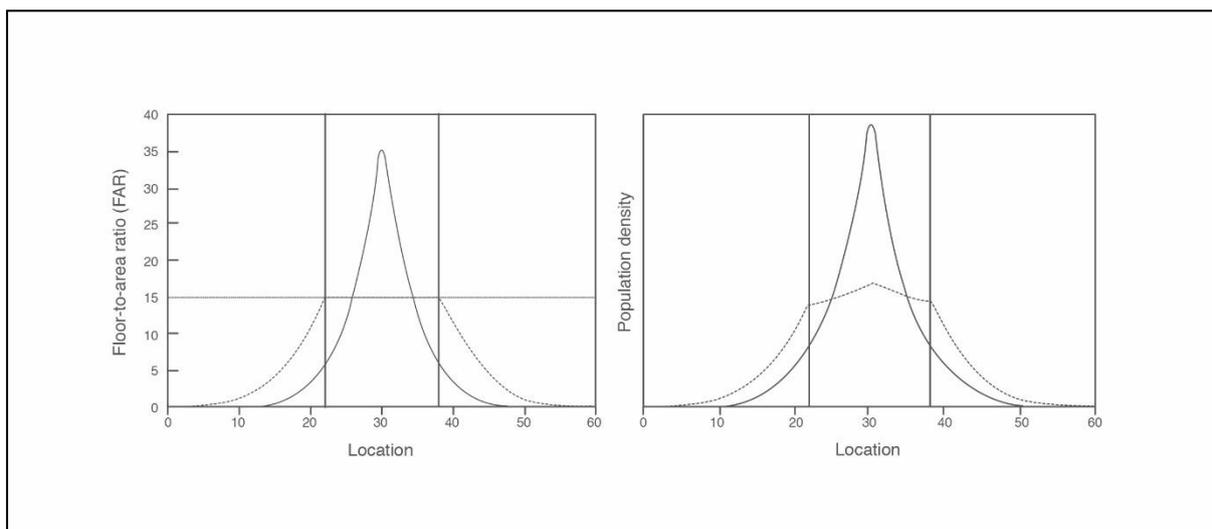
2.2.3 Institutional factors

Spatial and land use patterns are not only determined by market forces and social organization processes but are also mediated through institutional processes such as land use regulations, infrastructure investments decisions, and taxes (Ley & Mercer 1980; Bertaud 2004). These processes are influenced by the behaviour of and interaction between the direct agents of change in urban areas (such as architects, developers, and builders) and the indirect agents (planners and politicians) (Oliveira 2016). The behaviour of these agents are guided by overall national (or international level) political and planning ideologies (as described in Sections 2.2.1 and 2.2.2), as well as through regional and local institutionalised urban planning processes and policies. The institutional environment within which the local spatial planning processes are embedded determines how they function and operate. In many instances this institutional environment is characterized by a specific ‘planning doctrine’⁹ that represents a certain ideology, set of values or normative aims that can be regarded as the accepted norm. For example, encouraging and supporting higher population densities, often in pursuance of transit oriented

⁹ The concept of a ‘planning doctrine’ is further discussed in more detail in Chapters 3 and 4.

development, and urban containment mechanisms such as ‘urban growth boundaries’ are widely recommended as a spatial planning policy by many cities around the world. These policies are however often not feasible to achieve in practical terms in specific local circumstances. Bertaud (2004) for example illustrated that for the city of Atlanta in the United States to reach the often used target of 30 persons per hectare over a period of 20 years, assuming that the historical population growth rate continues uninterrupted, the existing built-up area would actually have to shrink by 67%. The notion of more compact urban structures and increased population densities, especially in central city areas, also forms a key component of the South African spatial planning doctrine described in Chapter 3. Turok (2011) convincingly argued that the aim of increased population densities in central parts of South African cities such as Cape Town is a complex challenge that extends beyond the mere technical issue of providing more homes. One of the specific challenges identified is the tension between the different goals of accommodating low-income groups whose choices are limited by affordability constraints, attracting middle- and high income families with a choice of where to live, and providing flexible space for business and related activities.

Apart from macro-level policies as reflected in city-wide SDFs and frameworks making use of planning concepts such as development corridors, urban development boundaries and mixed-land use zones, more detailed local level land use policies and mechanisms play an equally important role. Provisions such as Floor Area Ratios (FARs) and building height restrictions can significantly affect city-wide urban footprints. The application of more stringent building height restrictions will for example result in a more dispersed urban footprint (OECD 2018). The impact of building height restrictions (dashed line) compared to no building height restrictions (solid line) on the extent of the urban footprint is illustrated on Figure 2.3.



Source: OECD, 2018.

Figure 2.3: Long-term effect of building height restriction on city footprint and population density

Urban containment mechanisms such as ‘urban growth boundaries’ and ‘greenbelts’ are also widely used as planning instruments (including in many South African cities) to limit the lateral expansion of urban footprints. It is not the intention to discuss the merits of this particular instrument or the extensive debates regarding its advantages and disadvantages here. The purpose is to illustrate the trade-off between short and long-term costs and benefits resulting from the implementation of such planning instruments and their impact on the development of urban form. The short-term impact of these types of instruments is that population growth will mostly take the form of urban development within the existing urban area but with an accompanying increase in housing prices. These upward pressures on land prices may eventually in the longer term result in ‘leapfrog’ development outside the urban edge or greenbelt. This will happen when the return from developing in remote areas will exceed the cost of alternative non-urban land uses in these locations (OECD 2018). The short term benefits of such policies may thus in the longer term have the opposite effects than originally intended. The structuring of property tax rates that influences the cost of property ownership and land prices also further influences these effects.

The operational environment within which the local spatial plans and policies are prepared, implemented and monitored also influences the level of impact of these types of policy instruments on urban form. This includes both the overall organizational quality of the wider local government organization of which the planning function forms part of, and the planning service quality itself. Planning service quality includes the operation of the planning service itself, both within and outside of the statutory processes (Carmona & Sieh 2005). The performance of the planning process in determining plan success is thus determined by the skills, leadership, and financial resources at its disposal (both within planning function and within the organization at large) and the extent to which it is able to integrate its functions with other local authority activities in order to deliver its aspirations (Beckford 2002).

The influence of spatial planning is however not only shaped by the technical elements and processes involved, but also the concept of communicative planning where communication between planners and stakeholders and interest groups aimed at debating ideas and reaching consensus on a course of action is viewed as the most important element of planning practice (Watson 2002a). This communicative process can however also assume a political nature highlighting the issue of power relationships in planning. Of particular relevance to the manifestation of urban form is that in a diverse (and often fragmented) society, charismatic individuals can challenge the bureaucratic state. This concept manifests in urban communities in the form of interest or pressure groups (often disguised in the form of lobby groups) influencing the decisions affecting spatial and physical development of urban areas, often in support of the interests of a specific group. These individual decisions do not necessarily change the overall trajectory of urban development (unless in the form of a ‘mega-project’ or a ‘game-changer’) but cumulatively influences the evolution of urban spatial form over time. Forester (1999) hence identified the ability of planners to examine issues of power as a key element of improved planning practice where the skills of planners extend beyond mere technical knowledge to also include the ability

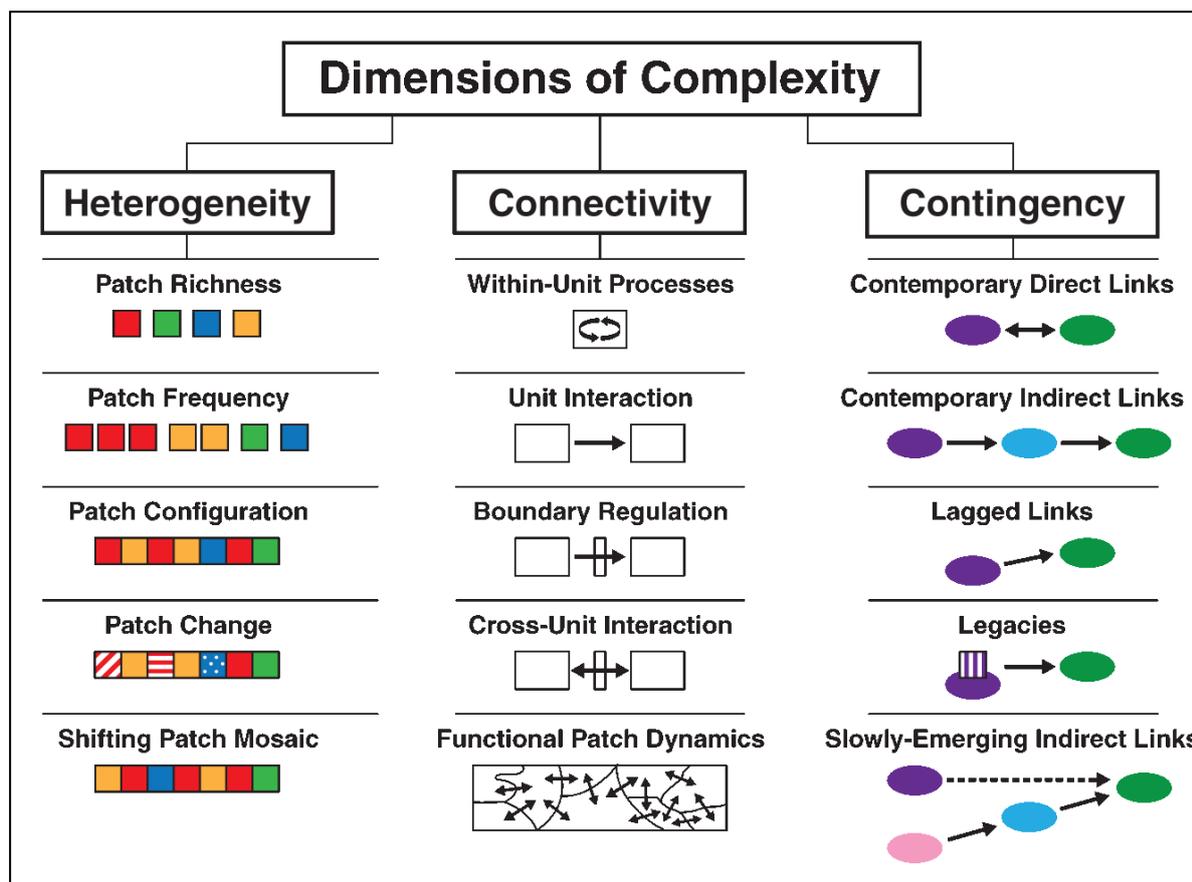
to anticipate the political processes, local personalities and neighbourhood history that might be of relevance in specific spatial localities.

2.2.4 Ecological factors

Cities have historically mostly been theorized by social scientists and economists as described in Sections 2.2.1 and 2.2.2. The recognition that urban social and ecological life are inseparable modes of existence that are dynamically produced in space and time however contributed to an improved interdisciplinary understanding of these different spheres (Niemelä 1999). The concept of urban ecology obtained specific prominence through the Baltimore school of urban ecology that views nature not only as the environment which is a mode of life separate from society, but focusses on urban social-ecological relations and processes of change ('ecology of the city' as opposed to ecology 'in the city') (Grove et al 2015). One of the important propositions of the Baltimore school of urban ecology is that the ecology of cities are not only confined to 'green spaces', but are concerned with the complete mosaic of land uses and their management in urban systems. Their framework for understanding the complexity of social-ecological systems includes the three dimensions of spatial heterogeneity, organizational connectivity, and temporal contingency.

The components of this framework as depicted in Figure 2.4 increase in complexity from top to bottom. For example, the complexity of spatial heterogeneity increases as quantification moves from patch richness, frequency, and configuration, to patch change and, at the highest level of complexity, the shifts in the patch mosaic. Complexity in organizational connectivity increases from within-unit processes, to the interaction of units and the regulation of that interaction, and to functional patch dynamics. Historical contingency increases in complexity from contemporary direct effects, through lags and legacies, to the highest level of complexity that includes slowly emerging indirect effects (Grove at 2015).

The concept of 'urban ecology' is diverse and complex and associated with different interpretations (Niemelä 1999) such as those of early social ecologists like Burgess from the Chicago School, the European pioneers of urban ecology, and the more recent American interdisciplinary urban ecology teams (Marzluff et al. 2008). In Europe, urban ecological research has traditionally focused on the biota of urban areas (especially flora), while North American research has been more oriented towards social sciences (Niemelä 1999).



Source: Grove et al. 2015

Figure 2.4: Framework for complexity of social-ecological systems

Marzluff et al. (2008: vii) defines urban ecology as "...the study of ecosystems that include humans living in cities and urbanizing landscapes" and identified three views of urban ecology. The first view regards urban ecology as primarily concerned with the ecology and evolution of organisms that live within city boundaries, while the second view considers it as the biological, political, economic, and cultural ecology of humans in urban settings. The third view considers cities as phenomena consisting of linked human and natural processes with implications for the evolution and survival of human and other species. The third view provides the point of departure for the Human Ecosystem Model (HEM) that describes the results of the interactions between the human and natural processes. The Human Ecosystem model as a process is discussed in more detail in Section 2.4.7.

2.3 LOCALLY AND HISTORICALLY CONTINGENT FACTORS

Urban change cannot be explained purely through a structural interpretation of prevalent social organization processes, dominant mode of production (whether capitalist or other), or institutional structures but must also consider the way in which these processes (and the interaction between these processes) are rooted in and influenced by locally and historically specific settings and contingent factors (Persky & Wiewel 1994). These can range from factors at a planetary scale such as global warming to

local factors such as the biophysical environment. The local biophysical environment largely determines the suitability of individual land parcels for specific land uses and include factors such as local topography, soil and geotechnical conditions, water sources, flood lines, and environmental sensitivity. These factors may prohibit urban development in certain areas or result in specific limiting development parameters imposing thresholds for aspects such as stand sizes, building heights and population densities. Physical constraints result in both direct impacts (extent of developable land available) and indirect impacts influencing land prices (OECD 2018). Site-specific characteristics can also include factors such as accessibility to transport and municipal infrastructure, social amenities, specialised labour, markets and sources of raw materials. Saiz (2010) found that the proportion of land unavailable for urban development (including physical and regulatory constraints) within a 50 km radius of all metropolitan Statistical Areas in the United States with a population in excess of 500 000 in the year 2000 ranged from as little as 0.93% to as much as 79.6 %. The urban footprint and growth patterns of the South African cities analysed as part of this research (see Appendix A) on face value reflect elements of a ‘fragmented’ urban structure. A significant proportion of the undeveloped parts of these urban footprints are however impacted by physical constraints such as historical mining areas in Johannesburg and existing mining areas in Witbank, environmentally sensitive areas and physical constraints in Cape Town, and topographical constraints in eThekweni and Pietermaritzburg. These locally contingent factors thus impact on the relevance and applicability of widely supported normative planning concepts such as ‘compact development’ and ‘densification’ to local circumstances.

Although no longer in operation, the effects of historical policy and planning practices and choices can have long lasting effects on urban structure through path dependent processes. A good example of the impact of historically different patterns of development is the spatial differences between North American and European cities. Many European cities have their origin in medieval towns and villages while American cities generally originated in era of commercial capitalism and speculative land development (OECD 2018). These different historical starting points are partly responsible for different perceptions of what constitutes appropriate land use policies. Residents of European cities generally place a higher premium on collective open space and communality while American citizens in contrast favour privacy (Fainstein & Campbell, 2012). Historical factors are of particular relevance in the South African context where urban growth and development was substantially influenced by historical colonial and political ideologies. These historical factors influenced South African urban spatial patterns and urban structures that became widely associated with the term ‘apartheid city.’ These historical factors are described in detail in Chapter 3.

2.4 SPATIAL ORGANIZATION PROCESSES

The major trigger factors driving the processes that shape urban development were discussed in Section 2.2 and the locally and historically contingent factors that mediate these factors in Section 2.3. This section focusses on some key resulting from these trigger factors.

2.4.1 Migration processes at inter-urban and intra-urban scale

In line with the basic concept of push and pull factors driving migration (both at an inter-urban and intra-urban scale) personal preferences play an important role in the physical growth of cities. The concept of a spatial reward determined by these push and pull factors at destination and source areas is a central element in most theories of migration decision making (Arango 2000) and leads to migration patterns both between and within cities. These push and pull factors, and the elements of spatial reward, are in turn driven and influenced by the triggers and conditions outlined in Sections 2.2 and 2.3. The synthetic model of migration (Gelderblom 2006) attempts to bring together these push and pull factors with the influencing triggers and conditions as outlined in the preceding sections into a single conceptual model and specifies their mutual relationships. The key factors of this conceptual model include a spatial reward structure determined by the interaction of individual characteristics and rewards, structural variables of decision-making, information sources, motivations and decision-making, and filters. The spatial reward structure dictates that migration is due to a spatial disequilibrium of socio-economic and political development (Gelderblom 2006).

Two primary underlying concepts in the triggering of migration decisions is productionism and environmentalism. Productionism is driven by economic motivations such as more employment opportunities, higher wages, and better service provision, while environmentalism is motivated by increased environmental qualities and lower congestion costs (Geyer 1996). At an intra-urban level many households value aspects such as proximity and access to open space, lower noise levels, and scenic landscapes and will be willing to pay for these attributes in lower density parts of cities (Gordon & Richardson 1997), whilst others will be seeking locations optimising access to potential economic opportunities. The differential urbanisation model links production-driven and environmental-driven migration with the concepts of mainstream and sub-stream migration (Geyer et al. 2012). This model provides a dynamic framework that reflects the combined outcome of individual migration decisions influenced by a mixture of social and economic factors with diverse impacts on different socio-economic groups at different points in time. Although the model is particularly relevant in explaining migration patterns at a national scale, it is also relevant at an intra-urban scale to explain both population settlement patterns, as well commercial and industrial location patterns resulting from migratory processes. As indicated by the spatial analysis results contained in Appendix A, there is a general tendency towards decentralised development in the fringe and peripheral areas of all the South African cities analysed. From a differential urbanisation perspective this is informed by two processes (Geyer et al. 2012).

Firstly, although urbanisation is fundamentally aimed at settlement in inner-city areas in response to productionist motivations, historic path dependencies in South African cities have resulted in deflected urbanisation of low-income urban migrants along the urban fringe. Secondly, environmentalism as a driver of middle to high-income migration resulted in decentralisation away from inner city areas towards the fringe areas of cities, as well as to satellite cities and intermediate-sized cities located near the metropolitan daily urban systems (Geyer & Geyer, 2016). Most of these factors at play in productionism and environmentalism can be traced back to the trigger factors described in Section 2.2.

2.4.2 Agglomeration

The concept of New economic geography (NEG) is primarily concerned with where and why economic activity takes place and provides an explanation for the formation of a large variety of economic agglomeration (or concentration) in geographical space. The concept of NEG evolved over three stages (Martin 2011). The first generation in the early 1990s focussed on the initial development of the concept by Krugman (1991) focussing on the basic core-periphery model. The second generation emerged during the mid- to late 1990s and elaborated on the basic model to extend its application to regional development, the emergence of cities and urban systems, local economic specialization, and the formation of industrial clusters. The third generation emerged from the 2000s onwards and included further developments such as endogenous technical change and knowledge spill overs.

The various different types of agglomeration at different geographic levels are embedded in a larger economy and together forms a complex system reflected by urban economics, location theory and international trade (Fujita & Krugman 2004). Agglomeration, or the clustering of economic activity, occurs at many geographical levels and is the result of both agglomeration (centripetal) and dispersion (centrifugal) forces associated with the triggers and factors described in Sections 2.2 and 2.3. The centripetal forces include factors such as information spill overs, the size of local markets creating both 'backward' and 'forward' linkages, and industrial concentration supporting thick local labour markets (especially for specialized skills) where it is easier for employees to find employers and vice versa. The centrifugal forces include immobile factors such as land and natural resources, concentrations of economic activity generating increased demand for local land resulting in higher land rents, and concentrations of activity generating external diseconomies such as congestion (Krugman 1998). The manifestation of these spatial patterns of economic agglomeration in South African metropolitan cities are clearly depicted on Figure C3 in Appendix C. This figure illustrates the statistical significance of the observed spatial patterns of growth in economic activity density as determined by the application of the Anselin Local Moran I technique ('cluster-outlier' analyses). These results indicate clearly defined and

statistically significant emerging spatial clusters of economic activity density (commercial and industrial) over the period between 1994 and 2010 in four of South Africa's largest metropolitan cities¹⁰.

2.4.3 Decentralization

Joel Garreau (1991) described various forms of decentralization processes in large metropolitan areas in terms of three waves of urban living. The first wave is represented by the large scale suburbanization of population, followed by a second wave described as the resultant move of marketplaces to suburban areas – also referred to as the so-called ‘mallings’ in the case of American cities. He developed the term ‘Edge City’ to describe the third wave of urban living represented by the large scale suburbanization of employment. Many of these edge cities developed at or near existing or planned freeway intersections or major airports. Garreau identified five criteria for the identification of these edge cities (Garreau 1991:6-7):

- At least five million square feet¹¹ of leasable office space (referred to as the workplace of the information age).
- At least 600,000 square feet¹² or more of leasable retail space.
- More jobs than bedrooms.
- Is generally perceived by the population as one place.
- Did not have the characteristics of a "city" as recently as 30 years ago.

These edge cities often also form part of the governance structures of surrounding counties or municipalities, rather than the city they are primarily associated with.

Gordon & Richardson (1996) however presented a somewhat different view on this process of decentralisation of employment by hypothesizing a more uniformly dispersed spatial structure rather than clustering in major sub centres as espoused in the concept of polycentricity or Garreau's edge cities. Based on their research on the dispersion of employment in Los Angeles they formulated a hypothesis of a more generalized dispersion in metropolitan areas. They claimed that agglomeration activities are possible throughout metropolitan regions and that driving forces of dispersion includes the mitigation of congestion costs, adjustments in business organization contributing to the emergence and growth of outsourcing, and changes in the labour market reflected by the increasing reliance on part-time and temporary workers. Their results indicated that the share of jobs in downtown areas and major sub centres of Los Angeles have been small and declining over the period 1970 to 1990 and showing signs of change towards a more uniformly dispersed spatial structure, rather than dispersed clustering in a

¹⁰ These results are more fully described in Chapter 7.

¹¹ Equivalent of 464 515m²

¹² Equivalent of 55 742 m²

limited number of major sub enters as postulated by the concept of polycentricity (Gordon & Richardson 1996).

More recent findings however indicate the emergence of some reversal of these decentralisation and suburbanisation trends. Kotkin (2014) identified some signs of urban revival in many downtown districts of American cities. Although these trends do not necessarily indicate a return to their former status in the first half of the 20th century, it indicates the emergence of a very different conceptualization of downtown. This conceptualization views downtown areas as a residential alternative that attracts young and childless couples, and one of numerous nodes in the metropolitan area with a significant presence of financial institutions, government offices and business service firms. Kotkin (2014) found that after an era of population decline, the downtown cores of the 51 metropolitan areas in the US with populations over a million, gained just over 200 000 residents over the period 2000 to 2010. This represents 1.3% of all the growth in the major metropolitan areas of the US. Although these figures do not reflect a mass 'back to the city' trend and a return to the former status of the old urban cores, it is indicative of at least some improvement in the market attractiveness of city centres.

2.4.4 Trade-off processes

Two of the fundamental triggers of urban change is differentiated land values as operationalised in the concept of bid rent theory (described in Section 2.2.2.2) and the concept of friction cost (described in Section 2.2.2.3) representing the cost of reaching a place of employment, social facilities or other amenities (measured as either a time or cost factor). The interplay between these two forces forms the basis of trade-off theory as a residential location theory. According to trade-off theory households' locational decision-making is based on a trade-off between housing costs (primarily driven by the concept of bid rent theory) and transport costs as a manifestation of friction costs (Geyer 2009). This would generally imply trading off cheaper land further away from central city locations with higher transportation costs associated with these locations. These decisions ultimately leads to various levels and forms of residential decentralization (suburbanisation) further away from the traditional city centre and are inevitably also influenced by the availability of land for new development relative to city centres. The location optimization of decision making by households hold important implications for pursuing spatial concepts such as compact cities and understanding the implications of such concepts.

2.4.5 Invasion and succession

The Chicago school (based on the original work 'The City' published in 1925) developed an urban ecological view of cities strongly influenced by concepts and evolutionary processes such as invasion and succession. The process of invasion and succession as an explanation of neighbourhood and urban change originated from the two related principles of dominance and succession operating in natural

habitats and applying it to human communities. Proponents of the Chicago school argued that different functional areas within a city is the result of dominance and indirectly to competition. This school of thought is amongst others based on the work of authors such as Burgess, McKenzie and Park. Burgess (1925) described the structure of a city as a series of concentric zones of different land uses that evolves through the process of invasion and succession, while McKenzie (1925) applied an ecological approach to classify different types of urban communities and their evolutionary change through a process of intra-community invasions. Park (1936) took a somewhat different view and described the city as a product of human ecology based on principles similar to the symbiotic interrelationships of plants and animals, but with the difference that culture limits the symbiotic social order in human ecology. These models were later followed by others such as Hoyt (1939) who explained the growth of cities from the city centre in terms of sectors rather than concentric zones and Harris and Ullman (1945) proposing that cities have a cellular structure developing around multiple nuclei and not around a single centre. In essence, these theories assume a linear evolutionist paradigm of development, view the city as a coherent entity where the centre organizes its hinterland, and personal choices of individuals driving the functioning of the city (Dear 2002). Urban growth and development is viewed as a process where communities and individuals are filtered through a process of competition for space according to their residential and occupational requirements (Bridge & Watson 2002b).

Despite the wide application of invasion and succession as an urban structuring process, it is often criticised for being overly empirical in nature and focussed on generalising laws and patterns from large data samples. The concept of invasion and succession (for example as applied in neighbourhood lifecycles) has also been criticised as being a unidirectional process and that the application of the theory is compromised by the proliferation of alternative living arrangements (Temkin & Rohe 1996). The growth of informal housing is an example of the latter.

2.4.6 Diversification and integration

Postmodernism in general and the Los Angeles School of urbanism specifically, represents an alternative view of urban development processes from that of the Chicago school. Postmodernism in a general sense refers to a broad-based movement in social science (and other disciplines) critical to the grand theory of the modern era and accepting a wide range of views in social studies. In urban studies specifically, the focus is on social differentiation and a diversity of lifestyles (Pacione, 2009b). The Los Angeles school of urbanism can be viewed as part of the postmodern movement in urban studies and emerged during the 1980's through the work of a group of scholars and professionals interested in the form of urban development transforming Southern California in the United States. The work of Scott & Soja (1986) in particular provided impetus to this movement in their work to characterize and reinterpret the geography of Los Angeles in what they considered as "the paradigmatic industrial metropolis of the modern world" (Scott & Soja, 1986: 249). In the postmodernist view, popular societal attitudes towards

minority groups (ethnic or lifestyle, single parent households, unemployed, disabled) can influence underlying patterns of residential segregation in cities. They also argue that spatial planning based on modernist concepts such as zoning that leads to spatial segregation of functions is outdated and instead advocate for the integration of separated and specialised places and cultural and ethnic integration (Gottdiener & Budd 2005). New urbanist planners in particular are strongly opposed to the idea of urban sprawl in favour of pedestrian and public transport oriented neighbourhoods and districts. This in turn is based on the idealised notion of relatively self-contained¹³ neighbourhoods characterised by a 'balanced' mix of uses and functions such as dwellings, places of employment, retail facilities, parks, and social institutions in a single neighbourhood. The manifestation and relevance of this new urbanist concept of 'mixed land use' in South African cities is analysed in detail in Chapter 7.

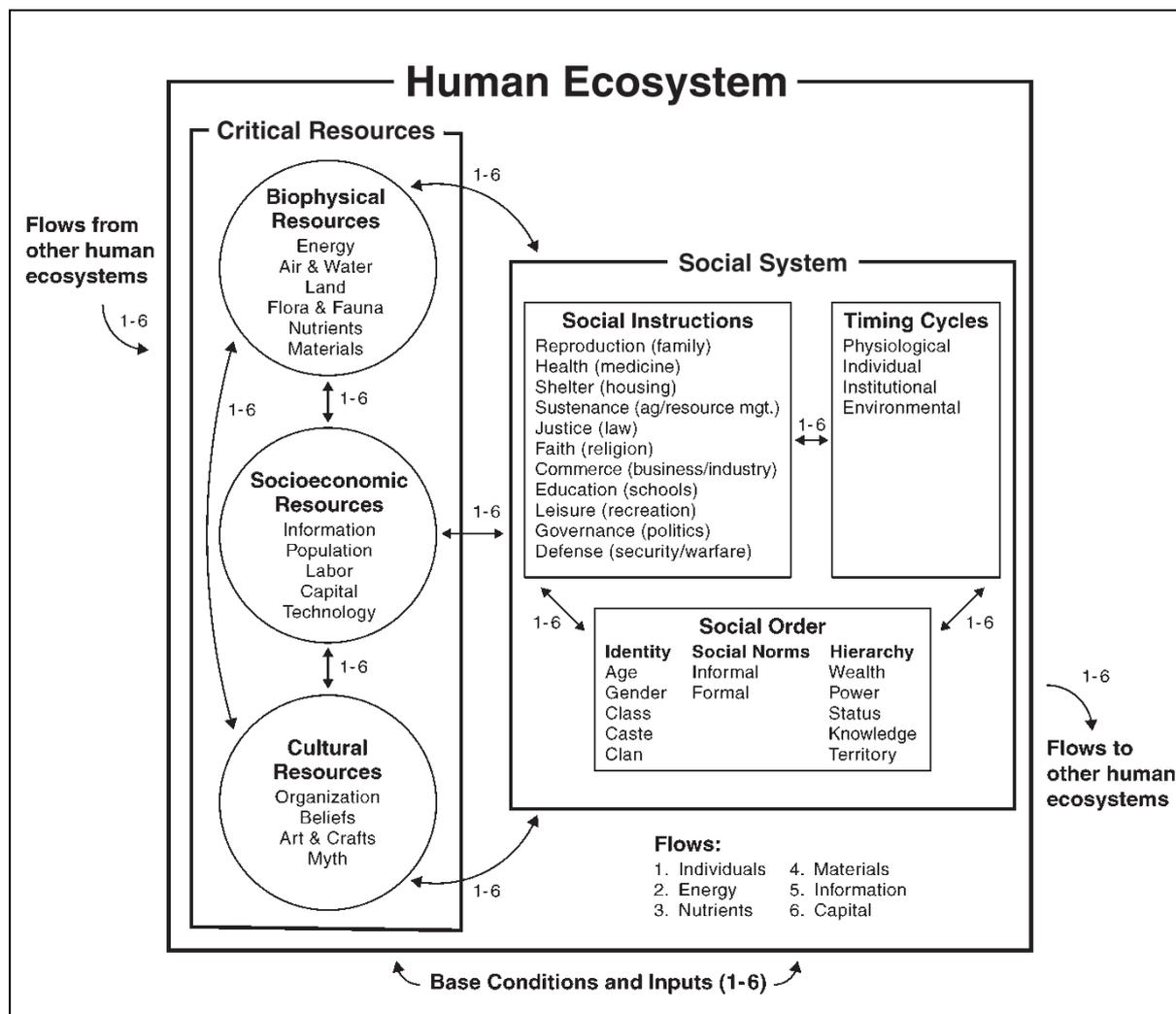
2.4.7 Flows within and between Human Ecosystems

As discussed in Section 2.2.4 one of the principle points of departure of urban ecology is that urban social and ecological life are inseparable modes of existence that are dynamically produced in space and time. This concept of urban ecology obtained specific prominence through the Baltimore school of urban ecology (Grove et al 2015) that views cities as integrated ecosystems consisting of biotic, physical, social, and built components. It emerged from the work of scientists and other stakeholders residing in Baltimore over a period of more than 20 years (approximately 1995 – 2015). The growing prominence of the Baltimore school is based on two important occurrences. The first is the increasing global levels of urbanization, and the second the increasing levels of ecological knowledge of urban areas as a result of increasing scientific investment in studies of urban ecological systems since the mid-1990s. One of these long terms ecological research projects funded in 1997 by the National Science Foundation was the Baltimore Ecosystem Study. Although recognizing some of the basic concepts of the earlier Chicago school, the Baltimore school of urban ecology differs in a number of important ways. The Chicago school was unaware of the theoretical controversies associated with some of the key ideas they adopted from ecology such as ecological succession. A further difference is that the Chicago school emphasized the pathologies of cities whereas the Baltimore school do not assume cities and urban systems in negative environmental terms (Grove at 2015).

The concept of a Human Ecosystem Model (HEM) is central to the Baltimore school of urban ecology. It originated in the 1960s and have subsequently developed into the widely recognised concept of human

¹³ The Charter of New Urbanism sets out 27 principles to guide new urbanist development practice, urban planning and design at regional, neighbourhood and block scale. Nine principles are identified to guide policy, urban planning and design at neighbourhood and district level. The idea of relatively self-contained neighbourhoods are based on principles such as compact, pedestrian friendly, and mixed-use neighbourhoods; a variety of activities of daily living occurring within walking distance; a broad range of housing types and price levels within neighbourhoods to cater for a variety of ages, races, and incomes; concentrations of civic, institutional, and commercial activity embedded in neighbourhoods; and a range of range of parks and recreation facilities distributed within neighbourhoods (Biddulph 2000; Berke 2002; The Congress for New Urbanism 2018).

ecosystems. According to the HEM human ecosystems are coherent systems of social and biophysical factors capable of adaption and sustainability over time, and can be described at different spatial scales that are nested hierarchically (Burch, Machlis & Force 2017). They describe the basic underlying concepts of the HEM as constants, base conditions, and variables. Constants (for example thermodynamic properties) do not vary measurably and are universal, while base conditions exhibit little (but some) variation over space and time (for example changes to the nitrogen cycle). Variable are factors that can fluctuate widely over space and time.



Source: Grove et al. 2015

Figure 2.5: The human ecosystem model

As indicated in Figure 2.5 the HEM consists of three key elements - critical resources, social systems and flows. The critical resources provide the social system with the necessary supplies and includes biophysical resources, socioeconomic resources and cultural resources. The flow and distribution of these resources maintain ecosystem coherence and sustainability over time and keep the ecosystem functioning. The second element is the social system that guide human behaviour and that regulate the flow and use of these resources. The social system consists of three components. These three

components are a set of social institutions, a set of cycles (temporal patterns for allocating human activity)¹⁴, and the social order¹⁵ which is a set of cultural patterns organizing interactions among persons and groups. The social order provides predictability to human behaviour. The third key element of the HEM is flows that create the dynamics of human ecosystems and includes the flow of individuals, energy (such as heat), nutrients (such as food), materials (both biophysical such as water and man-made such as concrete), information, and capital (Burch, Machlis & Force 2017).

The increasing complexity and interdependence of social, economic, and ecological issues as discussed in the preceding sections informed a new focus of urban planning to increase the sustainability and resilience of cities. The interdependence of processes such as migration and urbanization, economic restructuring and globalisation, climate change, and water supply require planning that is focussed on increasing the sustainability and resilience of cities and resulted in the birth of the concept of ‘resilient cities’ (Pickett et al. 2004). Resilience can be defined as the “...ability of a system to adjust in the face of changing conditions” (Pickett et al 2004:381). This view differs from earlier interpretations of resilience in a narrow engineering sense that considered resilience to be the ability of a system to return to an equilibrium condition after disturbance. The overall goal of the idea of resilient cities is to decrease their impact on regional ecological systems, and to integrate ecological functions of nutrient, biomass, and water flow more effectively into built environment (Pickett & Cadenasso 2006). The concepts of sustainability, resilience, and climate change hence increasingly influenced urban planning over the last two decades.

2.5 OUTCOMES

The combined result of the interaction between the triggers outlined in Section 2.2, the locally and historically contingent factors summarised in Section 2.3, and the urban structuring processes referred to in Section 2.4 can be described in terms of both systems of cities, as well as cities as systems. The focus on this research is on ‘cities as systems’ which at a generic level are composed of urban tissue and constituted by a generic set of elements of urban form including streets, street blocks, plots and buildings (Oliveira 2016). The spatial organisation and composition of these generic elements of ‘cities as systems’ at different scales resulting from the triggers and processes described in the preceding sections reflects the changes to urban structure over time. The focus of this research is specifically on the influence of spatial planning on the urban structure of cities in South Africa. The manifestation of historically contingent factors in South African cities are described in detail in Chapter 3, and the

¹⁴ Examples of institutional cycles such as trading hours of specific economic activities, environmental cycles can be drought cycles, individual cycles may be associated with the daily routine of individual persons

¹⁵ Social order includes three mechanisms for ordering behaviour – personal identities such as age and gender, norms for behaving, and hierarchies such as wealth, power and status.

outcomes of these triggers and processes on various dimensions of urban structure and change in Chapters 6 and 7.

2.6 CITIES AS COMPLEX SYSTEMS

The preceding sections identified numerous triggers and processes influencing evolving urban form. These triggers and processes however do not operate in isolation but within a complex interacting system operating at various scales and across various timeframes. This final section of the chapter thus considers some important fundamentals of cities as complex systems and the implications for spatial planning. The generalised systemic characteristics of cities provide a useful point of departure to approach the complex interactions of the identified triggers and processes within an urban system (Bai et al 2016:71-72):

- Cities are open systems that continually exchange resources, products, people, by-products and finances with the broader world
- Cities are complex, self-organizing, and constantly evolving
- Cities includes various actors with a variety of different responsibilities, abilities and priorities, as well as processes that operate across the institutional compartmentalized institutional functions of city administration
- Cities are nested in broader ecological, economic, technical, institutional and governance structures that often constrain their systemic function, and that cannot be separated from wider power relations
- Urban processes are causally interlinked, with interactions and feedbacks that result in both intended and unintended consequences.

Such a systemic view of cities¹⁶ is not a new concept to planning, and reflects many of the principles inherent to the HEM as described in Section 4.2.7, but it is only in recent decades that the concept of complexity in planning is being more widely accepted than traditional rational comprehensive systems focussing on objects and forms (Graham and Healey 1999; Innes & Booher 1999; De Roo 2010a;). The maze of definitions attributed to the term ‘complexity’ necessitates a clear distinction between the terms ‘complex’ and ‘complicated.’ A system consisting of a large number of component parts and that can be understood by identifying and disassembling its components parts can be regarded as complicated. Conversely, a system that consists of non-linear interactions between its parts and that cannot be understood through merely a reduction to its component elements is complex. A complicated system is thus not necessarily complex in the sense of complex behaviour; a complex system may however also

¹⁶ See Chapter 4 for a detailed discussion of the systems view of planning

be complicated (Martin & Sunley 2007). The characteristics of such complex systems can be described by seven generic properties as outlined in Table 2.1.

Table 2.1: Key generic properties of complex systems

Property	Attributes
Distributed nature and representation	The functions and relationships are distributed across system components at a variety of scales, giving the system a high degree of distributed connectivity.
Openness	The boundary between a complex system and its environment is neither fixed nor easy to identify, making operational closure dependent on context. Such non-isolated systems tend to be dissipative – subject to constant interaction and exchange with their environments.
Non-linear dynamics	Systems display non-linear dynamics because of various complex feedbacks and mutually self-reinforcing interactions amongst components. Complex systems are thus often characterized by path dependence.
Limited functional decomposability	Because of its high degree of connectivity, and the open, dynamic nature of its structure, there is limited scope for decomposing a complex system into stable components.
Emergence and self-organization	There is a tendency for macro-scale structures (including spatial structures) and dynamics to emerge spontaneously out of the micro-scale behaviours and interactions of system components.
Adaptive behaviour and adaption	The processes of self-organization provides complex systems with the potential to adapt their structures and dynamics, whether in response to changes in the external environment, or from within through co-evolutionary mechanisms.
Non-determinism and non-tractability	Complex systems are fundamentally non-deterministic. It is not possible to anticipate precisely their behaviour even if we completely know the function of their components. This does not imply, however, that the behaviour of such systems is random, in the sense of being haphazard.

Source: Martin & Sunley, 2007: 578.

Complex Adaptive Systems (CAS) is a subset of complexity thinking (Hillier 2010) and is something different from a complex system. CAS comprises many interacting elements or agents that are changing and adapting over time in response to information gathered from its environment to determine the structure of the system (Huys & Van Gils 2010). One of the key characteristics of CAS is the concept of ‘emergence’ described by Innes and Booher (1999:417) as “...the idea that simple elements that are governed by a few simple rules and operate through trial and error with interaction and feedback can produce persistent and systematic patterns that are quite unlike the original elements”. The key characteristics of a CAS thus include the ability to adapt to changing circumstances through interactions between its parts (self-organisation) that generate diversity (De Roo 2010b) and of being transformed by reasoning agents and agencies with the ability to learn and change their behaviour (Sengupta, Rauws & de Roo 2016). CASs are often stable for long periods and then rapidly transform into a new state where they remain for some time, a process described as ‘punctuated equilibrium’ (Baskin 2008). The

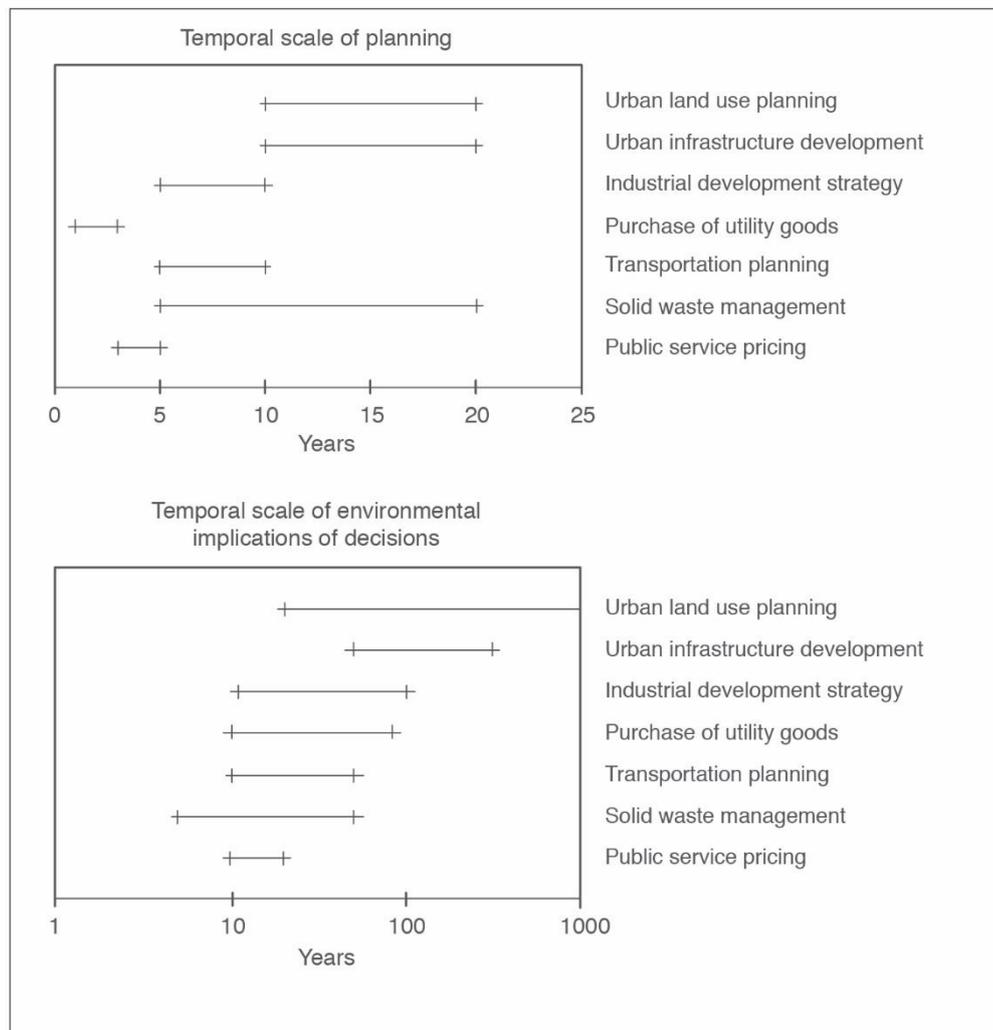
primary difference between a complex system and a CAS is that complex systems can simply be chaotic but not necessarily self-organizing, whereas CAS is necessarily self-organizing (Martin & Sunley 2007)

Cities are increasingly being recognized as CASs that integrate, respond to and influence a variety of processes (such as those described in the preceding sections of this chapter) across a range of spatial and temporal scales (Bai et al 2010). The cycles of change of a CAS consist of four main phases (Dovey 2017): growth, conservation, release and re-organization. Growth entails a major phase of development and in an urban growth context could be equated to rapid expansion on vacant land. The conservation phase is reached when gains are significant and reaches a certain threshold requiring consolidation, maintenance and protection of infrastructure and buildings. Growth rates are reducing and may even become stagnant and can be compared to older and mature neighbourhoods and commercial precincts of cities. The release phase is a brief period where the forces of change overwhelm the consolidation and maintenance regime and the system crosses a threshold into a new form of organization. In an urban development context, this can refer to areas of renewal and redevelopment. Reorganization is described as a creative period when a new order begins to appear.

The perspective of cities functioning as CASs and planning within the context of complexity implies an appropriate view of three interrelated concepts particularly relevant to spatial planning: space, scale and time. Firstly, planning in a complex system requires a relational view of space where proximity does not necessarily imply relationship but where interactions occur at multiple scales with local affairs influenced by events in a global system, but also where local events or actors can affect the larger system (Graham & Healey 1999). Cities as CASs forms part of different cycles of change at multiple scales as appropriately described by Byrne (2003:173):

“...urban systems are complex open systems that are nested in and intersecting with regional, national, block (e.g. European Union) and global systems and which in turn have nested in and intersecting with them individuals, households and neighbourhoods”.

Secondly, numerous interrelated systems operate at different speeds over various spatial scales. Smaller (and in a spatial sense more local) systems tend to function faster and in smaller areas while larger systems move more slowly and cover larger areas. The larger, slower moving systems usually maintain stability in the smaller systems with faster cycles of innovation. The ability to influence the overall system requires an understanding of both the fast moving variables (often easy to identify), as well as slow-moving variables crucial to the long-term future of the system. The larger systems often influence the smaller systems during renewal, enabling them to ‘remember’ and the history of a system thus influences its future behaviour (Holling 2001). From an urban perspective this could be equated to the historically contingent factors (as described in Section 2.3) mediating the triggers to urban change and influencing the behaviour of these triggers.



Source: Bai et al. 2010:131

Figure 2.6: Temporal scales of urban planning and potential impacts

Thirdly, different parts of a CAS change at different timescales and the evolution of cities should thus be viewed from the perspective of relative time and not absolute time. Some components of a city such as the built form change slowly, while others such as commuting patterns can fluctuate frequently. Locally optimal solutions may thus not represent the best long-term solution and a fragmented understanding of cities can result in suboptimal city design outcomes (Olsson et al 2006; Patorniti, Stevens & Salmon 2017). Urban decision makers are generally confined to their relatively short temporal scale of concern, within the spatial scale of their jurisdictions, and within their specific

institutional settings (Bai et al 2010). The contrast between the typical temporal scale of urban planning and the temporal scale of potential impacts of decisions is depicted on Figure 2.6.

2.7 SUMMARY AND CONCLUSIONS

The form and character of cities throughout the world is the result of the interaction of a range of interconnected demographic, social, cultural, economic and ecological forces influenced by the institutional and governance framework within which it functions and involving various resources such as land, natural resources, finance, and human capacity. These forces do not operate in isolation but within a system of interactions that are diverse and complex, and differ across time and at different spatial scales. The resulting urban structuring processes are diverse and often have different (and sometimes opposing) impacts on different urban sub-systems.

Demographic transitions resulted in the dominance of people migrating from central cities to suburbs (the 'fourth migration') in the early part of the 20th century, but also the emergence of an opposite 'fifth migration' repopulating inner cities in some parts of the world during the 21st century. The social spatial organization of individuals represents a tension between the need for individual privacy on the one hand and the desire to live in familiar environments and 'belonging' in identifiable neighbourhoods on the other. These decisions of individuals are influenced and shaped by both push and pull factors and are driven by the underlying concepts of productionism and environmentalism.

From an economic perspective, the two opposing world orders of capitalism and communism have very different impacts on the spatial structuring of cities. Capitalistic systems are generally characterised by free-market competition largely unconstrained by government regulation, and the general spatial impact (globally and locally) is the tendency of capital to flow to and accumulate at locations that will yield the biggest potential return. In communist countries government control rather than market forces, determined the spatial patterns of investment and development. The demise of communism since the 1980s and the growing dominance of capitalism coincided with the emergence of the concept of globalisation that fundamentally altered the understanding of cities from the traditional view of cities as a central point linked to the distinct market of a hinterland, to an understanding of its role and function in wider global economic processes. This increasing international mobility of capital, labour, goods, and information created opportunities for industries and businesses to relocate production processes to countries with the most favourable set of production conditions. This global process of industrial restructuring is also influenced by changes in command and production functions of firms. Production processes are increasingly located in newly industrialised countries, with many of the multi-national command and control functions and associated advanced producer services retained in the international prominent cities of industrialized countries. Production cost escalations related to welfare economics and the introduction of stricter environmental controls also contributed to a decline in the profit levels

generated from mass production, and many businesses evolved to focus on more differentiated or specific services niche markets as part of the transition to Post-Fordism. In addition, technological advances (especially in the field of ICT and transportation) has made certain segments of the labour market more geographically independent and resulting in a general willingness to live further away from work and larger commuting distances becoming more acceptable to individuals and households.

At the level of individual firms or households the trade-off between land cost or rent (or housing costs) and transport costs as a manifestation of friction costs provides one of the fundamental drivers of urban structure. In principle the land use that provides the highest revenue (also factoring in transportation cost) at a particular location will outbid all other uses. These mechanisms are however not only determined by market forces and social organization processes, but also influenced by historical path dependency (such as historical spatial planning ideologies in South Africa) and mediated through institutional processes such as land use planning, infrastructure investments decisions, and taxes. Spatial planning concepts and mechanisms such as building height controls and 'urban growth boundaries' can limit the lateral expansion of urban footprints, but with an accompanying increase in property prices.

The triggers and factors summarised above result in various spatial structuring processes influencing urban spatial structure. These include processes such as agglomeration, centripetal and centrifugal forces, decentralization, invasion and succession, and urban ecological processes as operationalised by the HEM. These processes often operate in a bi-directional manner and influence different urban sub-systems in different ways at different scales. Agglomeration processes occur at many geographical levels and are the result of both centripetal and centrifugal forces associated with the triggers and factors described in Sections 2.2 and 2.3. Decentralization as a process can manifest itself in terms of distinct urban elements such as the suburbanization of the population, the decentralization of marketplaces, and the decentralization and suburbanisation of employment. The latter in turn can take different forms such as dominant nodes in the form of Garreau's edge cities, dispersed clustering in a limited number of major sub centres as postulated by the concept of polycentricity, or a uniformly dispersed spatial structure of decentralization. Under certain conditions these decentralization processes are reversed and result in the revival of urban core areas.

What is clear from these triggers and processes are that the interactions are diverse and complex and differ across time and at different spatial scales. The resulting complex interacting system exhibits a number of important systemic characteristics. The perspective of cities functioning as CASs thus implies an appropriate view of three key concepts particularly relevant to spatial planning: space, scale and time. Planning in a complex system requires a relational view of space where proximity does not imply relationship but where interactions occur at multiple scales. In such a system local events or actors can affect the larger system and local affairs are influenced by events in a global system. Numerous interrelated systems operate at different speeds over various spatial scales, with smaller (and in a spatial

sense more local) systems functioning faster and at a smaller scale while larger systems move more slowly and cover larger areas. Locally optimal solutions may thus not necessarily represent the best long-term solution and a fragmented understanding of cities can result in suboptimal city planning outcomes. The ability to influence the overall system requires an understanding of both the fast moving variables (often easy to identify), as well as slow-moving variables that may be vital to the long-term future of the system. Different parts of a CAS change at different time scales and the evolution of cities should thus be viewed from the perspective of relative time and not absolute time. From a spatial planning perspective this implies the need for change from identifying interventions in the physical environment based on current situations to a mode of planning that considers time, rate of development and direction of progress (de Roo 2010a). The relevance of the factors and processes described in this chapter to spatial planning processes and concepts in South Africa is further analysed in more detail in Chapter 3.

3 CHAPTER 3: SOUTH AFRICAN SPATIAL PLANNING DOCTRINE

As discussed in Chapter 2 the impact of the triggers and forces on urban form is mediated through local and historically contingent factors. These factors are of particular relevance in the South African context where urban growth and development were substantially influenced by historical colonial and political ideologies. This resulted in spatial patterns and urban structures that became widely associated with South African urban areas and the almost default use of the term ‘apartheid city.’ An appreciation of the operation of the triggers and forces described in Chapter 2 in South African cities, and the influence of contemporary post-1994 spatial planning policies on the evolving urban form hence requires an understanding of the historical context of South African urban spatial planning. This chapter firstly provides an overview of the pre-1994 South African urban spatial planning history and considers the role and influence of both Colonial and Nationalist ideologies. It then proceeds to describe the urban spatial characteristics of contemporary South African cities that were influenced by this historical context. Building on this background the chapter then briefly reviews the transformation of the South African urban spatial planning system post-1994 and the emergence of a new spatial planning doctrine. The concept of a planning doctrine originates from the work of Faludi who describes the term doctrine as “a coherent body of thought” (2000:312) concerning the spatial arrangements within an area, the development of that area and the way in which both these aspects are handled in planning approaches. A planning doctrine reflects a number of key concepts combined into an overall principle of spatial organisation (often relying on a metaphor) and that influences the views of decision makers, politicians and the broader public at large. A broadly accepted (and mostly unchallenged doctrine) has two important elements to it. Firstly, a number of broadly accepted spatial planning goals, and secondly spatial planning concepts believed to be relevant to the implementation of the accepted goals. This chapter concludes with a summary of the South African post-1994 spatial planning ‘doctrine.’

3.1 SOUTH AFRICAN URBAN SPATIAL PLANNING HISTORY (PRE-1994)

The term ‘apartheid cities’ has become uniquely associated with South African city structure and is an almost universally used concept in literature on South African cities, both locally and internationally. On closer inspection of the literature, it becomes clear that this term is used in two very distinct but closely related contexts. On the one hand it is used as a historical phenomenon referring to cities that were substantially influenced (especially from a spatial and physical perspective) during the period when enforced racially segregated development was pursued as a national policy after 1948 until the late 1980s. On the other hand, it is also used to describe contemporary South African cities that, despite more than 20 years of democratic government rule, ostensibly still reflect many of the pre-1994 physical and socio-economic characteristics. It is thus imperative to consider the deeper meaning of the apartheid

city from both these perspectives. The apartheid city as a historical phenomenon is inherently related to its historical physical development and merits consideration of the historical processes that played a role in its formation. These historical events are discussed in the remainder of Section 3.1. The second interpretation of the apartheid city as a contemporary phenomenon still reflecting some of the effects of its historical roots is described in Section 3.2.

The term apartheid city is generally understood to refer to the outcome of the post-1948 urban era in South Africa when the physical structure of cities were shaped by policies and legislation such the various versions and amendments of the Group Areas Act between 1950 and 1966 (Christopher 1989). However, a less well known and published fact is that pre-1948 South African cities were already highly segregated and, although the impact of apartheid ideology on South African city structure is indisputable, the colonial legacy and influence also contributed to the footprint of South African cities (Jones 2000). Understanding and acknowledging the pre-1948 city dynamics is arguably as important to the interpretation of the evolving post-apartheid city as is the more widely acknowledged impact of the Nationalist policies post-1948. The concept of an ‘apartheid city’ from an urban planning perspective inevitably focusses on the spatial and morphological dimensions. However, as pointed out by Swilling (1991) this phenomenon can best be understood as a series of interacting sub-systems consisting of a spatial system, urban services system, housing system, land system and local government system, each of which have been devised to advance the policy objectives of the state. For the purpose of this discussion the concept of ‘apartheid cities’ will be specifically focussed on the spatial sub-system. Broadly speaking the apartheid spatial system manifested itself at two levels (Swilling 1991). Firstly, at an urban systems level where policies were aimed at decentralizing and deconcentrating employment at the macro level and to restrict entry of the African population to cities. Secondly, at the individual city level where the aim was to develop cities according to different racial areas. The five broad phases in the pre-1994 development of planning in South Africa as identified by Harrison, Todes & Watson (2008) provide a useful framework for structuring this discussion:

- Pre- and early modernity (until the 1880s), also referred to by Davies (1981) as the ‘settler-colonial’ period from the beginnings of European settlement in the Cape in 1652.
- The rise of modern South Africa (1880s to 1940s), including the introduction of The Natives (Urban Areas) Act of 1923 which signalled the active nationwide pursuit of urban segregation.
- High apartheid (1940s to early 1970s) marked by the introduction of a more rigid policy of urban apartheid implemented through the Group Areas Act of 1950.
- Apartheid in decay (from mid 1970s to 1990).
- Final transition (1990 to 1994).

Christopher’s (1983; 1988; 1989) detailed descriptions of early South African urban history and the role of colonialism established little practical racial segregation in South African cities until the mid-nineteenth century apart from practical segregation in terms of wealth based differentiation of style of

housing. African urbanization was not centrally controlled by the state prior to 1923 and municipal controls were absent through most of the nineteenth century (Lemon 1991). Structural segregation was only introduced in the period after 1850 and coincided with the rise of the age of imperialism. Based on his analysis of British colonial cities in Africa, Christopher (1983) concluded that British African colonial cities exhibited many of the features of the apartheid city. Of particular importance was the introduction of the 'location' with its orderly layouts and administrative structure as an element of urban development from colonial times (Robinson 1997). It was also during this period that the mainly British system of town planning was introduced to the Union of South Africa. It however remained a relatively minor activity until the 1930s (Harrison et al. 2008).

The four colonies that merged to form the Union of South Africa in 1910 experienced very different constitutional and political histories during the period of European colonization (Christopher 1988). The application of a liberal policy on segregation in the western Cape¹⁷ and the lack of a formulated policy of segregation in Natal implied that urban areas in the then Cape of Good Hope and Natal were more radically altered through the implementation of policies after 1910 aimed at achieving segregation. This is in contrast to the Orange Free State where segregationist policies were strictly applied even prior to 1910, and Transvaal which applied these policies less strict and where the towns were less affected by subsequent legislation after 1910 (Christopher 1988). There were thus substantial regional variations based on different colonial practices (Christopher 1989) but all sharing a common British colonial urban heritage with other parts of the world. Christopher (1983:145) hence argued "...the historical foundations of modern Soweto (the all Black suburb of the all-White city of Johannesburg) were laid by Edward I in his Welsh military foundations in the thirteenth century..." As can be expected these views did not go unchallenged. Simon (1984) did concede to some of Christopher's arguments about the influence of colonialism on South African cities but pointed out two fundamental aspects differentiating the modern apartheid city from the colonial apartheid city. Firstly, the degree of sophistication and institutionalisation of segregation policies that was established in a politically independent post-colonial society. Secondly, the fact that apartheid was not limited to urban segregation but formed part of a broader set of political economic viewpoints. Both Christopher and Simon however agreed that the unique difference in the South African context is that the Nationalist government after 1948 refined the colonial system they inherited to advance the political aims of segregated development during a period when European colonialism elsewhere had ended.

The period between 1923 and 1950 was characterised by the growth of manufacturing employment in the cities and deteriorating economies in the so-called 'African reserves.' This led to the recommendations of the Stallard Commission in 1922 to restrict the number of urban Africans to minimize expenditure on their 'locations' (Rich 1978). These principles were formally adopted through

¹⁷ Western Cape in this context referring to the western parts of the then Cape of Good Hope and not the current Western Cape Province.

the introduction of The Natives (Urban Areas) Act of 1923¹⁸. This act empowered local authorities to, amongst other things, set aside land for African occupation in segregated locations and hence established the basic principles of segregated urban development. These pre-apartheid cities before 1948 were thus highly but not completely segregated (Lemon 1991). The political developments in South Africa during this period culminated when Jan Smuts led South Africa into war on the side of the British in 1939 and which led to his defeat in the 1948 elections when DF Malan's Nationalist Party defeated him. An important but less recognised outcome of this era was the failure by the Smuts administration to manage the rapidly accelerating urbanisation process during the 1940s when the focus was on the war effort (Harrison et al. 2008).

Harrison et al. (2008:25) describe the period from the late 1940s to the early 1970s as the "era of high apartheid." The introduction of The Group Areas Act of 1950 had the most significant impact in terms of the spatial structuring of South African cities and proved to be the cornerstone of apartheid. The ultimate goal of this act was the establishment of separate areas for exclusive occupation by different race groups. Although residential segregation is conventionally associated with the Group Areas Act, Maharaj (1992) argues that local authorities (city level) also played a critical role in the formulation and implementation of this act. The implementation of the Group Areas Act had two very distinct spatial impacts for South African cities: large-scale forced removals on the one hand and large-scale township development on the other. By 1987 more than 1300 so-called group areas had been proclaimed, with most of these areas located at peripheral urban locations (Lemon 1991). It also provided for designated 'border strips' to act as barriers between different group areas to ensure physical separation between various group areas (Lemon, 1991). Harrison et al. (2008) pointed out that although apartheid planning in this era was unique in terms of its controls over non-white population groups, the trends in spatial planning were similar to those in Europe or North America (e.g. low-density suburbanization, separation of land uses, large-scale investment in freeways).

Harrison et al. (2008:31) describe the era from the mid-1970s to 1990 as a period of "apartheid in decay". This period was characterised by the Soweto uprising of 1976 and the later township uprisings of 1984. Proposals for abandoning influx control and the Group Areas Act started to surface during the early and mid-1980s. In 1989 FW de Klerk replaced PW Botha as president and in February 1990 announced the unbanning of liberation movements and the release of Nelson Mandela from prison. An important event in this final transition period was the multi-party Convention for a Democratic South Africa (CODESA) convened in 1991 where the transition to the first democratic elections of 1994 was negotiated.

¹⁸ Davenport (1991) provides a detailed description of the Botha-Smuts era (1910-1924) leading up to the introduction of this act.

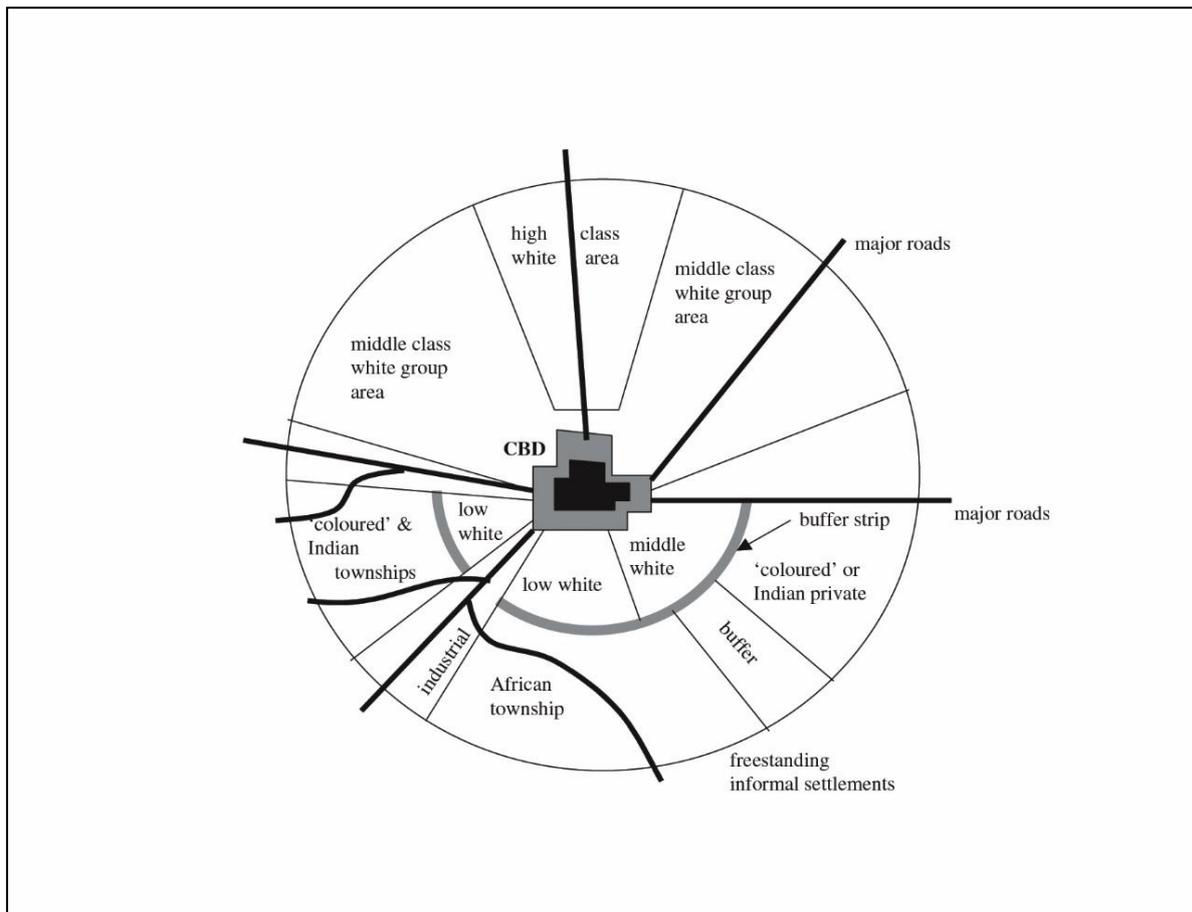
3.2 SOUTH AFRICAN URBAN SPATIAL STRUCTURE LEGACIES

The outcome of both the colonial city and the post-1948 apartheid city policies is a very distinct set of characteristics attributed to South African cities and that have been extensively documented (e.g. Davies 1981; Christopher 1989; Lemon 1991; Drakakis-Smith 1992; Maylam 1995; Robinson 1997; Boraine et al. 2006; Donaldson 2006; Landman 2006; du Toit 2007; Turok 2011).

The first of these distinguishing characteristics is a segregated and fragmented spatial form. This element of segregation and fragmentation is generally associated with two distinct urban morphological patterns. The first is social segregation at neighbourhood level and the second is the separation of different types of land uses often also associated with achieving or supporting the notion of social segregation. The typical South African 'apartheid city' is widely attributed with both these elements. From the perspective of separation of land uses, the typical spatial arrangements include residential neighbourhoods located and developed according to race groups; traditional white neighbourhoods closer to central business districts and with good access to social amenities and economic opportunities, and with non-white townships located at peripheral locations. The white and non-white suburbs were separated by means of so-called buffer strips in the form of elements such as green belts, industrial zones and major transport infrastructure (Lemon 1991; Landman, 2006). The archetypal 'apartheid city' is illustrated in Figure 3.1. The separation of residential areas did not only result in racial segregation but also increased separation between home and workplace for many households (Simon 1989). This contributed to high levels of automobile use and dependency in the higher income suburbs, while the use of multiple modes including pedestrians, buses, minibus taxis and trains are prevalent in the poorer areas (Donaldson 2006).

Despite the undoubted existence of social segregation in South African cities, the general perception of a physically 'fragmented' spatial form can however not in all instances be universally ascribed to apartheid planning. The concept of fragmentation (which in urban spatial policy terms generally implies a condition to be changed for the better) within a postmodernist discourse can arguably also be viewed as diversity and not something to be countered but viewed as part of the richness and complexity of urban life (Harrison 2003).

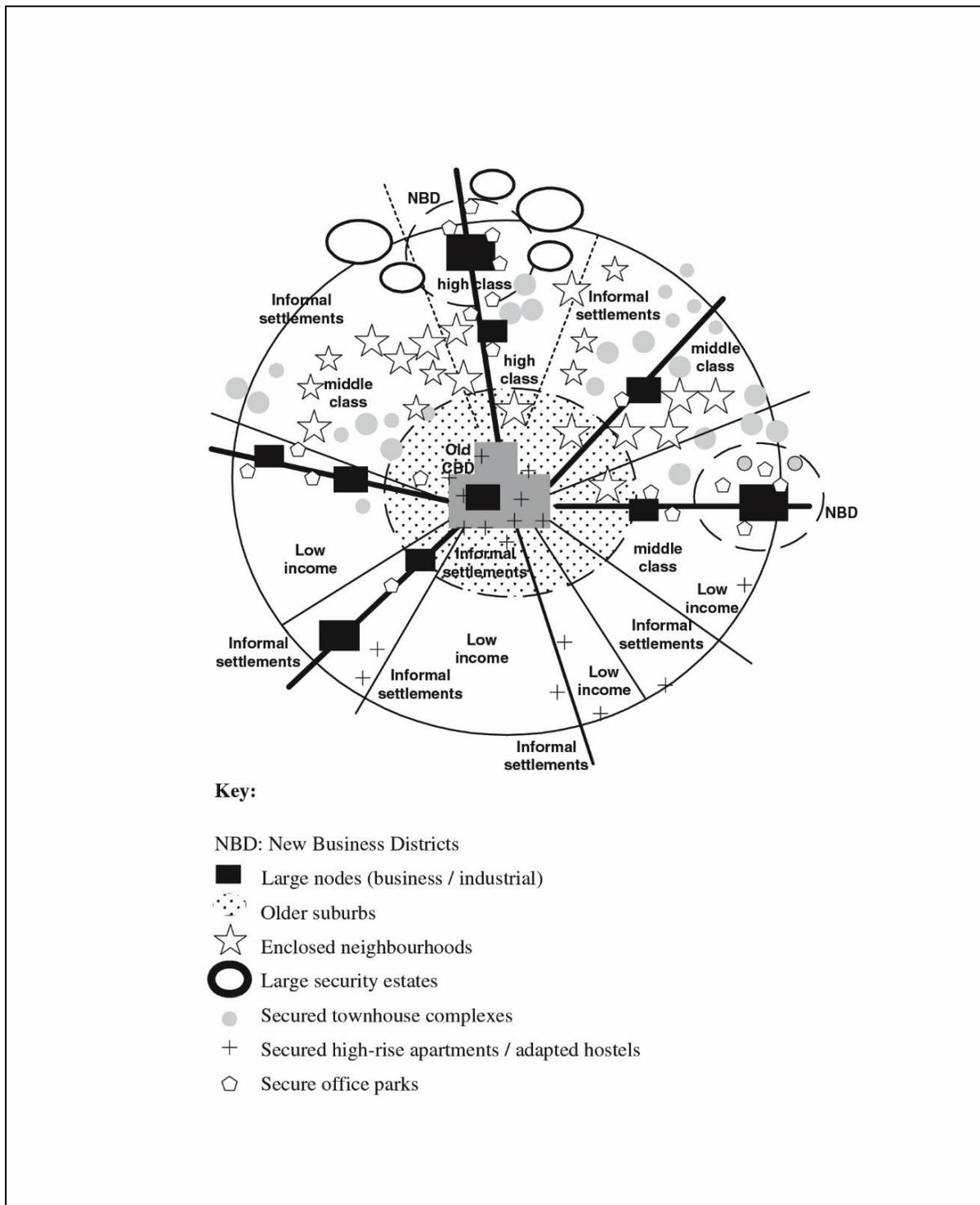
The local biophysical environment of individual cities also determines the suitability of specific areas within the overall city structure for development. Some elements in the structure of South African cities generally perceived as fragmented are however the result of the existence of biophysical constraints such as flood lines, topography and geotechnical conditions prohibiting any form of urban development (although many of the so-called 'buffer strips' indeed coincided with these physical constraints). South African city literature thus often use the concept of fragmentation in abstract terms without also considering the local factors and circumstances.



Source: Landman 2006

Figure 3.1: Typical structure of 'apartheid city'

A second characteristic of the contemporary South African city is the peripheral location of low-income settlements resulting in unequal access to economic and social opportunities. The peripheral locations of low income settlements are however not in all instances the direct result of historical apartheid planning. The development of mass low cost housing on cheap land at peripheral locations after 1994 have tended to reinforce historical patterns (Turok 2011). This trend is strongly influenced by market forces that, through the dynamics of bid-rent theory (as described in Chapter 2), result in high property values in central city locations. This in turn leads to higher density or higher-income housing (or both) to overcome the impact of high land prices. The inevitable result is that affordable housing is often forced to decentralised locations on cheaper land. Despite the peripheral location of most low-income settlements (relative to historical city structure), they often remain the first recipients of migrants from rural and other areas to the larger urban areas (SACN 2016). A third distinguishing characteristic is high levels of social segregation. This stems from the historical racially exclusive residential structure of South African cities that was aimed at minimizing racial interaction at neighbourhood level (Simon 1989).



Source: Landman 2006

Figure 3.2: Typical structure of the new 'apartheid city'

The policy solution for social segregation is generally viewed as integration – an aspect included as a spatial planning goal in the plans of many municipalities (see Section 3.3.3). The South African urban spatial planning policy over the last 20 years rather simplistically assumed that physical desegregation would lead to social integration (Lemanski 2006). This was exacerbated by the relatively loose interpretation of the term 'integration' within an urban policy and planning context (including variations

such as social integration, racial integration, and spatial integration) and a lack of clarity on the appropriate scale at which to measure integration (this could be anywhere between the level of an individual household and that of the state). Physical desegregation however does not necessarily result in social integration and from a policy perspective it has been suggested that institutions (such as work places and social institutions) rather than neighbourhoods could provide the best sites for social integration. This then implies that planning concepts such as activity corridors, rather than suburb or individual-level desegregation or integration should be prioritized as urban strategies (Lemanski 2006). Although a decrease in levels of segregation have been observed in South African cities (Horn 2005; Lemanski 2006; Rex & Visser 2009; Parry & Van Eeden 2015) it should be noted that these decreases generally occurred from very high base values and overall segregation levels remain high (Christopher 2001). The rate of desegregation is also highly variable between different cities (Kotze & Donaldson 1998) and racial and spatial integration does not necessarily improve the lives of the least advantaged (Oelofse 2003). It has also been argued that the rapid growth and popularity of enclosed neighbourhoods or so-called ‘gated communities’ introduced a new form of fragmented and segregated urban environments after 1994 that is not race based, but based on affordability and can be viewed as a new form of ‘new-apartheid city’ (Landman 2006). It can thus be argued that the concept of ‘class,’ based on the two key characteristics of income and power (Marcuse & Van Kempen 2000), is the main force of social organization in cities. Based on this argument the allocation of land for different uses or social groups is determined through the market with higher income individuals that will be able to pay higher prices and hence their choices prevailing over lower income individuals. Continued social segregation in South African cities is thus not merely a remnant of apartheid planning ideology only, but also the outcome of market forces similar to that experienced in most cities across the world.

A further result of this fragmented spatial form (and fragmented institutional structures governing urban development) is the claim that South African cities are characterised by urban sprawl. Although there are many views on what exactly constitutes urban sprawl¹⁹, the South African urban discourse almost universally accepts it as having a negative connotation associated with the undesirable conversion of land for the purposes of urban development. Todes (2006:68) provides a comprehensive definition of urban sprawl in the South African context:

“Lateral spread of urban development, generally at relatively low densities, which may encroach on agricultural or environmentally important areas. Sprawl is associated with suburban development, but also with townhouse complexes, peripherally located housing projects, and increasing densities on land held under traditional tenure on the edge of cities.”

The articulation of the concept of urban sprawl is often inevitably linked to normative policy positions expressing a desire for ‘compact’ urban forms as an important element of sustainable cities. The SACN (2016:56) for example expressed the view that poor and higher-income residents “...need a major mind-

¹⁹ See Chapter 6 for more detailed discussions on the concept of urban sprawl.

set shift, towards new realistic, inclusive and sustainable visions and aspirations for urban living.” The mind-set shift referred to here is away from the aspiration of many urban residents (both rich and poor) of owning a car and living a suburban lifestyle. Despite the alleged benefits of more compact and higher density development from an urban planning perspective, the type of claims referred to above assume the articulation of the preferences of the majority of urban residents at large. However, as discussed in Chapter 2, some research results however indicated that variations across space cannot be related to the locality of settlement in a simplistic way and that locations that are more central do not necessarily result in lower overall costs and offering more benefits than more peripheral locations. The notion of ‘compact development’ thus cannot be viewed over simplistically and in a static context that only relates to the distance from the historical city centre. It may be as dependent on local area conditions as it is to relative location within the broader urban structure (Venter, Biermann & Ryneveld 2006). Moreover, as indicated in Section 2.2.2, current fragmented urban structures may in some instances represent a logical step in an economically efficient long-term process of urban land transformation.

A further characteristic generally attributed to South African cities related to urban sprawl is low population densities. The density profiles of South African cities are unusual in two respects: city densities are low compared with cities in other countries with similar incomes (Bertaud & Malpezzi 2014; SACN 2016) and density profiles are inverted and rises with distance from the centre (Turok 2011). The argument in favour of higher densities generally revolve around three key issues (Turok 2011): increased sustainability from an environmental (energy consumption and carbon emissions) and financial point of view (capital costs of providing bulk infrastructure and traffic congestion costs), productive efficiency and growth through positive externalities, and higher density central cities required for social inclusion and integration. However, not all per capita costs decrease with increasing densities and centrally located areas can be as costly to develop as more peripheral locations due to factors such as existing spare capacities and environmental and land use characteristics (Biermann 2000). This interpretation of densification also implies that the principal target of densification is middle- to high-income groups working in the city centre who would otherwise live in the outer suburbs and would result in substantial gains by reducing car-based commuting and economising on peripheral land. The argument that higher density central cities are important for social inclusion and integration implies accommodation for low-income groups, as well as for middle and high-income groups. Affordability is the overriding consideration for low-income groups and their space and service standards are very different from middle and high-income groups who would prefer to live in inner city areas and would demand well-designed and secure surroundings and attractive public spaces (Turok 2011).

3.3 TRANSFORMATION OF THE SOUTH AFRICAN SPATIAL PLANNING SYSTEM (POST-1994) AND THE EMERGENCE OF A NEW SPATIAL PLANNING DOCTRINE

3.3.1 Introduction

Section 3.1 described the South African urban spatial planning history pre-1994 and Section 3.2 the urban spatial characteristics attributed to contemporary South African cities influenced by this historical context. This section analyses the post-1994 spatial planning policy response. Although identified as a critical area for reform, the transformation to a new post-1994 spatial planning system proved a much more challenging and lengthy process than most anticipated. From a chronological perspective, the key elements of the evolving national level spatial planning and policy framework in South Africa subsequent to 1994 include the following elements and their contribution to the evolving spatial planning doctrine is traced in the subsequent sections:

- White Paper on Reconstruction and Development (1994)
- The Development Facilitation Act (1995)
- The National Urban Development Framework (1997)
- The Local Government: Municipal Systems Act (2000)
- The Local Government: Municipal Planning and Performance Management Regulations (2001)
- The National Spatial Development Perspective (2006)
- The National Development Plan 2030 (2012)
- The Spatial Planning and Land Use Management Act (2013)
- The Department of Rural development and Land Reform guidelines for the development of provincial, regional, and municipal spatial development frameworks and precinct plans (2014)
- The Integrated Urban Development Framework (2016)

Many of the spatial planning goals and concepts of this post-1994 policy framework were strongly influenced by and based on the ideas of Dewar and Uytendogaardt documented in “*South African Cities: A Manifesto for Change*” (1991). They argued that a compact city form is a central pre-condition for efficient urban environments and that the multifunctional use of space and facilities is both desirable and economically essential. They also identified increased densities and the integration of urban activities and land uses as central elements in the transition of South African cities (Dewar & Uytendogaardt 1991). These concepts became embedded in the official spatial planning and policy framework as part of what can be referred to as the post-1994 South African ‘spatial planning doctrine.’ As indicated in Section 3.1 a ‘spatial planning doctrine’ can be regarded as a coherent body of thought concerning the spatial arrangements within an area and that influences the views of decision makers, politicians and the broader public at large. Two important elements

of a doctrine are broadly accepted spatial planning goals, and spatial planning concepts believed to be relevant to the implementation of these goals. In the South African context, two interrelated processes and outcomes shaped the emergence of this doctrine since 1994:

- Spatial planning goals and concepts articulated in the key components of the national level urban spatial planning policy and legal framework since 1994
- Application of these spatial planning goals and concepts in municipal and sub-municipal SDFs.

These components of the spatial planning doctrine are analysed in the following sections.

3.3.2 Spatial planning goals as articulated in the evolving post-1994 urban spatial planning policy and legal framework

The Reconstruction and Development Programme (RDP) was developed as a policy framework for integrated socio-economic progress and as an instrument to give direction to the transformation strategy. The programme was intended to integrate the different organs of state in all three spheres of government in a coordinated initiative towards the national goals of renewal (South Africa 1994). Although the RDP was not very specific about spatial planning goals it did introduce the principle that land for housing development must be suitably located with respect to access to economic opportunities and social amenities.

The Development Facilitation Act (1995) was promulgated shortly after the introduction of the RDP with the purpose to establish extraordinary measures to facilitate and speed up the implementation of reconstruction and development programmes and projects in relation to land. This act represented the first tentative steps of instituting a new planning system and introduced a set of general principles governing land development throughout South Africa. Of particular importance was the principles for promoting the efficient and integrated development of land that included amongst others the following (South Africa 1995):

- Integration of the different dimensions of land development such as environmental, social and economic;
- Improved spatial integration of employment and residential areas;
- Making the best use of resources such as land and its physical attributes, services infrastructure, transport networks and social amenities;
- Encourage a higher level of land use mix in the development of land;
- Promote the development of compact city structures and discourage the occurrence of 'urban sprawl';
- Support the modification of historically distorted spatial patterns; and
- Advance the notion of environmentally sustainable land development practices and processes.

This set of principles for land development remained the de facto point of departure for informing urban spatial planning processes until the promulgation of the Spatial Planning and Land Use Management Act (SPLUMA) in 2013 that included a new set of principles applying to spatial planning, land development and land use management in South Africa.

The Urban Development Framework of 1997 (subsequently followed by later versions and finally culminating in the Integrated Urban Development Framework in 2016) was developed in response to the need identified in the RDP for national guidelines for the development of urban areas in South Africa towards the goal of sustainable human settlements. It contained government's vision for sustainable urban settlements, as well as guidelines and programmes for the achievement of the vision. A number of urban development goals (South Africa 1997) underpin the urban vision for 2020 articulated in this Framework:

- To support growth and development of local economies leading to productive and efficient cities;
- To reduce inequalities in the levels of infrastructure and facilities between different communities;
- To provide improved security of tenure and enhanced housing and shelter for urban residents;
- To improve accessibility to employment and other opportunities by addressing spatial inefficiencies, by promoting urban densification and providing more efficient public transportation;
- To ensure improved integration of environmental aspects into development planning and urban management resulting in improved urban environmental quality; and
- To implement capacity building programmes and promote active interaction of civil society to transform municipalities into effective and accountable institutions.

This Urban Development Framework also identified a number of urban development programs to ensure the implementation of the goals outlined above. Of specific relevance to this research is the programme for 'integrating the city' that included specific recommendations on:

- More flexible zoning and planning mechanisms to promote mixed land-use (co-locating residential, commercial and industrial uses) and complement local economic development;
- Improved integration of and linkages between the various urban components through high-density activity corridors, urban infill, development and integration of apartheid developed 'buffer zones, inner city redevelopment, and upgrading of townships,
- Development and provision of adequate open spaces for recreational purposes;
- Focussing investment in developed and emergent nodal points and activity corridors in the urban system to promote higher density land-use development;
- Reforming the urban land and planning system;
- Improved efficiency of urban transport system to reduce commuting distances and costs; and
- Environmental management integrated with urban planning and development processes.

One of the most far-reaching post-1994 reforms has been the promulgation of the Local Government: Municipal Systems Act (South Africa 2000) and the subsequent Local Government: Municipal Planning and Performance Management Regulations (South Africa 2001). This ushered in an important era of so-called 'joined-up' governance and introduced the system of municipal IDPs. The primary focus was to ensure focused delivery through the temporal and spatial coordination of development and investment initiatives of all three spheres of governance. Section 26(e) of the Systems Act specifically requires that the IDPs of municipalities must include a SDF. The Municipal Planning and Performance Management Regulations further describes the provisions of what such a framework must contain. Of specific importance is Section 4(a) of these regulations which states that a SDF reflected in the IDP of a municipality must give effect to the principles contained in Chapter 1 of the Development Facilitation Act of 1995 as summarised earlier in this section. The DFA principles at that stage thus continued to remain effective as the primary overall urban spatial planning goals. Although the National Spatial Development Perspective (South Africa 2006b) was also introduced after 2000 and provided a set of principles to contribute to the growth and development objectives of government, these principles were focussed on higher levels of spatial planning and did not directly affect municipal level planning, neither was it ever formally endorsed.

The next major consideration of spatial planning and its effects on urban structure in South Africa came with the establishment of the NPC in 2010 and the subsequent adoption of the NDP 2030 in 2012. The NPC was established in April 2010 as an advisory body tasked with preparing recommendations to the cabinet on issues affecting South Africa's long-term development. The first step towards a new NDP was a series of Diagnostic Overview Reports. The detailed Material Conditions diagnostic report identified the form of future towns and cities as one of the six 'big issues' requiring significant focus in the national plan. Very low overall densities in international terms, an inverted density gradient with the highest densities in pockets of low-income settlements along the periphery, and the spatial fragmentation of the labour market, which disperses available work were identified as three critical concerns with regard to urban form and density (Republic of South Africa 2011c). The transformation of human settlements was subsequently also identified as one of the key elements in the final NDP. The NDP recognises that many of the elements of its spatial vision were known and accepted in 1994 but that the challenge has been "to translate the vision into implementation and meaningful spatial outcomes" (NPC 2012:286). The NDP identified a number of key elements forming part of the spatial vision for urban areas:

- Limit the occurrence of urban sprawl and support higher development densities;
- The development of affordable, large-scale, high density housing in inner cities should be supported by special incentives and subsidies ;
- Upgrade non-sustainable settlements by providing the required public infrastructure and services;

- Investment in new urban development and infrastructure should be focussed around public transport corridors and existing and emergent economic nodes;
- Improve integration of urban poor communities into city life through investments in transport infrastructure and corridors of development;
- Develop nodes of diverse economic activities within historically black townships to facilitate improved integration with wider urban economy;
- In-situ upgrading of well-located informal settlements;
- Promote a mix of race and income groups in new housing developments; and
- More attention should be given to the design and quality of urban public space

From an urban spatial planning perspective, the most profound post-1994 development has been the promulgation of the Spatial Planning and Land Use Management Act (SPLUMA) in 2013. The specific elements of this act relevant to urban spatial planning are the provisions that requires the development of a set of norms and standards for spatial and land use management; a set of development principles applicable to spatial planning, land development and land use management; and the sections describing the preparation and content of Spatial Development Frameworks (SDF) at various levels of spatial aggregation (ranging from a national level to a precinct level within an individual municipality). Section 21 of this act requires the SDF to include an implementation plan containing the specification of implementation targets, including dates and monitoring indicators. The identified principles for spatial development are spatial justice, spatial sustainability, efficiency, spatial resilience and good administration. These SPLUMA principles in turn underpin the objectives for the development of SDFs as outlined in the Department of Rural development and Land Reform guidelines for the development of provincial, regional, and municipal spatial development frameworks and precinct plans (2014).

The Integrated Urban Development Framework (DCOGTA, 2016) builds on various chapters in the NDP and specifically extends Chapter 8 of the NDP dealing with the transformation of human settlements and the national space economy. The IUDF aims to guide the development of inclusive, resilient and liveable urban settlements to address the unique conditions and challenges facing South Africa's cities and towns. The IUDF defines four overall strategic goals to achieve the vision of spatial transformation as follows (DCOGTA 2016:16):

- “Spatial integration: To forge new spatial forms in settlement, transport, social and economic areas.
- Inclusion and access: To ensure people have access to social and economic services, opportunities and choices.
- Growth: To harness urban dynamism for inclusive, sustainable economic growth and development.

- Governance: To enhance the capacity of the state and its citizens to work together to achieve social integration.”

These goals inform the nine policy levers of the IUDF and are premised on an understanding that (1) spatial planning forms the basis for achieving integrated urban development, which follows a specific sequence of urban policy actions: (2) integrated transport that informs (3) targeted investments into integrated human settlements, underpinned by (4) integrated infrastructure network systems and (5) efficient land governance, which all together can trigger (6) economic diversification and inclusion, and (7) empowered communities, which in turn will demand (8) effective governance and (9) financial reform to enable and sustain all of the above. Some of the identified policy priorities directly relevant to urban spatial planning within the context of this research include the following:

- Cities must identify the core public transport nodes and corridors and other infrastructure investments as part of a long term transit-oriented development (TOD) approach. The SDFs should ensure that new growth is concentrated along core transport corridors.
- Tenure upgrading, provision of basic services, social services, spaces for economic activities and alternative delivery models to upgrade informal settlements should be prioritised.
- The renewal and redevelopment of inner cities should be prioritised, with the focus on providing affordable housing, improving public sector investments and management, and urban management to make these areas safer.
- Densification, including support for back yarding in townships and low-cost housing neighbourhoods, should be supported. SDFs should recognise and accommodate various choices and options for increasing densities. Suburban densification options must also be intensified and extended through high-rise opportunities where appropriate.
- Townships should be redeveloped with a specific focus on investing in public infrastructure, improving public health and education, and strengthening the transport links between townships and areas of economic opportunities.

As indicated in the introduction to this chapter a planning doctrine reflects an overall principle of spatial organisation and influences the views of decision makers, politicians and the broader public at large. The two important elements of a planning doctrine are broadly accepted spatial planning goals, and spatial planning concepts to implement these goals. The first question to answer regarding the existence of a post-1994 spatial planning doctrine is whether a clear and consistent set of goals can be identified from the policy framework described in the preceding sections. An analysis of the various spatial goals and principles identified in this evolving policy and legal framework does indeed reflect a number of common and consistent urban spatial planning goals:

- **Goal 1:** Location of new urban development must provide access to economic opportunities and social amenities
- **Goal 2:** Greater integration and mix of a variety of different functions and land uses

- **Goal 3:** Optimum use of existing infrastructure and facilities
- **Goal 4:** Promote compact urban forms and higher population densities and discourage urban sprawl
- **Goal 5:** Reconfigure historically distorted spatial patterns and reduce spatial disparities
- **Goal 6:** Ensure environmentally sustainable development
- **Goal 7:** Promote efficient and productive cities through local economic growth
- **Goal 8:** Introduce more efficient public transport systems

The matrix provided in Table 3.1 below summarises and compares (across a temporal trajectory) the essence of the urban spatial planning goals articulated in the national level policy and legal framework since 1994.

Table 3.1: Summary of overarching urban spatial planning goals advocated by key elements of post-1994 national level policy framework

Policy framework component	Goal							
	1 – Access to economic opportunities & social amenities	2 – Greater integration & mix of functions & land uses	3 – Optimum use of existing infrastructure & facilities	4 – Compact urban form & increased densities	5 – Reconfigure distorted spatial patterns	6 – Environmentally sustainable development	7 – Efficient & productive cities through local economic development	8 – Efficient public transport systems
1.White Paper on Reconstruction and Development (1994)	•							
2.Development Facilitation Act (1995)	•	•	•	•	•	•		
3. National Urban Development Framework (1997)		•		•	•	•	•	•
4.Municipal Systems Act (2000) and Regulations (2001)	•	•	•	•	•	•		
5.National Development Plan (2012)		•		•	•			•
6.Spatial Planning and Land Use Management Act (2013)			•	•	•	•		
7.DRDLR guidelines for development of SDFs (2014)			•	•	•	•		
8.Integrated Urban Development Framework (2016)	•	•	•	•	•	•	•	•

The information depicted in Table 3.1 clearly indicates that these overall spatial planning goals consistently remained part of the post-1994 spatial planning agenda. Goal 4 (compact urban forms and increased population densities) and Goal 5 (reconfigure historical distorted spatial patterns and reduce spatial disparities) feature particularly prominent in this framework. Table 3.1 also indicates that, reading from top to bottom, these planning goals have consistently remained part of the policy framework since 1994.

3.3.3 Application of spatial planning goals in municipal level spatial planning

The overall urban spatial planning goals summarised in Section 3.3.2 are reflective of the spatial policy and legislation at a national level. Although local urban level processes and experiences informed this national level spatial policy and legislation, the question remains if, and to what extent, these goals have been embraced and incorporated in the municipal level SDFs as the principle municipal level spatial planning instrument. Only if the national views on urban spatial planning goals and the local municipal level implementation thereof in SDFs both reflect a similar set of goals and principles would it be possible to confirm a ‘spatial planning doctrine.’ The purpose of this section is thus to review the contents of the SDFs (municipal and sub-municipal level) of a selection of metropolitan and intermediate-sized cities which form part of this research with the aim of determining the application of the identified spatial planning goals.

Table 3.2: Application of urban spatial planning goals in sample of municipal SDFs

Spatial Development Framework	Goal number							
	1 – access to economic opportunities & social	2 – greater integration & mix of land uses	3 – Optimum use existing infrastructure & facilities	4 – Compact urban form & increased densities	5 – Reconfigure distorted spatial patterns	6 – Environmentally sustainable development	7 – Efficient & productive cities	8 – Efficient public transport systems
Metropolitan & Municipal level SDFs								
Johannesburg Spatial Development Framework 2011		•	•	•	•	•		•
Cape Town Spatial Development Framework 2012	•	•		•	•	•	•	•
eThekweni Spatial Development Framework 2011	•	•		•	•	•	•	•
City of Tshwane Spatial Development Strategy 2010	•			•	•	•	•	
Buffalo City Spatial Development Framework 2003	•	•		•	•	•	•	•
Mangaung Spatial Development Framework 2011		•		•		•		
Rustenburg Spatial Development Framework 2011	•	•		•	•	•	•	•
Msunduzi Spatial Development Framework Review 2009	•			•		•	•	
Emalahleni Local Municipality Spatial Development Framework 2010	•	•		•	•	•	•	
Mbombela Spatial Development Framework 2006				•	•	•		
Sub-metropolitan/Sub-municipal SDFs								
Johannesburg Regional Spatial Development Framework for Region D 2011			•			•		•
Helderberg District Plan: Spatial Development Plan and Environmental Management Framework (Cape Town) 2011	•	•		•	•	•	•	•
eThekweni Municipality Central Spatial Development Plan 2011	•	•		•		•	•	
Tshwane Regional Spatial Development Framework North Eastern Region 2007		•	•	•	•	•		
Bonza Bay Local Spatial Development Framework (Buffalo City) 2008	•	•			•			

These municipalities are generally regarded as having the necessary operational and planning capabilities for the effective interpretation and implementation municipal spatial planning processes. For geographical diversity, the cases are also located in different regions of South Africa. The SDFs that were analysed are summarised in Table 3.2. The analysis of the plans focussed on the urban spatial planning goals as outlined above, as well as the spatial concepts and spatial planning proposals to implement these goals. The narrative content, spatial proposals and concepts contained in the SDFs were analysed. The information depicted in Table 3.2 clearly indicates that most of the identified urban spatial planning goals synthesized from the national level policy and legal framework have been widely applied in the local SDFs under consideration. In seven of the 15 SDFs analysed, six or more of these goals were adopted. Those SDFs that pursue a smaller number of the identified goals are mostly sub-metropolitan SDFs, or SDFs of smaller intermediate-sized city municipalities where it can be expected that local level issues will dominate the planning debate.

The results indicate that as much as 14 of the 15 reviewed SDFs showed clear evidence of pursuing the goal of environmentally sustainable development, 13 of the 15 SDFs pursuing the goal of compact cities, increased densities and discouraging urban sprawl, and 11 of the 15 SDFs pursuing the goals of integration of different land uses and functions, and reconfiguring historically distorted spatial patterns. The application of these goals in the SDFs indicate the extent to which they form part of a ‘coherent body of thought’ amongst decision makers and the broader public.

3.3.4 Urban spatial planning concepts applied in municipal and sub-municipal Spatial Development Frameworks

As indicated in Section 3.1, the second element of a planning doctrine is a set of spatial planning concepts believed to be relevant to the implementation of these goals. The results portrayed in Sections 3.3.2 and 3.3.3 reflected on the spatial planning goals. In this section the attention turns to the planning concepts applied in the SDFs to pursue the implementation of these overall spatial planning goals. Both the narrative content and the spatial proposals and concepts contained in these SDFs were analysed for this purpose. As indicated in Table 3.3 a total of 13 broad spatial concepts consisting of as many as 85 sub-classes were identified in the 15 SDFs that were reviewed in detail.

The three most widely used spatial planning concepts are development corridors; development nodes; and economic investment zones. The former was applied in 14 of the 15 SDFs and the latter two in 12. This finding is consistent with the results of earlier research that indicated that by the year 2000 most municipalities in South Africa applied development corridors as a planning tool (Donaldson, 2006). Both these spatial planning concepts are crosscutting and contributes to the implementation of all eight the overall urban spatial planning goals. Other widely applied spatial development concepts in the municipal SDFs are open space systems (applied in 11 of the 15 SDFs), urban expansion areas (applied in 10 of the 15 SDFs), and urban edges/boundaries (applied in 9 of the 15 SDFs). What is also evident from this analysis is the wide range of interpretations attached to the concepts of development corridors, and development nodes. As many as 16 different sub-classes are used to describe each of these concepts in the SDFs evaluated. In contrast, other concepts such as urban edges and open space systems are much more consistently described across the various SDFs.

3.3.5 Summary and assessment of spatial planning doctrine

Based on the findings above there is clear evidence of a well-established urban spatial planning doctrine in South Africa, including a number of broadly accepted spatial planning goals and spatial planning concepts for the implementation of these goals. Although many of these elements have emerged after 1994, some have their origin earlier during the final stages of decay of the apartheid spatial planning system. The elements of this spatial planning doctrine are well established in national policy and legislation spanning over a period of more than 20 years and have been widely applied in the spatial plans of the larger urban municipalities in South Africa. This urban spatial planning doctrine (or overall principle of spatial organisation) can thus be described as follows:

1. *Reconfiguring historically distorted spatial patterns (long-term vision)...*
2. *...by creating compact, sustainable and productive cities (long-term outcomes)...*
3. *...through establishing a greater mix of land uses, increased population densities and access to economic opportunities, and improved public transport systems (medium term outputs)...*
4. *...focussed on a network of nodes and corridors (implementing spatial concepts).*

Having convincingly established the key components of the spatial planning doctrine it is imperative to evaluate these components against the reality of the triggers and processes driving evolving urban form as described in Chapter 2.

The first key component of the doctrine described above is the vision to ‘**spatially reconfigure**’ South African cities to modify the identified spatial legacies from historical colonial and political ideologies. One of the key elements of the social organization of space is that people prefer to live in small and identifiable places such as specific neighbourhoods or urban precincts where they feel intuitively most

comfortable with (Geyer 2007a). Spatial plans to drive ‘reconfiguration’ are thus likely to yield the best results if approached from a neighbourhood or precinct level, instead of higher city level plans. Although consistent interventions are required at various scales, the real success of ‘reconfiguration’ will be determined at local neighbourhood level.

A simple, but often overlooked, aspect affecting the idea of reconfiguration is the element of physical constraints. The urban structure of South African cities (see Appendix A) on face value reflects a ‘fragmented’ urban structure with widespread occurrence of undeveloped areas. In practice, a significant proportion of the undeveloped parts of these urban footprints are however influenced by physical constraints such as historical mining areas in Johannesburg and existing mining areas in Witbank, environmentally sensitive areas and physical constraints in Cape Town, and topographical constraints in eThekweni and Pietermaritzburg. These locally contingent factors thus have a significant impact on the relevance and applicability of widely supported normative planning concepts to implement the ‘reconfiguration’ vision.

The view of cities as complex systems described in Section 2.6 emphasized the importance of the concept of ‘emergence’ where “...elements that are governed by a few simple rules and operate through trial and error with interaction and feedback can produce persistent and systematic patterns that are quite unlike the original elements” (Innes and Booher 1999:417). The implication is that spatial plans and policies that are based on a limited number of simple rules or principles, rather than complicated ‘integrated’ plans, can produce persistent and systematic patterns unlike the original elements. This in essence is what the vision of ‘spatial reconfiguration’ aims to achieve. The first condition as specified in this idea of ‘emergence’ is that the rules and principles have to operate through trial and error with interaction and feedback. This principle of trial and error is a much more plausible approach at smaller scales such as neighbourhoods, rather than the overall metropolitan scale. The second condition is the need for relevant and ongoing evaluation and feedback to assess the effect of the established basic principles. The detailed requirements of such an evaluation and feedback system for spatial planning are described in detail in Chapter 4.

A final relevant aspect related to the vision of ‘reconfiguration’ is the impact of the quality and effectiveness of the planning system. As indicated in Chapter 2 the availability (time and resource wise) and quality (skills levels) of human resources available in the planning system determines the complexity of spatial planning processes that can be successfully dealt with, and largely influences the quality of outputs and outcomes from spatial planning. The concept of cybernetics as applied to spatial planning by Karadimitriou (2010:442) is particularly relevant here: “No system can be controlled by another, less complex, system unless that control becomes restrictive, thus reducing the complexity of the controlled system. The outcomes of failed attempts to control complex socio-spatial systems through

much less complex controlling systems plague societies all over the world". This implies that complex urban systems cannot be successfully controlled or influenced by a planning system (and operating environment) without the necessary level of sophistication and complexity.

The second key component of the identified spatial planning doctrine is the notion of **compact city structures and increased population densities**. As indicated in Section 2.2, demographic structural changes as manifested in Mumford's (1925) 'fourth migration' (dominance of people migrating from the central cities to the suburbs) and Fishman's (2005) 'fifth migration' (re-urbanisation of inner-city districts that were previously depopulated, especially through immigrants) significantly influence the overall spatial patterns of cities. The results outlined in Appendix B and described in detail in Chapter 6 indicate that there are clear evidence of increases in population density in and around the traditional CBD areas, as well as widespread increases in decentralised suburban locations in the metropolitan cities analysed. These findings confirm elements of Mumford's fourth migration, as well as Fishman's concept of a 'fifth migration' in some of the cities analysed in this study. This implies that the concept of spatial planning aimed at compact city structures and increased population densities in specific locations cannot assume a simplistic view – it has to recognise the different factors and processes operating at various scales in cities and resulting in different outcomes.

These include aspects such as advances in ICT and transportation resulting in certain segments of the labour market becoming more geographically independent, and the concept of bid-rent based on the principle that the land use that provides the highest revenue at a particular location will outbid all other uses. As a result, affordable housing is often developed at decentralised locations on cheaper land, which is the opposite outcome than the vision of compaction and densification (Geyer 2007a). The interplay of these various forces are however not always that simple. Although middle and higher income groups may generally prefer ample space over shorter journey-to-work, poorer households with limited ability to spend on transportation costs will prefer to reside within easy access to employment and services. These households may consequently be willing to bid more per unit of land than richer households (Green 2012) and many cities thus have poor people living in city centres at very high densities (and often of poor quality), and not only at peripheral locations on cheaper land. These trends are particularly noticeable in the case of Johannesburg and Tshwane with a significant concentration of high-density low-income households residing in inner-city locations such as Hillbrow, Arcadia and Sunnyside. This does not only take the form of high-density residential buildings, but also some derelict industrial and commercial buildings (who left the inner-city areas because of decentralization) that are converted for residential purposes (often informally and/or illegally).

As discussed in Section 2.2.3 the aim of increased population densities in central parts of South African cities thus presents a complex challenge going well beyond the mere technical issue of providing more homes (Turok 2011). One of the specific challenges identified is the tension between the different goals

of accommodating low-income groups whose choices are limited by affordability constraints, attracting middle- and high-income families with a choice of where to live, and providing flexible space for business and related activities. Spatial planning concepts such as urban development boundaries and zoning mechanisms also play an important role in the goal of compact city structures and increased densities. As indicated in Section 3.3.4 above, urban edges are a widely used planning instrument to limit the lateral expansion of urban footprints. The short-term impact of these types of instruments is that population growth will mostly take the form of urban development within the existing urban footprint. This will however result in upward pressures on land prices that may eventually in the longer run be strong enough to result in ‘leapfrog’ development outside the urban edge. The short-term benefits of such policies may thus in the longer term have the opposite effects than originally intended.

The concepts of productionism and environmentalism as the primary triggers of migration decisions are also particularly relevant in the assessment of the goal of compact city structures and increased population densities. At an intra-urban level many households value aspects such as proximity and access to open space, lower noise levels, and scenic landscapes and will be willing to pay for these attributes in lower density parts of cities (Gordon & Richardson 1997). Others will be seeking locations optimising access to potential economic opportunities, often in closer proximity to inner-city areas. Spatial planning policies can thus not only make provision for the latter and ignore the spatial implications associated with environmentalism. The interplay of centripetal and centrifugal forces resulting in the agglomeration of economic activities is a further factor that do not necessarily support the concept of compact development. The manifestation of these spatial patterns of economic agglomeration in South African metropolitan cities is reflected on Figure C3 in Appendix C and discussed in more detail in Chapter 7. It shows clearly defined emerging decentralised spatial clusters of economic activity density (commercial and industrial) over the period 1994 to 2010 in South Africa’s four largest metropolitan cities. These trends in principle do not align with the principle of ‘compact’ city structures.

The third key component of the spatial planning doctrine is the overall goal of establishing a **greater mix of land uses**. This goal is mainly informed by the postmodern view, and especially the views of new-urbanists, that spatial segregation of functions is outdated should instead be replaced by the integration of separated and specialised places and cultural and ethnic integration (Gottdiener & Budd 2005). The new-urbanist notion of relatively self-contained neighbourhoods characterised by a ‘balanced’ mix of uses and functions such as dwellings, places of employment, retail facilities, parks, and social institutions in a single neighbourhood also informs the concept of mix of land uses. Although there are undoubtedly elements of this view that are applicable in the South African urban context, there are also a number of factors to consider when determining the relevance thereof in individual local contexts. As eluded to earlier, people in cities across the world prefer to live in small and identifiable places such as specific neighbourhoods or urban precincts where they feel intuitively most comfortable.

This implies a limit to the level of ‘land use mix’ that would be acceptable at a neighbourhood or precinct level, before processes such as invasion and succession as described in Chapter 2 will start to modify the planned character of a precinct. Despite the widely accepted principle of ordering urban structure based on economic function (for example based on zoning), there is a general fear amongst urban governments worldwide that socially homogenous clusters in urban and suburban settings can be perceived as fragmented cities (Boterman & Musterd 2017).

One of the arguments in support of an increased mix of land use and the idea of relatively self-contained neighbourhoods is the co-location hypothesis. This hypothesis assumes that conditions of greater employment-housing balance at a local level will result in a decrease in congestion (Kim 2008). This assumption is however not that clear. As indicated in Chapter 2, the results of empirical studies revealed divergent views on this matter. Some research found that the co-location of jobs and housing as part of the suburbanization process have mitigated congestion in urban areas with polycentric and dispersed structures and facilitated shorter commuting times and distances (Gordon, Kumar & Richardson 1989; Crane & Chatman 2003). Other authors however established increases in average commuting time and distance with higher levels of employment decentralization (Hamilton & Röell 1982; Cervero & Wu 1998) or stable average commute time and distance regardless of residence and workplace mobility (Kim 2008).

3.4 SUMMARY AND CONCLUSIONS

This chapter provided an overview of the historical and local contingent factors in South Africa influencing the operation of the triggers and forces described in Chapter 2. The spatial development of South African cities was strongly influenced by both the pre-1948 colonial legacy that first introduced structural segregation of towns and cities in the period after the 1850’s (coinciding with the rise of the age of imperialism), and the post-1948 apartheid planning system shaped by policies and legislation such as the various versions and amendments of the Group Areas Act. The outcome of both the colonial and the post-1948 apartheid city policies is a distinct set of characteristics attributed to South African cities and commonly referred to as the ‘apartheid city’. The characteristics widely attributed to the ‘apartheid city’ include a segregated and fragmented spatial form, peripheral location of low income settlements resulting in unequal access to economic and social opportunities, social segregation, urban sprawl, and low population densities.

The notion of ‘spatial transformation of cities’ hence emerged as a key element of planning policy in South Africa subsequent to 1994. The analysis of this evolving policy and legal framework as described in Section 3.3 clearly identified a number of common spatial planning goals and concepts that have been widely applied in the SDFs analysed. This doctrine (or principle of spatial organisation) can thus be described as follows:

- Long term vision: Reconfiguring historically distorted spatial patterns
- Long term outcomes: Compact, sustainable and productive cities
- Medium term outputs: A greater mix of land uses, increased population densities and access to economic opportunities, and improved public transport systems
- Implementing spatial concepts: A network of nodes and corridors.

This identified spatial planning doctrine is well established in national policy and legislation and widely applied in the municipal SDFs of the cities analysed. In accordance with Objective 2 of the research, the results of this chapter confirmed that the identified doctrine has influenced the spatial plans of the case study cities investigated. As indicated in Section 3.3.5 the relevance of the individual elements of this doctrine at a local level should be critically evaluated against the reality of urban processes as described in Chapter 2. The theoretical and methodological framework for evaluating the influence of spatial planning processes and spatial plans are subsequently described in Chapter 4, and the changes to urban structure and the influence of SDFs on these changes in Chapters 5 to 7.

4 CHAPTER 4: THEORETICAL AND METHODOLOGICAL FOUNDATIONS OF SPATIAL PLANNING EVALUATION

4.1 INTRODUCTION AND BACKGROUND

Despite increasing research attention into public policy and plan implementation in fields such as public administration and management sciences (McKevitt & Lawton 1994; Carmona & Sieh 2005; Mayere et al 2008), little focus has been directed at the evaluation of implementation processes and outcomes in the physical and spatial spheres of planning (Talen 1996; Berke et al. 2006). The problem statement presented in Chapter 1 identified the inadequate theoretical and methodological underpinnings of spatial planning and spatial plan evaluation methodologies, the paucity of empirical evidence of spatial planning evaluation results, and the reliance on assumptions and anecdotal evidence to pronounce on the successes and failures of spatial plans as a specific issues of concern. Existing empirical research on planning evaluation also tends to focus on the characteristics and quality of plans and planning practice, with little attention to the achievement of plan objectives and policies in practice (Seasons 2003). A further important, but often overlooked, fact is that although planning is generally a relatively minor public service in expenditure terms, it has potential major impacts in economic, social and environmental terms (Carmona & Sieh 2005).

An important point of departure to address these shortcomings is thus to reflect on the evolving theoretical views in the field of procedural urban planning theory as a point of departure towards identifying a set of basic principles to guide the development of appropriate spatial planning²⁰ evaluation processes and methods. This chapter contextualises the concept of spatial planning evaluation against the background of the changing paradigms prevalent in the broader field of procedural urban planning theory. A theory can be defined as “a set of statements that makes explanatory or causal claims about reality” (Mouton 2011:177). These theories can either be developed through an inductive approach (such as statistical analysis of empirical data leading to the development of theory) or a deductive approach departing from certain hypotheses and theoretical propositions that is ultimately tested against empirical data. Paradigms on the other hand can be viewed as broader frames of reference that assist theorists to channel their observations and findings and include norms, values, and methods in addition to theories (Mouton 2011).

This chapter firstly focusses on the main paradigm shifts in procedural planning theory (‘theories of planning’) and its implications for spatial planning evaluation (Section 4.2). It then proceeds to highlight a number of conceptual challenges and dilemmas for spatial planning evaluation in Section 4.3 and

²⁰ The term ‘spatial planning’ refers to both the processes and products prior to the final adoption of a plan (including activities such as goal articulation, development and evaluation of alternatives, stakeholder consultation, and the compilation of a final plan document), as well as those subsequent to plan adoption (including plan implementation procedures and processes, and the eventual outcomes of plans).

methodological considerations in Section 4.4. The implications of these sections are then synthesized into a number of basic principles for spatial planning evaluation as a point of departure for the development of a comprehensive methodological framework. This synthesis (described in Section 4.5) uses the intersect between the main paradigm shifts in procedural planning theory (as described in Section 4.2) and the conceptual and methodological considerations (described in Sections 4.3 and 4.4) as a structuring framework. Current practices with spatial planning evaluation in South Africa are described in Section 4.6 and, using the basic principles established in Section 4.5, it identifies potential shortcomings in the existing approaches and methods. Section 4.7 systematically incorporates the relevant elements from the various preceding sections to describe a proposed comprehensive spatial planning evaluation methodological framework.

4.2 PARADIGM SHIFTS IN PROCEDURAL PLANNING THEORY AND ITS IMPLICATIONS FOR SPATIAL PLANNING EVALUATION

4.2.1 Mapping the landscape of planning theory

The theoretical understanding of urban planning since the second half of the twentieth century have proliferated both in terms of scope and depth. This is evidenced by the number of ‘readers’ or ‘companions’ on planning theory that appeared since the 1980s. Some of these well-known works include *Planning Theory in the 1980s: A Search for Future Directions* (Burchell, Sternlieb & Beauregard 1978); *Planning Theory: Prospects for the 1980s* (Healy, McDougall & Thomas 1982); *Explorations in Planning Theory* (Mandelbaum, Mazza & Burchell 1996); *Planning Futures: New Directions for Planning Theory* (Allmendinger & Tewdwr-Jones 2002); *Planning History and Methodology* (Wegener, Button & Nijkamp 2007); *Critical Essays in Planning Theory* (Hillier & Healy 2008); *The Ashgate Research Companion to Planning Theory* (Hillier & Healy 2010); *A Planner’s Encounter with Complexity* (de Roo & Silva 2010); *Readings in planning theory* (Fainstein & Campbell 2012), and numerous others. Any discussion of planning theory and its relevance to a specific matter of interest thus requires some structure or classification to give order to this very broad field of study. Attempts to classify and describe planning theory in general, and procedural planning theory specifically, generally provides either a chronological or thematic exposition of this subject. Despite these attempts there is no general consensus of opinion to the extent that Yiftachel (1989:23) stated that the theoretical foundations of planning are “deeply divided, confused, and of little help to students and practitioners.” Although probably a somewhat pessimistic view, it does highlight the need for some framework to logically map the landscape of ideas in planning theory.

One of the best known earlier attempts, and an important point of departure to classify urban planning theory, is the dichotomous typology of Faludi (1973) distinguishing between ‘procedural’ and ‘substantive’ planning theories. He described substantive theories as dealing with interdisciplinary

knowledge relevant to the content or object of planning (cities and urban land use), and procedural theories as concerned with preferred methods and processes of decision-making. This dichotomous classification of planning theory, although recognized as offering a useful point of departure, was however criticized for not providing an adequately nuanced framework for comprehensively dealing with a wide body of planning theory (Christensen 1985; Yiftachel 1989). Building on his original procedural-substantive distinction, Faludi developed a revised typology consisting of three categories: object-centred, control-centred and decision-centred views of planning (Faludi 1982). In terms of this classification the object centred view of planning refers to the comprehensive knowledge of the object (city or other unit of spatial analysis) leading to prescriptive action. The control centred view of planning deals with the extent of control required to affect change, while the decision centred view is focused on the preparation and evaluation of alternative courses of action. Yiftachel (1989) proposed a similar triad of categories originating from distinctly different but overlapping disciplinary tradition of planning theory (Figure 4.1). The first category of theories explores the societal goals of urban planning. The second category deals with different theories on how best to achieve these given goals (procedural debate) and is similar to Faludi's decision centred view of planning, while the third category (urban form debate) considers theories of the actual physical effects of planning goals and procedures and are similar to Faludi's object centred view of planning.

A simple Planning process	Level of analysis	Theoretical debate	Dominant theoretical characteristics
<pre> graph TD A[Formulation of goals] --> B[Translation of goals into plan] B --> C[Analysis of plan] C --> A </pre>	Broad societal/political	What is planning? (Analytical)	Explanatory and substantive
	Narrow professional	Good Planning process? (Procedural)	Prescriptive and procedural
	Broad professional	What is good urban form? (Urban form)	Prescriptive and substantive

Source: Yiftachel, 1989

Figure 4.1: Operational levels and theoretical characteristics of the three debates of planning theory.

More recent attempts to classify urban planning theory (Davoudi 2015; Alexander 2016) focused on the interrelationships between the various elements of planning. These classifications attempt to associate planning theories to the interrelated elements of the planning process (with some element of chronological sequencing) and include the following categories:

- Theories dealing with the '*what*' (the object) of planning, referred to by Davoudi (2015) as cognitive/theoretical knowledge and the 'object' described by Alexander (2016) as human activities in space and the context within which they occur.

- Theories dealing with the ‘where’ of planning. Alexander (2016) refers to the social–institutional context of spatial planners’ practice and suggests analysis of the relevant institutional environment of spatial planning institutions and processes.
- Theories dealing with the ‘how.’ Davoudi (2015) refers to ‘skills and technical knowledge’ and ‘doing’ while Alexander (2016) describes it as the tools including the concepts, methods, skills, and competencies needed for effective practice.
- Theories dealing with ‘to what end’ and referred to by Davoudi (2015) as moral choices (e.g. what is ideal urban form).

Ultimately the aim of this chapter is not a general discussion of urban planning theory for the sake of a literature review of ‘planning theory’, but primarily to understand the fundamental evolving paradigms and theories in urban planning relevant to the identification of basic principles to guide the development of a comprehensive methodological framework for spatial planning evaluation. This analysis of planning theory is thus concerned with ‘procedural’ planning theory as opposed to ‘substantive’ planning theory (key elements of the latter were discussed in Chapter 2). Despite the inherent value of the different approaches to ‘classifying’ urban planning theory as outlined above, none of them provides an entirely satisfactory framework for the purposes of unravelling the procedural issues in planning theory.

The structure as outlined in Figure 4.2 is thus used as the guiding framework for the remainder of this section. It brings together the main trends in evolving ‘procedural’ urban planning theory (conceptually similar to Yiftachel’s procedural debate, Davoudi’s theories of dealing with the ‘how’, and Alexander’s tools for effective practice), with the broader contextual norms and conceptual orientations of these procedural theories.

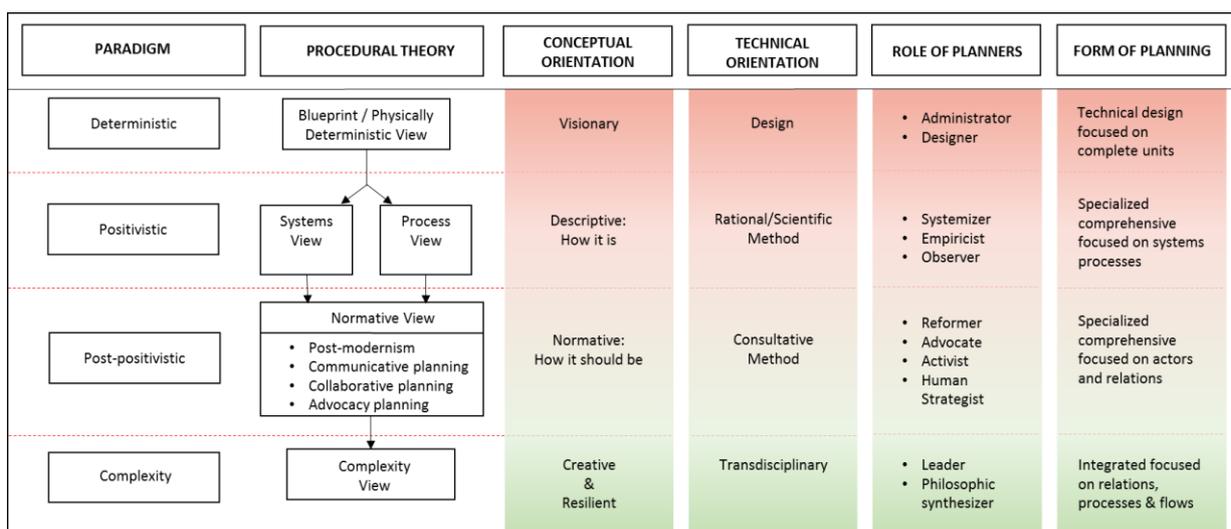


Figure 4.2: A conceptual representation of broad paradigm shifts in procedural planning theory

This structure links the main theoretical streams with the associated predominant conceptual and technical norms and values, as well as the primary role of planners associated with each framing

paradigm and the implied form of planning. Although not strictly chronological it provides some temporal perspective to the analysis framework. The metaphors used to describe the four identified paradigms are the ‘deterministic’ paradigm, the ‘positivistic’ paradigm, the ‘post-positivistic’ paradigm, and the ‘complexity’ paradigm. The identified theoretical views within each of these broad paradigms do not lay claim to ‘scholarly primacy’ within a specific paradigm, nor representing an exhaustive listing of alternative theoretical views. Its aim is to broadly map the theoretical landscape and the dominant conceptual and philosophical orientation within each paradigm.

Important to the interpretation of this framework and the subsequent narrative discussion is the author’s view that there is no strictly defined impermeable boundaries between the identified paradigms in spatial planning. Most spatial planning processes contain some elements from more than one, or all of the paradigms discussed in the subsequent sections. The principles guiding the development of a comprehensive spatial planning evaluation methodology should thus be sufficiently robust to accommodate these different approaches or at least parts of them.

4.2.2 Deterministic paradigm

Urban planning has its origins in attempts to solve the social and functional problems of the industrial city and the aim to provide less congested urban space primarily through physically deterministic plans (‘blueprint planning’). Planning as a profession was brought to prominence by the early planning visionaries of the pre-war period such as Soria y Mata (well-known for his concept of a ‘linear city’ developed along an axis of high speed and high intensity transportation), and Le Corbusier with his ‘Radiant City’ consisting of very high densities in the form of very tall structures interspersed within a predominantly open landscape. It also includes prominent thinkers such as Ebenezer Howard and his concept of garden cities, Geddes’s development of a planning process with a logical ‘survey-analysis-plan’ structure, Frank Lloyd Wright’s concept of ‘Broadacre City’²¹, and Abercrombie’s introduction of decentralized city-regions and new towns (Hall & Tewdwr-Jones 2011). This physical blueprint planning mode of urban planning is also associated with the extensive post-war rebuilding efforts that focused on comprehensive urban reconstruction and renewal schemes and the reconstruction of damaged areas (Hall 2000).

The planning process was focused on producing complete planning units and neighbourhood planning was a key element in the planning of urban settlements (Mumford 1954). The defining characteristics of this mode of planning were its focus to produce overall blueprints for the development of entire cities or parts of cities with a specific focus on physical planning and design (Taylor 1998) administered by

²¹ The concept of planned, but completely dispersed, low-density urban development connected by highways and primarily serving the needs of automobile owners. It can be viewed as the conceptual opposite of Le Corbusier’s high density cities.

public professionals . The concepts of modernism (uniformity, tidiness and order) and the improvement of cities through scientifically devised intervention (Hamer 2000) are important underlying principles of this mode of planning. Many current municipal SDFs still contain some elements of detailed physical planning in the form of urban development and design guidelines. The latest set of guidelines for the preparation of SDFs in fact specify guidelines for land use management, social facility provision, conservation and other aspects as one the required deliverables of the process. The primary role of planners under this paradigm can best be described as ‘administrators’ and ‘designers’ (Udy 1994)²² responsible for implementing the principles of modernism through ‘bureaucratic intelligentsia’ viewed as responsible for the greater cause of social transformation (Scott 2012).

The main point of criticism that emerged against this mode of planning was its lack of involvement from and consultation with citizens and assuming a consensus view of planning values (Meyerson & Banfield 1955, Hall 2000). A further criticism against blueprint planning is that it assumes certainty and control as the bases for its actions and hence planners acting on the basis of a simplified view of the world around them (Lane 2005). These criticisms influenced the emergence of alternative approaches such as Lindblom’s (1959) ‘muddling through’ approach based on the principles of choosing from a restricted range of policy alternatives and consequences, and a process of constantly adjusting policy objectives²³. The planning approaches under the blueprint paradigm were also criticized based on its assumption that the physical layout of an environment resulting from a comprehensive planning process would necessarily determine the resulting quality of social life (Broady 1968). Although not the only factor influencing the quality of life in a defined area, the physical layout of an environment remains one of the prominent factors in this regard. These various criticisms resulted in the emergence of a new positivistic or ‘scientific’ planning paradigm during the 1960’s.

4.2.3 Positivistic paradigm

4.2.3.1 Conceptual and technical orientation

This changing paradigm from deterministic to positivistic represented a shift from a primarily physical and architecturally design oriented process to planning as a science that not only deals with the physical aspects of cities, but also with social life and economic activities (Taylor 1998). Positivism assumes objective interpretations of reality through scientific method and cause-effect relationships. According to Khakee (2003), one of its underlying principles is neutrality of research implying that analysts are unbiased neutral observers undertaking value-free inquiry. This view perhaps overstates some of the

²² Based on the ‘matrix of planners’ as conceptualised by John Udy (1994) who postulated four major types (reformers, synthesizers, systemizers and administrators) each divided into four subgroups that represent differences in professional orientation.

²³ Despite the emergence of new theoretical approaches Lindblom re-asserted his approach twenty years later claiming that despite its limitations, incrementalist analysis remained a pragmatic approach (Lindblom 1979).

characteristics of the positivistic planning process. Rather than being uninvolved and ‘neutral,’ positivistic enquiry in planning requires the planner to be involved, yet unbiased towards all groups being planned for. It implies a balanced scientific approach towards the planning environment which is not ‘value-free’ but one where applied values are empirically supported. Empirically derived applied knowledge of reality is therefore a basic point of departure in positivistic planning enquiry. The conceptual orientation of this paradigm can be described as a descriptive approach that views the purpose of planning as understanding the ‘how it is’ of aspects such as land-use and other related forms of planning (Alexander 1988). Its primary technical orientation is a rational view of planning based on scientific planning methods and was spearheaded by the introduction of technical approaches such as economic base studies of cities (Blumenfeld 1955), empirical analysis of the impact of accessibility on land use (Hansen 1959), and the analysis of cities as integrated systems (Alexander 1965) – analyses that are still being pursued in spatial planning and economic enquiry (e.g. Su & Ang 2010; Partridge & Rickman 2010; Geyer HS Jr & Molayi 2018; Zhu et al 2018). The results of these rational and ‘scientific’ approaches are the view that social, economic, and environmental dynamics are interrelated within the space of cities (Graham & Healy 1999).

The dominant form of planning in this paradigm is based on the view that cities consist of sub-systems that can be analyzed and modelled individually as part of specialized comprehensive planning processes. The role of planners within the positivistic paradigm can best be described as ‘systemizers’, ‘empiricists’ and ‘observers.’ The two distinct but related streams of procedural planning theory that emerged under this positivistic paradigm is the systems view of planning and the process view of planning.

4.2.3.2 Views of procedural planning theory

a. Systems view of planning

The view of cities as systems consisting of interacting and interrelated activities resulted in the emergence of a systems approach to planning during the 1960s (Berry 1964; Chapin 1965; McLoughlin 1969). Systems theory changed the traditional view of space into a view of individual land uses and settlements as forming part of a spatial system within networks of interrelated places (Hagget 1965). From an urban systems perspective urban planning deals with a system of interconnected parts and planning is primarily concerned with identifying interrelationships rather than individual components and seeing patterns rather than static situations (Nel 2009).

From a procedural perspective, Chapin (1963) provided one of the first attempts to outline a comprehensive system that can guide the integration of these interrelated components through various individual planning techniques. He suggested a system consisting of five interrelated components including a general plan for the metropolitan region, urban development policies, metropolitan area public works programme, an urban development code, and an informed metropolitan community.

Chapin recognized the criticisms against ‘blueprint plans’ as outlined in the previous section but maintained an important role for general plans (also known as a master plan, guide plan, and development plan) as part of a systems approach to planning. Within this context these plans recognize structural relationships in a functional context (such as different land uses, infrastructure and facilities), a time context for sequencing public action, and a spatial context by establishing the form of urban expansion. These long established principles of functional integration and sequencing of action remains key components of both the current IDP and SDF processes in South Africa²⁴. The fifth programme of civic education, although recognized as a relatively underdeveloped technique at that time, demonstrates the importance attached to the notion of civic participation as part of a comprehensive planning system – an element of planning more generally associated with later theoretical approaches of the post-positivistic paradigm.

McLoughlin was also one of the early pioneers attempting to apply systems thinking in the field of urban and regional planning and viewed planners as playing an important role in the urban system acting as the “helmsman steering the city” (McLoughlin, 1969:86). This ‘steering’ function was achieved through the two main controls under the influence of planners: influence over public investment development policy, and decisions regarding private proposals. The emergence of computer technology during the 1960s provided further impetus and introduced a new focus and ability to explore the idea of systems planning. The main points of criticism against these early, computer based urban models was that it lacked a sound theoretical base. The innovative pioneering work of Wilson (1967) who introduced entropy theory to spatial distributions, and Alonso (1968) who incorporated the concept of bid rent theory to location models represented significant advances with computer-based urban modelling by introducing a sound theory to the models.

b. Process view of planning

A second important stream of theoretical responses in the positivistic paradigm that emanated from the criticism against the blueprint mode of planning was the emergence of the rational process view of planning. It is essentially concerned with process and methods of planning. The rational process view considers the planning process as essentially linear in character and assumes that the planning process follows a logical and ordered sequence of phases. The earlier Gedessian view of planning (originating during the period dominated by the blueprint paradigm) identified this sequence of phases in the well-known concept of ‘survey-analysis-plan.’ These early conceptualizations were however characterized by three deficiencies (Taylor 1998). Firstly, the precondition that the reason for undertaking a survey is the existence of a specific problem or an aim; secondly the assumption of a singular best plan; and thirdly that the process ends with the ‘plan’. This rational process view represented a new approach that viewed planning as an ongoing process without a final end state and includes monitoring the effects of

²⁴ The concept ‘sequencing and willingness to prioritise’ is also included as one of the six critical success factors in the NDP.

the plan with feedback loops to any of the preceding stages. This rational process view of planning hence conceptualised the planning process as consisting of five distinct stages²⁵ in a rational process of planning and, despite criticism, have remained remarkably unchanged over more than 40 years of urban planning practice since its introduction in the 1970s (e.g. Roberts 1974; Chapin & Kaiser 1985; Taylor, 1998; Hall & Tewdwr-Jones 2011):

- Definition of problems and goals
- Information gathering and identification of alternative plans and policies
- Evaluation and selection of alternative plans and policies (decision making)
- Implementation of plans and policies
- Monitoring of effects of plans and policies

This view of planning as an ongoing process without a final end state represents a significant break from the blueprint paradigm of planning. It also introduced the important activity of monitoring the effects of the plan and making provision for feedback loops to any of the preceding stages.

4.2.3.3 Criticisms of the positivistic paradigm

The first main point of criticism levelled against the positivistic paradigm is its assumption of unbiased neutral observers undertaking value-free inquiry resulting in objective interpretations (Khakee 2003). However, as indicated earlier, positivistic enquiry in planning does not necessarily imply ‘neutral’ and uninvolved planners, but rather planners unbiased towards all groups being planned for. Empirically derived applied knowledge of reality is therefore a basic point of departure in positivistic planning enquiry, a view that is more in line with Torgerson (1986) who asserted that the enquiry of policy analysts (or planners) is mediated through their values as active participants. The second point of criticism against this paradigm is the underlying assumption of a high degree of control over the decision-making situation and the emergence of alternative views of planning as a coordinating mechanism and the concept of ‘planning-as-learning’. Faludi (2000:302) described planning-as-learning as “situations requiring the coordination of various actors, each with a perspective on the issues at hand of his or her own, perspectives that need to be adjusted to each other before action can be taken”. This point of criticism probably overstates the assumption of a high degree of control over the decision-making situation. The current SDF processes for example assumes some degree of control within the institutional environment as outlined in Chapter 2, but recognizes its limitations to have a high degree of direct control in the demographic and economic environments. A third point is the evolvment of

²⁵ There are some variations to the division and labelling of these phases but the basic premise remains largely the same. Friedmann (1987) for example identified seven stages in what he described as the ‘ideal-typical’ decision model in policy analysis. It includes five stages similar to the generic stages outlined here but with the addition of two further stages: evaluation of the consequences that will follow the adoption of each alternative identified, and decisions based on the evaluation of the alternative objectives. Both these stages form part of the activities in the third stage of the generic process.

computer technology and perceptions of overreliance on ‘black box’ urban models in this paradigm. Wong (1998:221) go as far as arguing that these models created “a technical facade beyond which planners claimed their professional credibility based on the belief of a value neutral process”. This point may be applicable to some of the ‘comprehensive’ urban simulation models of the 1980s and 1990s. However, recent developments over the last two decades in the fields of GIS and spatial statistical analysis to a large extent dispelled the notion of ‘black box’ models. The use of multi-criteria decision making models embedded in a GIS environment is in fact fast becoming an indispensable tool to facilitate interactive consultative planning processes called for in the post-positivistic paradigm. The use of spatial statistical analysis techniques also advanced traditional thematic mapping to a new level by adding the dimension of statistical significance to spatial analysis techniques. A fourth point of criticism specifically against the rational process view of planning is that policy and planning processes do not always unfold in a neat, orderly and sequential number of phases as conceptualised by the proponents of the process view of planning (Huys & Van Gils 2010). Karadimitriou (2010) also critiqued this mode of spatial planning on the bases that spatial planning is inhibiting creativity and spontaneity and is ignoring difference in cities. Despite the fact that current SDF processes are mostly still characterized by a phased sequential process, monitoring and evaluation is at least recognized as an activity spanning across all phases of the SDF process (see Figure 4.5). Although the methodologies required for this ongoing evaluation process are still weakly developed, it has been recognized as an important element in the spatial planning process. Possible remedies for these methodological shortcomings are further explored in Section 4.7.

These various points of criticism against the positivistic paradigm contributed to the emergence of a new paradigm of planning characterised by social learning and communicative action as its primary activities, and a shift from viewing planners as technical experts to planners as communicators. This shift towards a post-positivistic paradigm is further described in Section 4.2.4.

4.2.4 Post-positivist paradigm

4.2.4.1 Conceptual and technical orientation

This paradigm in principle assumes a much stronger normative (‘how it should be’) conceptual orientation towards procedural planning theory compared to the deterministic and positivistic paradigms. The most noticeable changes in orientation were the growing awareness of the many diverse values of society, the importance of providing an opportunity to these diverse groups to voice their opinions through public participation in the planning process, and the building of partnerships between stakeholders participating in the spatial planning process. Unlike the positivistic paradigm which incorporates procedural scientific methods, the form of planning in this paradigm is primarily focused

on resolving conflict, building sufficient consensus²⁶, and creating partnerships as part of a broader comprehensive planning process. The role of public sector planners and private planners representing individual clients or interest groups in this context is very different. Public sector planners must ensure a spatial planning process that makes provision for inputs from various groups, individuals, and perspectives (which may also be represented by planners). The resulting plan must objectively consider both the empirical data (from a positivistic perspective) and the different views expressed. Private planners will have a very different role in this process. Their primary aim is to ensure that the views and interests of the client or community group (often interest groups without the necessary capacity to participate in planning processes) they represent are accommodated in the spatial planning process and outputs. The technical orientation of planners is thus primarily associated with functions such as conflict resolution, bargaining, and coalition building and the role of planners (using Udy's matrix of planners) can best be described as 'reformers', 'advocates', or 'human strategists' and in some instances even 'activists'.

Various strands of procedural planning theory emerged against the background of this conceptual and technical orientation of the post-positivistic paradigm. The first of these is the concept of diversity and choice in planning as encapsulated in postmodernism. The second development is the view of the primary role of planners as communicators as conceptualized in communicative planning theory. A third main stream of theoretical perspectives focusses on the building of partnerships and the concept of collaborative planning, while a fourth stream specifically focusses on the political nature and the issue of power relationships in planning.

4.2.4.2 Views of procedural planning theory

a. Diversity, choice and Postmodernism

One of the main areas of change in the transition towards post-positivism was the emergence of postmodernism in planning. The growing influence of postmodernism shifted the emphasis from technical procedural issues in planning more towards normative approaches to planning concerned with the recognition of diversity and cultural difference. These emerging new approaches cannot be pinned down to a specific time period but are represented by a broader shift starting in the 1960s and continuing into the 1980s and 1990s. One of the best known voices introducing some of the ideals of postmodernism is Jane Jacobs (1961). She was opposed to the idea of order and uniformity resulting from clearly defined single land use zonings in urban areas in North America and argued for a greater mix of land uses to create greater diversity and present greater freedom of choice for inhabitants. Despite the undisputed enormous influence of her work, the points of criticism against some of her arguments cannot be ignored.

²⁶ Although it is unlikely to achieve full consensus between all parties in spatial planning processes at an urban or municipal scale, an important role of planners and the planning process is to achieve sufficient consensus between the various role players participating in the SDF to at least ensure the formal adoption of the spatial plan.

Some of these points of criticism however also reveal that some of her important concepts can not necessarily be considered as postmodernist viewpoints. Hospers' (2006) comprehensive overview of the life and work of Jacobs identified some points of criticism against her work, two of which is of particular relevance here. The first point is that Jacobs' argument of cities as the driving force behind prosperity and welfare is overly naive and almost create the perception that living in the countryside is impossible. Her strong views on cities as the driving forces behind prosperity (and the criticism thereof) however recognizes the importance of market forces and aspects such as the value of land. This coincides with Haig's (1926) original argument that the 'great cities' develop at the points from which the richest resources can be tapped with the lowest transportation costs. The second point stems from her arguments in favour of small-scaled cities, diversity, short building blocks, and high population density. This also represents the second point of criticism that her work over-emphasized the structural working of the physical environment of city life and can be viewed as a form of 'physical determinism'. This shows a strong resemblance with the central arguments of the deterministic paradigm – that the physical layout of an environment remains one of the prominent factors determining quality of life in a specified environment. There are however limits to the realistic extent to which the concept of a diversity of land uses is plausible in a single location. The triggers and processes described in Chapter 2 operate in different combinations for different land uses and have different influences on alternative land uses. There are thus theoretically only a limited number of locations within cities where these forces and triggers operate in sufficient harmony to result in the co-location of a specified mix of land uses.

The postmodernistic concept of diversity and freedom of choice also led to the emergence of the movement known as 'new urbanism' that calls for the physical redesign of cities to protect the environment, house a greater diversity of people, and bring households in closer proximity to employment and urban amenities (Fainstein & Campbell 2012). New urbanists in principle reject the idea of completely separated urban functions (originally conceived as one of the primary functions to address social and functional problems of the industrial city) in favour of relatively self-contained neighbourhoods with a 'balanced mix' of functions and land uses with a strong emphasis on pedestrian orientation and transit-oriented transportation corridors (Gottdiener & Budd 2005).

b. Planners as communicators and communicative planning theory

The changing view of planners as communicators and facilitators rather than technical experts popularised the concept of Communicative Planning Theory (CPT), also known as collaborative planning (Healy 1996; 1999). This approach is seen as a particularly relevant response to societies that are increasingly networked with growing differences in knowledge and values amongst communities (Castells 1996). The primary focus thus shifts from outcomes to process, and the primary activity of planners to communicate and interact with stakeholders. This process is aimed at communicating and debating the priority issues to be addressed by the spatial planning process, identifying alternative responses to address these issues, and reaching consensus on courses of action to achieve the agreed

spatial development vision (Beauregard 1998; Watson 2002a). Healy (1999:116) describes CPT as “...a normative approach, grounded in observations of planning practice, to the design of interactive governance processes and the ethics of experts involved in such processes”.

Probably the best-known work of citizen participation is Arnstein's typology of citizen participation that identifies the extent of citizens' power in determining or influencing the development of a plan or policy (Arnstein 1969). She defined her typology (or 'ladder' as it is better known) in terms of eight rungs classified in three levels, ranging from the level of 'non-participation' to the levels of 'tokenism and 'citizen power'. Non-participation includes the two bottom rungs of the ladder represented by 'manipulation' and 'therapy'. According to Arnstein the participation activities at this level are only used as a substitute for genuine participation with the primary aim to 'educate' the participants in the process. The second level of tokenism includes the rungs on the ladder described as 'informing', 'consultation', and 'placation'. When representing the total extent of participation these rungs will have inputs in the process but no right to decision making. The third level of citizen power (consisting of the rungs of partnership, delegated power, and citizen control) enables participants to at least engage in the negotiation of trade-offs to situations of full managerial power. Although there are no clearly defined boundaries between the different rungs on this ladder, it does provide a widely used²⁷ representation of what citizen participation may entail. This interpretation of participation has however been criticized on the grounds of its assumption that effective participation is only achieved by having power in decision-making and diminishing the benefits accruing from participation in other stages of a planning process (Lane 2005).

Proponents of CPT emphasize the difference between collaboration that simply means working together on a task, and consensus building which refers to a specific type of collaboration involving a structured dialogue process to achieve a shared vision and set of overall spatial development objectives (Innes & Booher 2015). The latter is the practice of bringing together stakeholders representing different interests for long-term dialogue aimed at resolving a policy issue of common concern (Innes & Booher 1999). The South African experience with consultative processes in integrated development planning and spatial planning however also revealed that overly-extensive and time-consuming consultation processes can cause frustration and 'participation fatigue' which in some instances result in outcomes quite different from the original positive outcome intended. This increasing importance of the consultative mode of planning resulted in two models generally adopted by planners within a spatial planning context specifically: a consultation model and a vision model (Needham, Zwaniken & Faludi 1997). The consultative model is mainly based on the coordination of a wide variety of stakeholders based on the notion of involving target groups that can directly influence the physical environment at an early stage of the process. The outcome of this model is strategic plans that are indicative in nature

²⁷ According to Google Scholar more than 16 500 citations in 2018.

and provide a frame of reference for ongoing negotiations (Mastop & Faludi 1997). Despite the fact that this process can be time consuming and expensive, its main advantage is the 'invisible benefits' of establishing a shared commitment towards the implementation of the plan. The alternative to the consultative model is the vision model. This model is focused on the end-state of the physical environment and the resulting project plan which includes the required measures to achieve that end state (Mastop & Faludi 1997). This approach aims to produce a powerful and convincing plan with the ability to gather and motivate support from target groups, a shift from blue print plans to blue print ideas or outcomes.

c. Building partnerships and Collaborative planning

The importance of considering both expert 'scientific' knowledge and experiential 'soft' knowledge in planning processes is incorporated in Friedmann's concept of 'transactive planning'. He argues that expert knowledge should (and must) be used in conjunction with experiential knowledge to achieve greater rationality in decision-making. Moreover, planning should be a collaborative process in which small group practices are a key characteristic of effective planning and where the emphasis is on personal and institutional development instead of pursuing specific functional objectives (Friedmann 1994). Healy (1998) further argued that good practice in collaborative planning is not limited to commitment of those involved in particular processes and practices, but it is also substantially influenced by important dimensions of the institutional context such as local institutional histories, legal obligations of planning authorities and competencies allocated to it, and dominant trends in policy discourses. It is however not only institutional structures that influence collaborative planning processes, but also different economic circumstances and cycles. Public authorities are trying to position the financing of the spatial plans and its proposals more centrally as part of the spatial planning process with the effect that spatial investment policies are increasingly dominated by public-private partnerships (Priemus 2002). During periods of strong economic growth, associated with widespread interest from the private sector for development, local planning authorities have greater influence on developers to conform to certain planning goals which might not otherwise have been realized (e.g. density of development, location of development). Conversely, in areas or during periods of economic decline or during periods of economic recession, potential developers are in a much stronger position to dictate the terms of development (Taylor 1998).

Collaborative planning as an approach has been justified on the bases of reducing longer term regulatory transactions costs, its contribution to political legitimacy of decisions, and building shared knowledge and capacity amongst stakeholders (Lane 2005). Disregarding the importance of local institutional structures and circumstances often result in an idealized view of the benefits of collaborative planning. Watson (2002a) highlights this aspect by pointing out the lack of cohesion and organization in civil society in many countries in Sub-Saharan Africa. This impacts negatively on the use and application of normative planning perspectives (and specifically collaborative planning) with the reality that power will often prevail over rationality in negotiation. Local level consultative processes for example are often

dominated by particularly vocal individuals or groups to the detriment of the broader credibility of such consultative processes.

d. Power, politics and advocacy planning

The concept of 'advocacy planning' as originally identified by Davidoff (1965) is premised on the existence of inequalities in society with advocacy planning aspiring to ensure greater equality in representation of people and groups in planning processes. Forester (1999) identified the ability of planners to examine issues of power as a key element of improved planning procedure and introduced the concept of 'practical anticipation' as a way of dealing with the political complexities faced by planners. Practical anticipation extends beyond the technical knowledge of planners to also include the ability to anticipate the political processes, local personalities and local history (e.g. neighbourhood history) that might be of relevance in specific spatial localities (Forester 1999). This principle is similar to the recognition of the institutional context as a key element of collaborative planning theory outlined above. Advocacy planning is thus concerned with advocating the interests of less articulate actors, and advocacy planners are essentially facilitators whose primary function is to facilitate the participation of inarticulate actors or advocate their interests directly (Lane 2005). This interplay between political power and planning requires planners to be skilled as effective communicators and negotiators able to negotiate with developers and also to protect the interest of less powerful and marginal groups (Forester 1989). An important implication for spatial planning evaluation processes is that these processes are not just academic exercises but involve real interests (including political interests) and have tangible consequences (Alexander 2009).

4.2.4.3 Criticisms against post-positivist paradigm

Despite the wide variety of new perspectives provided by the post-positivist paradigm it has also been criticized on various grounds. One of the main points of criticism is the dominant concern with process and social learning often to the exclusion of any form of scientific method, causing disinterest in the core task of planning and playing down the idea that urban planning deals with material reality (Yiftachel 2006; Harrison 2013). Partly in response to this critique there has been some return to a rationalist paradigm since the 2000's with a growing emphasis on so-called 'evidence-based' policy and practice. This concept of 'evidence-based' policy and planning has however also been met with some skepticism. The central question is what can be regarded as 'evidence'? According to Solesbury (2002) any form of evidence to be used as part of a planning process should be subjected to three questions: how relevant is the evidence to the objectives of what is being studied; how representative is the evidence; and how reliable is the evidence. He also recognized that the ability to craft convincing arguments based on the available evidence is as important as the evidence itself in the formulation of public policy. A second point of contention is the tension that normally exists between power and authority on the one hand and knowledge and expertise on the other, a distinction referred to as scientific rationality and political

reality (Innes 2002; Wong, Baker & Kidd 2006). According to this argument planning practice would be less ethically compromised if it were based only on rational and scientific knowledge. The challenge is that scientific style planning and policy research often do not include the information that makes the biggest difference to the policy maker – the potential political implications of particular strategies or choices, and the local knowledge of those familiar with local circumstances in an intuitive way (the political reality). A third point of criticism against the concept of evidence-based policy is that linear causality²⁸ cannot always be established between knowledge and action, and it is thus more appropriate to refer to policy being informed by, rather than being based on evidence (Davoudi 2015). The alternative concept of an ‘evidence informed’ process does not necessarily refer to a process informed by empirical analysis but implies an understanding of the complex interrelationships between “knowing *what* (cognitive/ theoretical knowledge), knowing *how* (skills/technical knowledge), knowing to *what end* (moral choices) and *doing* (action/practice)” (Davoudi, 2015:317-318).

These tensions between approaches and processes grounded in the positivist paradigm and those from the post-positivist paradigm is accurately summarized by Bridge & Watson (2002c: 453) who is of the opinion that “planning theory seems to be caught between the (modernist) desire for a solid ground from which to operate and a postmodern sensitivity to other experiences of the city”.

4.2.5 Complexity paradigm

4.2.5.1 Conceptual and technical orientation

One of the underlying assumptions of a complexity perspective of planning is that cities as CASs are constantly evolving “...as a result from perpetual and complex interactions among its parts and its contextual environment” (Huys & van Gils 2010:144) and that the system and its interacting parts are co-evolving where each element influences and is in turn influenced by all other related elements or actors in the system. The concept of cities as systems consisting of complex interacting parts originate from the 1960s (Berry 1964; Chapin 1965; Hagget 1965; McLoughlin 1969)²⁹. Within the terminology of CAS the environment of a process changes (‘perturbations’) when that system becomes the subject of plans or policies. The actors can (but not necessarily) influence the development of a system and the subject matter of planners (such as plans and policies) can hence influence the behaviour of these actors, but not necessarily in the way in which policy makers would want them to react. Based on the principle of co-evolution, interacting actors exchange information with their environment and adapt their behaviour based on this information. As more information circulates through the system both individual

²⁸ See Section 4.3.4 for a more comprehensive discussion on the problem of establishing causal links between planning actions and planning outcomes

²⁹ See Section 4.2.3.2 for their contribution to the concept of urban systems

actors and the system as a whole are better equipped to adapt to changing circumstances. The widest possible circulation of information and knowledge creates the potential for a more intelligent system. This implies two important skills required from planners (Huys & van Gils 2010). Firstly, the ability to recognise the mechanisms of co-evolution within the system that will be the subject of spatial planning. Secondly, the ability to facilitate the creation of conditions that would allow for an optimum circulation of information and knowledge through the planning process, and the physical and social systems it intervenes in. This implies a combination of empirical and statistical reasoning together with tools and techniques to facilitate a better understanding of the complex causality within the local urban system nested in interrelationships with other systems at various scales. This represents a return to the recognition of concepts inherent to the earlier systems view of cities and procedural planning approaches. This requires not only interventions in the physical environment limited to time scales required by regulatory spatial planning processes, but also focussing on the key windows of opportunity within the broader urban system that considers patterns and progress over multiple timescales. Some urban elements like the local economic structure and the urban footprint operate at a larger scale and changes relatively slowly. For example, the spatial structure and pattern of the formal economic sector changes at a regional and municipal scale and over a time scale measured in years or decades. Conversely, the location and operation of the informal sector can vary on a daily basis in response to key influencing factors such as pedestrian traffic volumes and patterns, and changes in optimal location can vary over a timescale of days or weeks. Spatial planning policies and proposals impacting the informal sector can thus not be conceived and implemented in a similar fashion and adhering to similar timeframes than formal sector economic policies.

From a technical orientation this led to the realisation that urban models based on aggregated behavioural data will be replaced by models which deal with the behaviour of individual decision units. Hägerstrand (1970) introduced the original principles for this new type of urban modelling based on the micro level analysis of individual choice driven by factors such as time, cost and other constraints. He argued that “life becomes an astronomically large series of small events, most of which are routine and some of which represent very critical gates” (Hägerstrand, 1970:14). This formed the bases for subsequent advances in urban analysis and laid the foundations for theories and urban models that generate and allocate urban activities (Batty 1976). Batty’s later work on cities and complexity (Batty 2007) brought together these concepts with complexity theory and revolutionized urban modelling through the application of Agent Based modelling and Cellular Automata. This concept is based on the notion that urban development emerges from the bottom up leading to patterns of spatial order at higher levels of aggregation, and a return of focus to some of the fundamental concepts of the earlier era of systems thinking in spatial planning (see Section 4.2.3.2). The simulation of this process is through the most basic elements of cities as two distinct but related components: cells representing the physical and spatial structure of the city and agents representing the human and social units that make cities work. The activities of the agents take place within the cells and these actions influence the nearest neighbours

of the cell (Batty 2007)³⁰. The concept of a ‘mosaic of land uses’ as conceptualised by the Baltimore school of urban ecology provides a very relevant framework for understanding these concepts within the context of complexity theory. Their framework for understanding the complexity of social-ecological systems that includes the three dimensions of spatial heterogeneity, organizational connectivity, and temporal contingency as described in Section 2.2.4 provides a practical framework to operationalize these concepts.

4.2.5.2 Views of procedural planning theory

From a methodological perspective complexity theory can also shed some light on how policy monitoring and evaluation can be approached. It places a strong emphasis on the complex, interactive nature of policy issues and recognizes the importance of exploring the link between activities, context, and outcomes within a dynamic framework (Wong, Baker & Kidd, 2006). As discussed in Chapter 2 and outlined in the earlier sections of this chapter, cities are increasingly being recognized as CASs that respond to and influence a variety of processes across a range of spatial and temporal scales. Spatial planning within this context implies an appropriate view of three interrelated concepts: space, scale and time. Firstly, in complex systems space cannot be viewed merely as an external container within which human activities take place and where various types of plans become the tools representing them spatially. It requires a relational view of space where proximity does not necessarily imply relationship but is based on functional relationships. Many of the issues influencing spatial change at a municipal level requires a relational view of space recognising interactions at multiple scales. It is thus important to focus spatial planning effort broader than mere municipal administrative boundaries and to also consider aspects such as shared environmental resources and regional economic interdependencies such as a commuting patterns and a shared consumer catchment areas. Secondly, numerous interrelated systems operate at different speeds over various spatial scales. Although ordering patterns may repeat itself at different scales within cities, the nature of the order and the processes of change however differs at various scales (Batty 2007). Smaller (and in a spatial sense more local) systems tend to function faster and over shorter distances while larger systems move more slowly and cover larger areas. Local affairs are influenced by events in a global system, but local events or actors can also affect the larger system (Graham & Healey 1999). Thirdly, different parts of a CAS change at different timescales and the

³⁰ In the context of spatial planning the understanding and definition of the concept of ‘agents’ representing the human and social units that make cities work is relatively straightforward to operationalize. The concept of ‘cells’ as representing the physical and spatial structure of the city is however a much more contentious aspect to deal with. The use of a grid cell structure as widely applied in GIS and cellular automata is a convenient analysis tool. It however does not address the fundamental question of appropriate functionally defined units of analysis (‘cells’). For example, functional cells related to different housing markets and commuter zones will have very different formats. If the basic point of departure in the definition of ‘cells’ is homogeneity based on the outcome of an empirical process the result will be a defensible set of alternative cell configurations. This result will however be viewed as based on a modernistic positivistic view. The alternative would be a postmodernistic approach to defining the cells based on the principles of diversity, freedom of choice, and mix of functions and land uses and reflecting specific viewpoints.

evolution of cities should thus be viewed from the perspective of relative time and not absolute time. Present conditions alone and the development of policies and plans based on static understandings no longer suffice. Planning must unravel past processes and understand the underlying driving forces whose aim is to direct future processes (Lichfield 2006). Urban decision makers are generally confined to their relatively short temporal scale of concern, within the spatial scale of their jurisdictions, and within their specific institutional settings (Bai et al 2010). Locally optimal solutions may thus not represent the best long-term solution and a fragmented understanding of cities can result in suboptimal city design outcomes. Spatial planning from the perspective of these three interrelated concepts must consider relations and processes rather than objects and forms to avoid generalizations about desirable urban forms (e.g. debates about urban sprawl) “based on a particular perspective at a particular period of the development trajectory of cities” (Graham & Healy 1999:642).

4.2.6 Summary assessment

What is clear from the assessment of the various paradigms on procedural planning theory as outlined in this section is that there are no strictly defined impermeable boundaries between the identified paradigms and its associated procedural theories. On the contrary, most current spatial planning processes (also the current practice in South Africa as described in Chapter 3 and Section 4.6) contain some elements from more than one or all of these paradigms. There is a general tendency in planning literature and planning practice for planners fundamentally aligned with one of these dominant paradigms to create caricatures of planners, or planning processes, fundamentally anchored in one of the alternative paradigms. The overview provided in this section however clearly established that no successful spatial planning process can be based on only (or mostly) one of these approaches.

What this analysis also revealed is that aspects often presented as elements of a planning process or application can in fact be more closely associated with fundamental planning theory than merely procedural planning theory. The different paradigms described in this section do not represent a strict chronological sequential development of procedural planning theory, but do provide a clear indication of gradual transitions between the dominant paradigms. What clearly transpired from these transitions is that, despite the approaches inherent to each paradigm having been improved through subsequent later developments, the critical elements of the original approaches have been maintained and remained an essential part of contemporary spatial planning practice. Many recent developments, especially in the field of systems thinking and complexity theory in urban planning, are in fact not as novel as often portrayed and in some instances represent ‘old wine in new bottles’.

4.3 CONCEPTUAL CHALLENGES AND DILEMMAS IN SPATIAL PLANNING EVALUATION

The lack of critical assessments of spatial planning implementation efforts have been attributed to factors such as the scarcity of methodologies for systematic analysis of plan implementation and the complex nature of quantified modelling of the effects of planning (Talen 1996; Laurian et al 2004; Tian & Shen 2011). Based on the literature reviewed, the conceptual challenges and dilemmas contributing to this situation can be synthesised into three broad categories: the issue of uncertainty in planning, the challenge of complexity and control, and the ability to establish causality. It is necessary to understand these challenges as one of the fundamental points of departure to develop appropriate methodological approaches for spatial planning evaluation.

4.3.1 Planning and uncertainty

One of the reasons for the relative paucity of information on spatial planning evaluation stems from Wildavsky's (1973) contention about planning and uncertain futures. His argument postulates that planning is concerned with control of the future, and because that future is uncertain, it is thus impossible to determine its quality or influence. The notion of uncertain futures however does not negate the need for trying to understand the influence of spatial planning in achieving the identified goals of the plan and planning process. The future decision making environment within which planning operates can undergo change both in terms of the political environment and the institutional environment within which spatial planning processes are embedded, and hence how they function and operate. The overall goals for spatial planning regarded as the accepted norm within a specific context or country/region (also described as the 'spatial planning doctrine' in Chapter 3) are unlikely to change drastically over the short term although it may be influenced by changes in the decision making environment and associated ideologies. This is also associated with uncertainty in related areas of choice and decision making which in a spatial planning context may include aspects such as infrastructure investment policies and decisions, economic development policies, and environmental legislation and guidelines. The recognition of these uncertainties however don't negate the requirement for evidence informed planning. In fact, an inherent part of any spatial planning process is to better understand the forces and trends that will influence future urban development patterns as the bases for informed or evidence-based planning. Spatial planning should also considers alternative combinations of intervening actions and various combinations of available resources to respond to these forces and trends and hence reduce the level of uncertainty about the future.

4.3.2 Complexity and control

Wildavsky (1973) claimed that planners have become the victims of planning because planning has become too complex for planners to deal with it in all its dimensions. Planning has numerous (sometimes contradictory) objectives and is embedded in a broader institutional network of actors dependent on each other to a greater or lesser extent, set within a framework of economic, social and institutional arrangements (Hall 1992; van Damme et al. 1997). Authority related to spatial planning thus lies in the hands of numerous actors with divergent interests and objectives and implies that no plan, whether prepared by public or private agencies, can fully control any city, and procedural planning models cannot fully regulate urban form (Driessen 1997; Alfasi & Portugali 2007). The outcomes of a plan are also affected by external influences that may have very little or nothing to do with the plan or policy itself. For example, the demand for land and housing can change rapidly in response to changes in variables such as interest rates. The challenge is thus that the exact nature and extent of the effect of spatial planning is unpredictable.

4.3.3 Causality

A third important conceptual challenge for spatial planning evaluation is the problem of establishing causality. In simple terms the question is ‘what is the causal link between planning actions and planning outcomes?’ Faludi (2000) contends that, in order to establish whether the plan has worked and achieved its objectives, a causal relation between intention and outcome needs to be established. However, plan evaluation processes have to recognize the complexity of development processes and usually cannot assume simple, direct causal links between plans and physical outcomes (Laurian et al. 2004). The physical change of a specific area which is the subject of a spatial plan or policy can be the result of many factors (some outside the control of the ‘planning’ function), only one of which is planning (Talen 1996), and it is difficult to isolate the effects of planning policies from other activities and policy streams. Planned decisions often also have unplanned consequences (Wildavsky 1973) and most spatial plans and policies can result in unintended outcomes (positive or negative) that are not expected or specified in the objectives. Total change resulting from plan implementation is thus the sum of planned change and unanticipated change (Calkins 1979). This challenge is probably best summarized by Lindblom (1959:86) in his well-known work on the concept of ‘muddling through’³¹ in which he stated that “a wise policy maker consequently expects that his policies will achieve only part of what he hopes and at the same time will produce unanticipated consequences he would have preferred to avoid.”

³¹ Refer to Section 4.2.2

4.4 METHODOLOGICAL CONSIDERATIONS IN SPATIAL PLANNING EVALUATION

4.4.1 Clarifying terminology

An important point of departure in considering the methodological aspects of spatial planning evaluation is the interchangeable use of terminology. The difference between outputs, outcomes and impacts in particular holds implications for the approach to plan evaluation. Outputs from the perspective of spatial planning evaluation refer to both the intermediate outputs (products retained within the land-use planning system such as a spatial plan), and final outputs emanating from the land-use planning system in the form of planning decisions (Carmona & Sieh 2004). Outcomes refer to the immediate tangible change resulting from a combination of a process and its outputs. Impacts reflect the combined long term effect from a sequence of outcomes (Morrison & Pearce 2000). Wong & Watkins (2009) are of the opinion that although outcome and impact are conceptually distinct, it is in practice unlikely that the impacts that can be directly attributable to planning can be isolated.

4.4.2 What must be evaluated?

One of the most fundamental aspects when considering different types and approaches to spatial planning is the distinction between spatial planning processes and spatial planning products. Products such as spatial planning documents can be regarded as 'visible' outcomes while planning processes leading to insights shared between the various parties participating in the planning process represent 'invisible' outcomes (Mastop & Faludi 1997). The evaluation of the planning product or the "what" to be evaluated normally includes the plan as a package, including the document that communicates goals and objectives, needs or problems, assumptions and method of reasoning, specific proposals, or implementation instruments (Baer 1997). This plan together with the outcomes thereof is the subject of 'planning product' evaluation, while the evaluation of the processes resulting in the plan and the processes to implement the adopted plan is subject to 'planning process' evaluation.

Notwithstanding the unique local circumstances that may prevail at the level of individual cities or municipalities and that may influence local processes, Carmonah & Sieh (2004) suggested that any holistic approach to planning quality measurement and evaluation should include the operational environment quality. Operational environment quality should address the aspects of service quality (for the purpose of spatial planning interpreted as 'process' quality), as well as planning product quality. From the perspective of operational environment quality, organizational culture in terms of support from senior management and the general attitude of staff towards monitoring and evaluation is a critical aspect to consider (Seasons 2003). Successful evaluation of planning processes and products requires a willingness to improve as an attribute of 'learning organizations' (Senge 1994). Many organizations are however averse to change and are content with the status quo. In these circumstances monitoring and

evaluation would be perceived as threatening and is often viewed with suspicion and even hostility (Seasons 2003). Potential shifts in power between different stakeholder groups resulting from the outcomes of evaluation and ‘jurisdictional protectionism’ which seeks to claim the positive effects of a plan or policy can contribute to organizational opposition against systematic evaluation and assessment (Carmonah & Sieh 2004; Rae and Wong 2012). From a more practical perspective, resource limitations can also be an inhibiting factor. The problem of data acquisition impacts negatively on the ability to undertake quantitative empirically based evaluations of plans. These include problems such as confidentiality of information, lack of quantified data, lack of consistent and systematic data relating to relevant planning processes, and data that may be biased due to accessibility or availability at the point of collection (Healy 1986; Carmonah & Sieh 2005). Staff skills and time constraints can also be a specific problem at municipal level where the majority of resources are deployed to deal with the administration and management of development proposals, resulting in limited time available for monitoring and evaluation (Seasons 2003). The availability (time and resource wise) and quality (skills levels) of human resources thus largely influences the quality of outputs and outcomes from spatial planning. Applying the concept of cybernetics³² to spatial planning Karadimitriou (2010:442) concluded that:

“No system can be controlled by another, less complex, system unless that control becomes restrictive, thus reducing the complexity of the controlled system. The outcomes of failed attempts to control complex socio-spatial systems through much less complex controlling systems plague societies all over the world”.

This implies that complex urban systems cannot be successfully controlled (or influenced) by a planning system and operating environment without the necessary level of sophistication and complexity.

4.4.3 When must urban spatial planning evaluation be done?

There are two elements to the question of timing in spatial planning evaluation: at what stage of the spatial planning and implementation process must evaluation be undertaken, and what is a relevant timespan to measure the outcomes and impacts of spatial planning.

Regarding the first element, plan evaluation can be conducted during the preparation phase (ex ante evaluation) and the implementation phase (ex post evaluation) (Alexander 2006a). In the case of the former the evaluation process will be concerned with ‘planning quality’, whereas evaluation in the implementation phase will focus on ‘plan success’. Both planning quality assessment and plan success assessment involves ‘process’ elements and ‘product’ elements. The process component of ex ante evaluation includes all procedures, processes and activities leading up to the adoption of a final plan document, while the final plan document represents the product component. In the case of ex post

³² Cybernetics can be described as a transdisciplinary approach to exploring the structures, constraints, and possibilities of regulatory systems.

evaluation, all activities and processes related to the implementation of the adopted plan can be regarded as the process component and the outcomes of the plan implementation process (such as spatial and land use patterns) as the product component.

The second aspect to consider is the relevant timespan for the commencement of ex post evaluation activities after formal adoption of the plan. Although spatial plans usually provide an indication of their time span (e.g. five year plan or a 20 year plan) they rarely indicate how much time should elapse before the full effects of the plan should be evaluated (Baer 1997). While it is generally accepted that the timeframe for measuring the outcomes and impacts of spatial plans is long term in nature (sometimes decades) realistic timeframes may differ from objective to objective in the same plan (Mayere, Heywood & Margerum 2008). In fast-growing and rapidly changing cities spatial plans have to be more flexible to respond to rapidly changing circumstances, and the frequent adjustment of plans are common making the evaluation of plan implementation even more difficult (Tian & Shen 2011). This will for example imply the timespan required for evaluating the outcomes and impacts of slow growing or stagnant cities (such as some European cities) will require a longer timespan compared to rapidly growing Chinese cities and city regions experiencing significant morphological changes over a period of a decade or less. Final judgements on the effectiveness of a plan or policy can thus only be made once the impact of decisions are fully understood (Carmonah & Sieh, 2004).

4.4.4 At what scale must urban spatial planning evaluation be done?

Related to the issue of growth rate is the scale and magnitude of change over which demonstrable effects of spatial plans and policies must extend (Mayere, Heywood & Margerum 2008). The impact of spatial policies and plans are often measured within administrative areas or units for which these plans are prepared. Section 4.2.5 however clearly identified that spatial planning is not bound to space and time, and administrative units thus do not necessarily correspond to the functional units or boundaries associated with individual spatial plan or policy objectives (such as commuting zones or housing market segments) (Wong and Watkins 2009). Spatial planning outcomes thus comprise of components at different levels of spatial aggregation (e.g. local area level, metropolitan level, regional level) and spatial processes at a wider level may be linked to local outcomes. This matter is further complicated by functional units that may change over time, sometimes in direct response to the implementation of the spatial policy or plan (Rae & Wong 2012). As referred to earlier in Sections 4.2.3 and 4.2.5.1 this represents a renewed recognition of concepts inherent to the earlier systems view of cities and procedural planning approaches. The outcomes of spatial planning thus have to be measured within differentiated spatial units of analysis appropriate to the specific objectives or groups of objectives under consideration and with consideration of wider systemic linkages.

4.5 PRINCIPLES FOR DEVELOPING A METHODOLOGICAL FRAMEWORK FOR COMPREHENSIVE SPATIAL PLANNING EVALUATION

The inadequate theoretical and methodological underpinnings of spatial planning evaluation methodologies and procedures were identified as an important element of the research problem statement described in Chapter 1. The consequence is a paucity of empirical evidence regarding the influence of spatial planning on urban development and hence a reliance on ideological assumptions and anecdotal evidence to review the successes and failures of spatial planning. As indicated in Section 4.4.2 an important conceptual distinction can be made between spatial planning as a service (or a process) and the products of planning. Spatial planning as a service includes all processes and activities undertaken by various parties (not limited to planners only) to develop and implement policies and plans to manage and facilitate spatial development and land use. Spatial planning products in this research refers to municipal and urban level SDFs (and plans for their implementation)³³.

The implications of the paradigm shifts and changing views on procedural planning theory (Section 4.2), as well as conceptual and methodological considerations discussed in Sections 4.3 and 4.4 are now synthesized into a number of principles as a point of departure for the development of comprehensive methodological framework for spatial planning evaluation. It uses the intersect between the main paradigm shifts in procedural planning theory on the one hand, and the methodological considerations on the other hand as a structuring framework (see Figure 4.3). Fundamental to the understanding of these principles is the author's view that there are no strictly defined impermeable boundaries between the identified paradigms and its associated procedural theories. The preceding analysis clearly illustrated that the concepts and approaches inherent in each paradigm is not merely replaced by a subsequent paradigm. Many of the ideas and concepts remain valid (although often in a revised and more refined format) and most current spatial planning processes contains some elements from more than one or all of these paradigms. The principles guiding the development of a comprehensive spatial planning evaluation methodology should thus be sufficiently robust to accommodate these different approaches or at least parts of them.

³³ Municipal SDFs in the South African context would be broadly equivalent to Master Plans in SA before the political change; urban General Plans or Master Plans in the US; Urban Development Programmes in Mexico; Urban Master Plans in Brazil; Master Plans and Local Area Plans in India; City Plans in China; Land Use Plans in Germany; General Plans in Russia; City Development Plans and Local Area Plans in Ireland; Urban Physical Development Plans in Kenya; Urban Development Plans in Nigeria, etc. (Ryser & Franchini 2015).

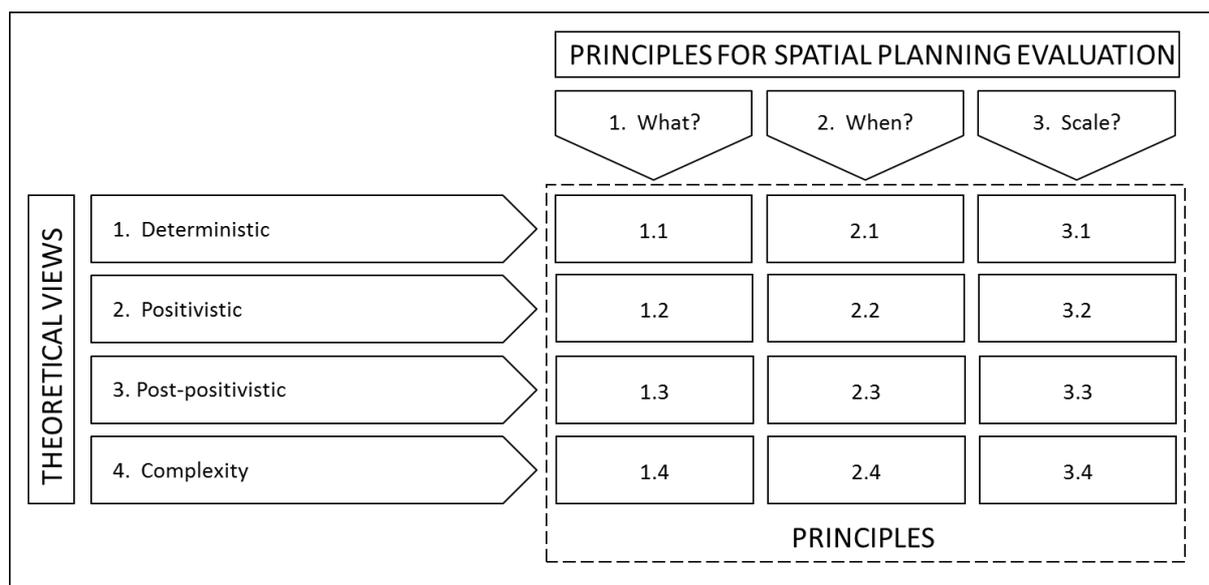


Figure 4.3: Principles for guiding the development of a comprehensive framework for spatial planning evaluation

Principle 1.1: Most spatial plans produced by contemporary spatial planning processes still contain some element of modernism and physical design in guiding land uses and physical development. Spatial planning evaluation will thus necessarily include a component to evaluate spatial ‘order’ as envisaged in the plan document.

Principle 1.2: Cities comprise of various interrelated sub-systems that can be analyzed and modelled individually as part of specialized comprehensive planning processes. Despite the fact that spatial planning can make provision for the spatial organization of these various sub-systems, the resulting ‘comprehensive’ plan may not necessary reflect the inter-relationships between these various activities and uses. Although the evaluation of the influence of spatial planning on the various individual sub-systems is an important element of spatial planning evaluation, it must also consider the interrelationships between these sub-systems.

Principle 1.3: The primary aim of spatial planning in a post-positivist paradigm shifts from outcomes to process with the focus on the ‘invisible benefits’ of establishing a shared commitment towards the implementation of the resulting plan. Spatial planning evaluation should thus include a component to assess the extent to which different views have been integrated in the plan, the relevance of the process of soliciting these different views, the level of functionality of civil society (at different levels of spatial aggregation if required), and the capacity of the institutional structures and operational environment relevant to the context within which the plan is intended to be implemented.

Principle 1.4: A complexity perspective emphasizes the interactive nature of policy issues and the importance of exploring the link between activities, context, and outcomes in a dynamic process of

change. Mutual interaction and conditions where each element within a system influences and is in turn influenced by all other related elements or actors in the system is characteristics of a co-evolving system. Spatial planning evaluation hence must include components to determine the extent to which mechanisms of co-evolution within the system have been recognised and to evaluate how successful spatial planning has been in creating conditions for optimum circulation of information and knowledge through the planning process, and the physical and social systems it intervenes in.

Principle 2.1: The ‘deterministic’ or physical design elements of spatial planning have to be evaluated in terms of ex-post conformance of physical outcomes against identified goals and plan proposals. The degree to which outcomes in the real world fit the plan or conform to identified goals and objectives should form an indispensable part of a comprehensive spatial plan evaluation process, and the success of a plan should not only be evaluated in terms of the ‘effort’ relating to the process.

Principle 2.2: The rational process approach to spatial planning views planning as an ongoing process without a final end state, and makes provision for monitoring the effects of the plan with feedback loops to the preceding stages. Appropriate monitoring indicators for each stage of the spatial planning process (with the ability to identify the need for feedback to any preceding stage) is a necessary element of comprehensive spatial planning evaluation.

Principle 2.3: Spatial planning evaluation research within the post-positivistic paradigm is primarily aimed at evaluating the quality of the planning process (ex ante and ex post) aimed at organising an inclusive discourse to promote a shared learning process and creating the necessary conditions for successful implementation. The evaluation methodology should thus evaluate the quality and success of both the ex ante planning processes and the ex post planning processes.

Principle 2.4: From a complexity perspective urban systems involve co-evolving elements and sub-systems that progress over multiple timescales. Spatial planning evaluation activities must hence evaluate goals, plan alternatives, and concepts not from generalized perspectives (e.g. debates about desirable urban form) but based on the perspective relevant at a particular period of the development trajectory of a city. Different goals and concepts within the same plan may have to be evaluated over different timeframes applicable to individual goals and concepts.

Principle 3.1: Spatial planning evaluation can not only be measured at the scale of the overall plan, but also at the scale of individual sub-systems or individual policy objectives. For example, objectives focused on reducing travelling time can either be evaluated at the scale of overall metropolitan level employment-housing balance or commuting time, at a sub-metropolitan level in terms of average travelling time from defined traffic planning zones, or at a local or neighbourhood scale in terms of average distance or walking time to the nearest public transport access point.

Principle 3.2: Spatial planning processes do not always unfold orderly and sequentially according to predetermined phases as planned. These processes should be sufficiently flexible in order to evaluate individual elements at various scales.

Principle 3.3: The post-positivistic paradigm emphasizes diversity and cultural difference in cities and promotes concepts such as neighbourhoods, districts and corridors as the foundations for organizing urban space with a focus on relatively self-contained neighbourhoods with a ‘balanced mix’ of functions and land uses. Spatial planning evaluation should thus be able to assess the influence of these concepts at various scales appropriate to the ‘diversity’ of the area being evaluated.

Principle 3.4: Although ordering patterns may repeat itself at different scales within cities, the nature of the order and the processes of change however differs at various scales. Spatial planning evaluation should thus incorporate these scale differences and recognise the reality that locally optimal solutions based on a fragmented understanding of cities can result in suboptimal city design outcomes.

These identified principles for spatial planning evaluation recognizes that the procedural views and the conceptual and technical orientations of the various dominant paradigms are not regarded as incompatible and mutually exclusive concepts. On the contrary, the results of Chapters 2 and 3 and the preceding sections of this chapter indicated that most spatial planning processes include elements of physical design, as well as elements of neutral empirical analysis (resulting in quantitative or ‘scientific’ knowledge) and of consultation and collaboration (resulting in qualitative or ‘soft’ knowledge). Most spatial planning processes, either implicitly or by design, recognises the complexity within local urban systems and sub-systems nested in interrelationships with other systems at various scales. The principles identified in this section provides the guiding framework for a comprehensive spatial planning evaluation methodology.

4.6 CURRENT PRACTICE WITH SPATIAL PLANNING EVALUATION IN SOUTH AFRICA

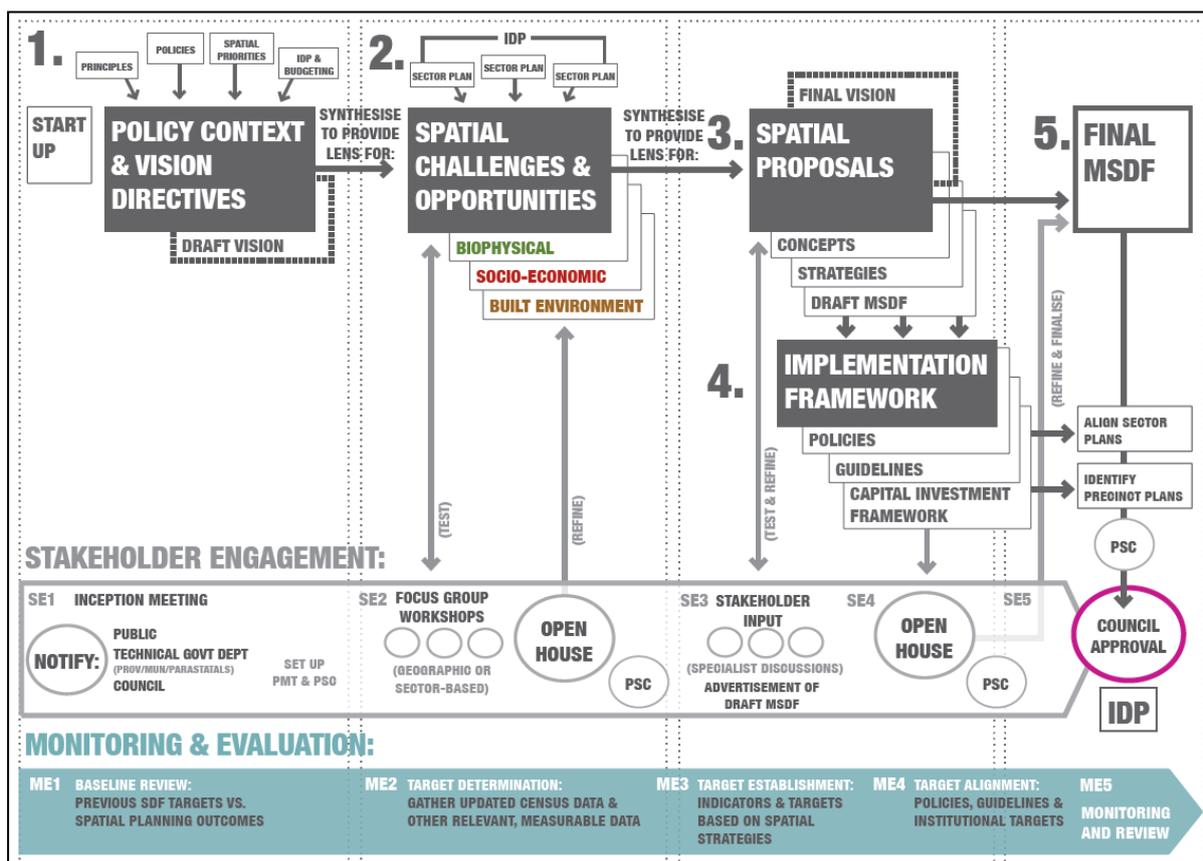
The evolvement of the South African spatial planning system since 1994 was discussed in detail in Chapter 3. The initial post-1994 planning reforms were focused mainly on the concept of reconstruction and development mainly focusing on broadening access to housing and basic services, and introducing important principles for spatial transformation. There was however no specific focus on the evaluation of planning outcomes in general, and spatial planning specifically. The promulgation of the Local Government: Municipal Planning and Performance Management Regulations in 2001 elevated the importance of monitoring and evaluation by introducing the concept of municipal performance management systems and the setting of key performance indicators. These regulations also prescribed

general key performance indicators to be applied by municipalities but these did not include indicators relating to spatial development patterns and processes specifically.

The subsequent growing realisation of the importance of evaluation in the overall government institutions resulted in the creation of a new ministry of Performance, Monitoring and Evaluation in the office of the President after the 2009 national government elections. This move clearly indicated the intention of government to efficiently monitor and evaluate machinery within government to assess the impact in key priority areas. The importance of monitoring and evaluation in the South African intergovernmental planning framework is emphasized by the cabinet approval of the government's National Evaluation Policy Framework (NEPF) which sets the foundation for the implementation of the National Evaluation Plan focusing on strategic evaluations of important government programmes (DPME 2011). This framework provides the bases for a minimum system of evaluation across government with its primary aim to improve the effectiveness and impact of government. It is however primarily aimed at planning and budgeting functions and activities within national and provincial government departments and does not provide any specific evaluation guidelines for spatial planning processes, spatial plans, or spatial outcomes. The more detailed municipal assessment tool subsequently developed by the Department: Performance Monitoring and Evaluation (DPME) further enhanced this process and provides holistic integrated information on the institutional performance of municipalities against key indicators in a coordinated and differentiated manner. The performance areas of this tool fall within six categories of which one is defined as 'Planning' (DPME 2012). None of these standards however relate to spatial plans and outcomes apart from determining whether a municipal SDF has been developed and whether it informs physical development.

SPLUMA seeks to promote consistency and uniformity in land use procedures and decision-making. Despite Chapter 4 of SPLUMA setting out in great detail the SDF process and products, including the specification of implementation targets, dates and the need for monitoring indicators, no details regarding the required monitoring system and indicators are however provided in SPLUMA or in the detailed regulations of the act promulgated in 2015. The Department of Rural Development and Land Reform (DRDLR) as the custodian of spatial data and planning in South Africa initiated a study to investigate the quality and status of SDFs throughout the country in 2008. One of the specific deficiencies identified in this study was the inability to formulate practical and implementable SDFs, and specifically the absence of measurable targets that will allow for assessing the success of an SDF. In response to these findings a set of guidelines for the formulation of SDFs (Republic of South Africa 2011b) were prepared. These guidelines included the first tentative steps towards some element of monitoring and the need for key performance indicators to be developed. However, apart from illustrative density factors and their potential application, no quantified guidelines or spatial statistical indicators were provided in these guidelines. As a further development and refinement of this process a more detailed and revised set of guidelines were published in 2014 (DRDLR 2014). This document

provides detailed process and content guidelines for the preparation of provincial, regional, and municipal SDFs. The process guidelines for the preparation of municipal SDFs are outlined in Figure 4.4 and indicates that the process makes provision for a monitoring and evaluation component in each phase of the process. The process outlined on Figure 4.4 is the equivalent of the ‘ex ante process’ described in Section 4.4.3.



Source: DRDLR, 2014:72

Figure 4.4: Procedural steps for preparing a Municipal Spatial Development Framework

However, despite this seemingly comprehensive process for evaluation and monitoring, only limited details are provided regarding the monitoring and evaluation methods, techniques and indicators to be applied. The guidelines that are provided for these monitoring and evaluation activities are summarised in Table 4.1. This information clearly shows that these monitoring and evaluation activities and deliverables are limited to the spatial plan preparation process (although it hints at the use of indicators to monitor implementation progress after formal adoption).

Table 4.1: Summary of monitoring and evaluation activities and deliverables in the process of preparing a municipal SDF

SDF Phase	Monitoring & evaluation activities	Monitoring & evaluation deliverables
1. Policy context and vision directives	Obtain and review baseline targets that were set in previous MSDF or other spatial planning processes and policies. Review previous targets in terms of Spatial Planning Outcomes (SPOs).	Database & review of baseline/previous targets against SPOs.
2.Spatial challenges and opportunities	Gather updated census and other relevant measurable data in accordance with the spatial challenges and opportunities identified	Updated data/census information
3.Spatial proposals	Establish clear, realistic, relevant and measurable indicators and targets according to the spatial strategies. Ensure that the targets are aligned with the Spatial Planning Outcomes	Set of indicators and targets
4.Implementation framework	Align the targets of the policies as set out in the implementation framework with the monitoring and evaluation targets. Align the targets of the guidelines as set out in the implementation framework with the monitoring and evaluation targets. Align the targets of the institutional requirements as set out in the implementation framework with the monitoring and evaluation targets.	Policy targets Guideline targets Institutional targets
5.Final MSDF	Set up a monitoring and evaluation process that will ensure the future evaluation and monitoring of the MSDF based on the established targets. Assign a department or person responsible for taking the monitoring and evaluation process forward.	Monitoring and Evaluation System Person/department responsibilities and timeframes

Source: Based on DRDLR, 2014

It does not reflect any evaluation aspects relating to the organizational structure or operational environment within which spatial planning operates, the interrelationship between different sub-systems and actors, or the evaluation process subsequent to plan approval during the implementation phase. It thus only addresses some of the principles for spatial planning evaluation as identified in Section 4.5. The current official guidance in South Africa for spatial planning evaluation and monitoring is thus

clearly insufficient to provide a suitable methodological approach for comprehensively evaluating the influence of spatial plans and policies on urban development processes and outcomes. The remainder of this chapter hence sets out a recommended methodological framework for spatial planning evaluation building on the findings of the preceding sections of this chapter.

4.7 A PROPOSED METHODOLOGICAL FRAMEWORK FOR SPATIAL PLANNING EVALUATION

In this section the relevant elements from the various theoretical approaches and concepts described in the preceding sections are systematically incorporated to describe a proposed comprehensive spatial planning evaluation methodology (see Figure 4.5). A central message from the preceding sections is that complex processes such as spatial planning and development cannot be oversimplified and reduced to a one-size-fits-all approach. A basic point of departure in the development of this framework is thus the importance of appreciating the range of potential planning evaluation tools and understanding which are appropriate for specific settings, rather than detailed knowledge of specific methods or individual indicators (Alexander 2006b). The suggested framework provides a comprehensive methodology for all components and phases of spatial planning evaluation based on a sound theoretical framework, but deliberately steers clear of identifying individual monitoring indicators. Significant time and resources are often invested in collecting data for long lists of potential indicators, but little effort is made to interpret these indicators within any relevant theoretical framework or against the policies and strategies of the plan (Rae & Wong 2012). A second point of departure is that in complex systems it is necessary to evaluate both the whole and individual parts. The framework for spatial planning evaluation should thus be flexible and make provision for the assessment of both individual processes and objectives, and the system as a whole (or both), while considering the interrelationships between the sub-systems and processes. The proposed methodological framework (Figure 4.5) outlines a flexible and modular approach to spatial planning evaluation including contextual evaluation, evaluation of the quality of the operational environment, and evaluation of various individual and combined stages of the spatial planning process and its outcomes. The overall framework consists of eight components:

- Contextual evaluation
- Evaluation of operational environment quality
- Goal evaluation
- Plan alternative evaluation
- Plan quality evaluation
- Ex ante planning quality evaluation
- Ex post plan performance evaluation
- Ex post plan conformance evaluation

These components can either be applied individually, or in selected combinations, or in totality based on the requirements of individual circumstances. Each of these components and its associated concepts and methods are described in the subsequent sections.

4.7.1 Contextual evaluation

The outcomes of spatial planning are affected by a myriad of external influences and processes as described in detail in Chapter 2. Spatial planning evaluation thus have to consider the impact of these contextual factors. As point of departure it should identify the important elements of the social, demographic, economic, technological, political, ecological and institutional forces and physical mediating factors that may influence the success and performance of the spatial planning process, the resulting products, and their implementation within a specific local context. These aspects have been discussed in detail in Chapter 2.

4.7.2 Operational environment evaluation

As outlined in Principle 1.3 the operational environment within which the plan preparation, implementation and monitoring process is embedded must form part of the evaluation process. The performance of the planning process (ex ante planning quality and ex post plan performance) is thus determined by the skills, leadership, and financial resources at its disposal (both within planning and within the organization at large) and the extent to which it is able to integrate its functions with other local authority activities in order to deliver its aspirations (Beckford 2002). This includes both the organizational quality of the wider local government organization of which the planning function forms part of, and the quality of the planning service itself that is directly responsible for the operation and implementation of spatial planning. The quality of the planning process is thus influenced by the leadership provided in the municipality (or city) relevant to the plan to be evaluated, the skills and resources made available to the service, and the extent to which planning objectives and activities are integrated with those in other parts of the municipality at large (Carmonah & Sieh 2004). Successful spatial planning evaluation not only requires an appropriate approach and the application of the correct tools, but also a willingness to learn and improve. Even in situations where this willingness may exist, resource constraints can dictate that the majority of resources are deployed to deal with the administration and management of development and land use management applications, with a resulting limiting impact on resource availability for monitoring and evaluation.

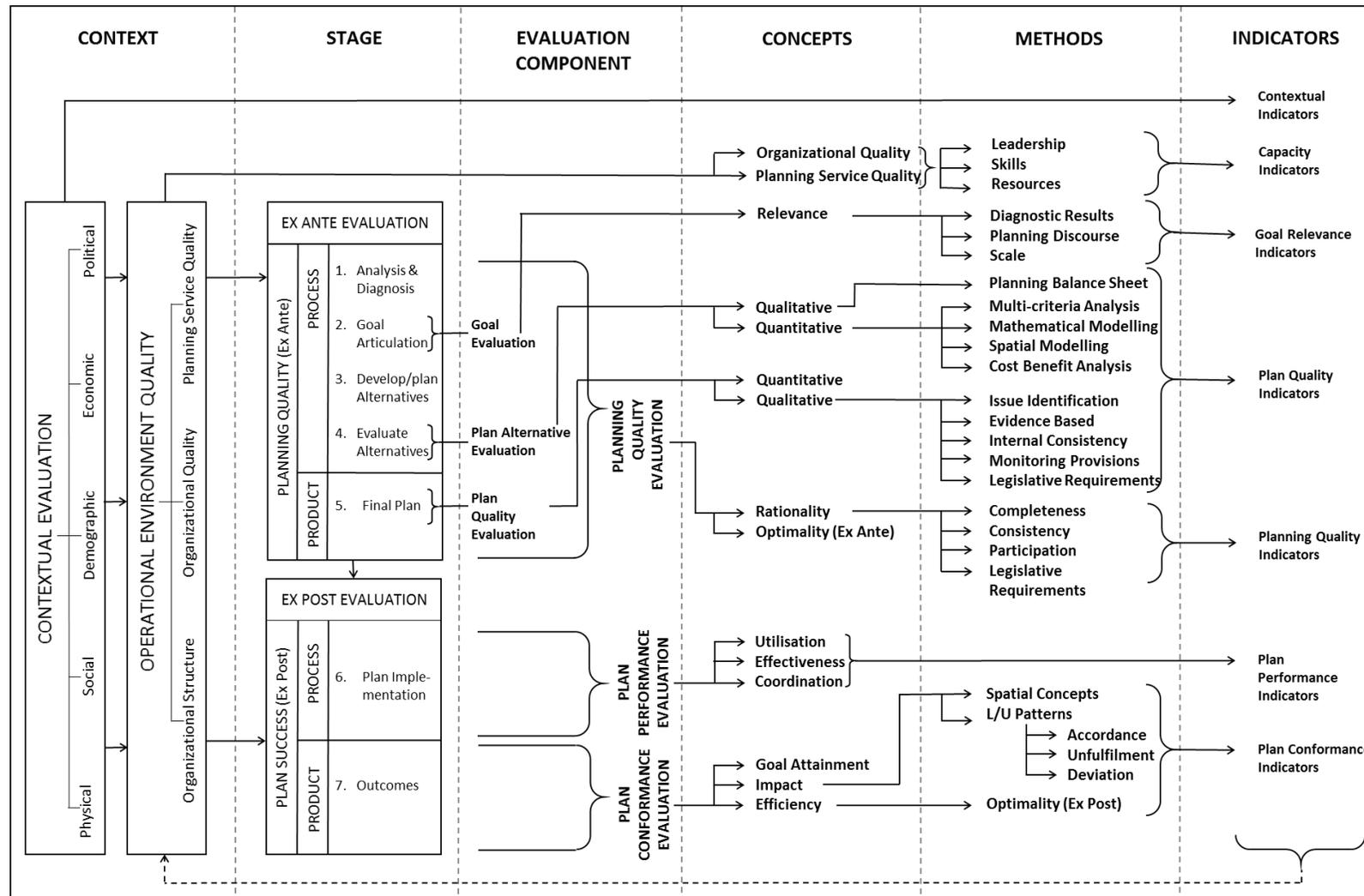


Figure 4.5: Proposed comprehensive spatial planning evaluation methodological framework

4.7.3 Ex ante spatial planning quality evaluation

Ex ante evaluation includes all procedures, processes and activities leading up to and including the adoption of a final plan document. Ex ante evaluation includes four distinct components: evaluation of the spatial planning goals, the assessment of plan alternatives, evaluation of the quality of the plan document, and evaluation of the planning process leading to the final plan.

4.7.3.1 Goal evaluation

Spatial planning in all its various forms and variants is driven by a set of values which underpins its normative aims – in other words what is it attempting to achieve (Hillier 2010). As discussed in Chapter 3, a specific set of spatial planning goals and concepts have become embedded in the South African context and is widely applied in urban level spatial planning (also referred to as the spatial planning doctrine). Debating or questioning the goals of spatial planning is traditionally not regarded as the task of planning practitioners and implies working within the confines of a set of social relations where the goals are not challenged (Hillier 2010). Based on principles 2.4, 3.3 and 3.4, this approach can however not be supported. The goals of spatial planning (as indeed the plan alternatives, spatial concepts, and eventual outcomes) should not be accepted on the bases of generalized perspectives or the rhetoric of popular planning discourse. Instead it should be based on the perspective relevant at a particular period in the development trajectory of a city, at various scales appropriate to accommodate the diversity of the study area, and the recognition that the processes of change differ at various scales.

4.7.3.2 Plan alternative evaluation

Plan alternative evaluation involves the testing of alternatives during the plan preparation process through the application of either qualitative or quantitative techniques. This type of evaluation is thus only concerned with the choice of the best alternative for the plan. Quantitative techniques include methods such as cost-benefit analysis (Lichfield, Kettle & Whitbread 1975), multicriteria evaluation (Whelan 1994; Boroushaki & Malczewski 2010; Van Niekerk et al. 2016) and mathematical modeling processes (Stimson & Haynes, 2012). Other approaches include attempts to explicitly consider non-quantifiable items such as the planning balance sheet approach (Lichfield, Kettle & Whitbread 1975).

4.7.3.3 Plan quality evaluation

Plan quality assessment involves the assessment of the resulting plan document and the primary concern is the question “How would you know a good plan if you saw one?” (Baer 1997:329). Plan quality generally suggests four key characteristics of good plans (Berke et al. 2006):

- a clear identification of issues important to the community;

- a strong empirical base leading to evidence based issue identification and the development of policies;
- an internal consistency among issues, goals, objectives, and policies; and
- provisions for monitoring how well objectives and goals are achieved.

These characteristics of ‘good plans’ clearly resonates directly with principles 1.3, 1.4, 2.2 and 2.3 as identified in Section 4.5. In view of the extensive policy and legal requirements for spatial planning as outlined in Chapter 3, a fifth important characteristic can be added to this list – legislative compliance. This refers to the extent to which the plan satisfies all the process and content requirements explicitly required by relevant legislation such as SPLUMA in the South African context.

4.7.3.4 Planning quality evaluation

The fourth component of ex ante evaluation is the assessment of spatial planning quality and is concerned with all aspects of the plan preparation process, the process of preparing the final plan document, and the formal adoption or endorsement of the plan. The planning process and the resulting plan should be evaluated from both a rationality perspective and an ex ante optimality perspective. The evaluation of rationality includes three distinct dimensions: completeness, consistency, and participation (Alexander & Faludi 1989). Completeness refers to the comprehensiveness of the process and the plan in terms of the various components of ex ante evaluation as described in Section 4.7.3 and outlined on Figure 4.5. The check for consistency should evaluate the internal consistency between identified issues, empirical analysis results, synthesis, goals, objectives, and recommended implementation measures including policies and strategies (non-spatial element) and spatial concepts and proposals (spatial element). The third component of rationality is the level of participation and involvement by relevant interested and affected parties in the development of the plan based on the inclusiveness of the process and the resulting ‘invisible benefits’ of establishing a shared commitment towards the implementation of the resulting plan (also see Principles 1.3 and 2.3). As is the case with plan quality evaluation a fourth dimension of rationality can be added – the extent to which the legislative process requirements have been complied with. The purpose of ex ante optimality evaluation is to establish whether the spatial planning process and the resulting plan product can be regarded as optimal in view of the contextual setting and operational environment prevalent at the time of the process and the plan product finalization.

4.7.4 Ex post evaluation (plan success evaluation)

Ex post evaluation refers to an assessment process subsequent to the adoption of plans. Plan success is determined by the interaction between planning quality, operational quality and the contextual environment as described in the preceding sections. Operational decisions do not simply convert plans

into reality but also entail deliberations in its own right about the consequences of alternative decisions in which spatial plans only form part of the information used by operational decision makers to reach their decisions (Mastop & Faludi, 1997). There are three alternative views on what can be regarded as planning success (Carmona & Sieh 2005). The first view is that, because planning attempts to control the future through the preparation of plans, planning has failed if plans remain unimplemented. The second view (strongly influenced by Mastop & Faludi 1997) is that the usefulness of the plan in informing and guiding the decision-making process is more important than whether the final outcomes reflect the goals envisaged in the plan itself. This implies that the primary purpose of strategic spatial plans is to act as an instrument for guiding and coordinating actions. In this view plans that are not implemented do not necessarily indicate failure. The third view assumes a compromise position which still regards implementation as important, but as long as outcomes are beneficial, departures from the formal plan are insignificant.

Ex post evaluation consists of two distinct components: plan performance evaluation and plan conformance evaluation as described in the subsequent sections.

4.7.4.1 Ex post plan performance evaluation

Plan performance evaluation is concerned with the way in which plans are utilised and consulted during decision making processes subsequent to its adoption and considers the concepts of utilisation, effectiveness and coordination. The aim of the concept of utilisation is to establish if the plan was used in the decision making process as a frame of reference for operational decisions, while effectiveness considers the extent to which plans influenced and contributed to decisions taken by decision makers. The third component of coordination provides an assessment of the extent to which plans contributed to the coordination of the actions of decision makers subsequent to decisions having been taken.

A number of important merits of the performance based approach to the evaluation of plans have been identified (Mastop & Faludi 1997; Carmona & Sieh 2005). The first benefit is that the performance perspective considers the entire process from the preparation of strategic policy right through to the identified measures to facilitate change in the real world. The second merit acknowledges that there are multiple actors involved in the planning process and that each actor evaluates the performance of the plan from their own individual perspectives. The performance approach thus allows the plan and related processes to be evaluated from different viewpoints. The third merit is that the performance approach can be applied from the most indicative type of plan on the one extreme to the most blueprint like plan on the other extreme.

This approach has however been criticised as a way of justifying the lack of accomplishment of plans by shifting the focus from the goals of the plan to the process and directing the assessment away from

what the plan does to how it goes about doing it. The essence of this criticism is synthesized in Wildavsky's view (1973:138) that "evaluation of planning is not possible so long as it refers to mere effort" and Talen's opinion (1996:255) that "diverting the focus of evaluation from plans to process removes the burden of accountability, and implementation is explained rather than evaluated as successful and unsuccessful".

4.7.4.2 Ex-post plan conformance evaluation

The conformance-based approach to plan evaluation is concerned with the degree to which outcomes in the real world fit the plan or conform to planning policy prescriptions (Alexander 2009) and primarily focuses on planning outcomes and the linkages between plans and actual development. This approach assumes a rational model of planning where plans act as guidance for future development and it assumes that the policies in the plan are specific enough so that the degree to which development adheres to these policies can be qualitatively or quantitatively measured (Laurian et al. 2004). Plan conformance evaluation deals with three related aspects. The first aspect is the evaluation of the extent to which the specified stated goals have been attained in terms of outcomes. The second component is impact assessment of spatial development concepts and proposals in terms of three potential outcomes. The first potential outcome is accordance (land use changed in accordance with the provisions of the spatial plan). The second outcome could be un-fulfillment (land use remained unchanged over the evaluation period), while the third potential outcome is deviation (land use changed over the evaluation period but not in accordance with the provisions of the spatial plan) (Tian & Shen 2011). The third aspect of efficiency considers the outcomes of the plan against the background of the contextual setting and operational environment within which the plan has been implemented and whether its performance and outcomes can be regarded as optimal within this context (ex post optimality).

The main reason why the conformance-based approach to the evaluation of plan implementation is often preferable to planning practitioners is because most planners focus on preparing rational plans to shape the physical outcomes of development and they consequently expect plans to influence development (Laurian et al. 2004). The conformance based approach for evaluating ex post plan success has however also been criticized on various grounds. The first point of criticism is that conformance as the ultimate test of effectiveness in a strategic context is constrained by the fact that the operational policy of strategic plans is generally not very specific and often only broadly described (Mastop & Faludi 1997). A second point of criticism is that a conformance based approach is less applicable in contexts dealing with complex problems. Research has found a negative relationship between conformity and the complexity of the planning issue, and a positive relationship between conformity and the intensity of communication between those involved (Eijck & Verhees as quoted in Mastop & Faludi 1997). A third and related point of criticism is that the implementation of spatial planning policies often follow a complex chain of

decision making involving a variety of actors and thus a likelihood of inconsistencies with original policy statements (Driessen 1997).

4.7.5 Selection of indicators

As indicated earlier, the proposed spatial planning evaluation framework deliberately steered away from the identification of individual indicators. The focus is on the identification of a broadly applicable set of principles and a comprehensive methodological framework for evaluation based on a sound theoretical underpinning. As indicated in Figure 4.5 each individual component of the evaluation process can be linked to specific indicators based on the identified concepts and methods associated with each individual component of the overall methodological framework. These detailed individual indicators will be identified based on the contextual environment and technical focus of each individual evaluation process. Some general comments regarding the identification and use of indicators will thus suffice for this purpose.

Indicators are proxy measures of broad and complex concepts and it is therefore important that the selection and analysis of indicators is guided by a well-defined theoretical framework (Wong and Watkins 2009) – in this instance as represented on Figure 4.5. In a generic sense indicators are essentially about ‘behaviour’ (difference, direction, and change) and ‘quality’ (the presence or absence, the nature, the quantity, the degree) (Carmonah & Sieh 2004) and should be used as tools for “simplifying complex phenomena and information into quantifiable measures that can be readily communicated” (Khalifa & Connelly 2009:1177). The type of indicators relevant to each of the key components of the evaluation process is outlined on Figure 4.6 and include contextual indicators, capacity indicators, goal relevance indicators, plan quality indicators, planning quality indicators, plan performance indicators, and plan conformance indicators.

The various versions (2004, 2006, 2011 and 2016) of the State of the Cities Reports of the South African Cities Network (SACN) provided extensive statistical comparisons between the cities forming part of the network based on a range of topics such as the economy, governance, finance, the built environment and other dimensions. It however did not focus specifically on urban form indicators and the impact of spatial plans and spatial planning processes on urban structure and functioning. The latest version (SACN 2016) however recognises the critical element of understanding spatial transformation through the tracking of spatial indicators and thus also includes a number of spatial indicators and indices illustrating specific components of change. It includes a wide range of 217 individual indicators under the various dimensions of productivity, inclusivity, sustainability and governance (SACN 2016). Very few of the indicators on this list however reflects directly on the key elements of the spatial planning doctrine as summarised earlier. Other potential sources of relevant standardized indicators that can also be considered include the 2030 Agenda for Sustainable Development (United Nations 2015),

International Standard ISO 37120: Sustainable development of communities: Indicators for city services and quality of life (ISO 2014), and the various policy papers of the Habitat III New Urban Agenda (United Nations 2016).

4.8 CONCLUSION

This chapter started by analyzing the main paradigm shifts in procedural planning theory ('theories of planning') and its implications for spatial planning evaluation. The four identified paradigms are the deterministic paradigm, the positivistic paradigm, the post-positivistic paradigm, and the complexity paradigm. The analysis considered the main theoretical streams within each paradigm and the associated predominant conceptual and technical norms and values, as well as the implied form of planning and the primary role of planners associated with each framing paradigm. An important conclusion is that there is no strictly defined impermeable boundaries between the identified paradigms and its associated theories in spatial planning, and that most spatial planning processes contains some elements of the dominant orientations from more than one or all of the identified paradigms. A comprehensive spatial planning methodological framework can thus not be grounded within one particular paradigm only.

Section 4.3 highlighted the challenges of planning and uncertainty, complexity and control in planning, and establishing causality between planning processes and outcomes. Section 4.4 discussed a number of prominent methodological considerations including the appropriate use of terminology, identifying the object of spatial planning evaluation (what must be evaluated), at what stage of the spatial planning and implementation process must evaluation be undertaken, what is a relevant timespan to measure the outcomes and impacts of spatial planning, and the scale at which urban spatial planning evaluation must be conducted. The findings of Sections 4.2 to 4.4 were then synthesized into a number of basic principles used as a point of departure for the development of comprehensive methodological framework. Current practices with spatial planning evaluation in South Africa was described in Section 4.6 and evaluated against the basic principles established in Section 4.5. This evaluation found that the current available official guidance in South Africa for spatial planning evaluation and monitoring is insufficient and does not provide a suitable methodological approach for comprehensively evaluating the influence of spatial plans and policies on urban development processes and outcomes. A proposed comprehensive spatial planning evaluation methodological framework was described in Section 4.7.

This proposed methodological framework provides a flexible framework for engaging in the process of spatial planning evaluation. This methodology could be applied either comprehensively or selectively in a modular approach, depending on the objectives of the evaluation process and the governing circumstances. For example, if the focus of the evaluation process is on the role and contribution of the quality of the plan in achieving the plan outcomes then the focus will be on the plan quality evaluation component and the plan conformance evaluation component. However, if the primary purpose of the

evaluation is to evaluate the contextual and operational factors influencing the plan outcomes, then the selected focus will be on the contextual evaluation component, operational environment quality evaluation component, and ex post plan conformance component. The individual components within this framework can thus either be applied individually, or in selected combinations, or in totality based on the requirements of individual circumstances.

The application of robust spatial planning evaluation techniques resulting in objective empirical evidence will contribute to conditions where planners would feel more confident about their role in achieving the end results. Wong (1998:234) is of the opinion that the “real innovation and improvement (of planning) can only come if we share the experience of our predecessors and consolidate past lessons, the right and the wrong, to develop new ideas and methods from that basis”. The challenge lies in what Alexander (2006c:274) pronounced in his reflection on the future directions for evaluation in planning: “... more attention to developing, testing, and applying integrated evaluation processes in real institutional contexts”. In response to this challenge identified by Alexander the subsequent three chapters apply selected components of this methodology in a range of case study applications. The ‘product’ element of the planning quality evaluation component of this framework is applied in Chapter 5 to evaluate urban spatial plan quality in South Africa. The plan conformance component of the methodology is then applied in Chapters 6 and 7. It aims to evaluate the influence of SDFs as the key instrument of spatial planning policy on guiding the spatial transformation of a sample of South African cities between 1994 and 2011 in terms of two of the prominent goals of the post-1994 spatial planning doctrine: (1) compaction and densification and (2) spatial and land use integration.

5 CHAPTER 5: A CRITICAL REFLECTION ON URBAN SPATIAL PLANNING PRACTICES AND OUTCOMES IN POST-APARTHEID SOUTH AFRICA (SPATIAL PLAN QUALITY EVALUATION)

5.1 INTRODUCTION AND BACKGROUND

There is a growing body of evidence to suggest that cities make a disproportionate contribution to economic production and employment creation, (Bridge & Watson 2000; Baycan-Levent 2002; Bourne & Simmons, 2002; Geyer 2007b) and function as sources of economic dynamism (Turok & Parnell 2009). In the South African context urban areas are recognised as the drivers of economic and population growth and points where many social and ecological challenges are concentrated. Nearly three-quarters (71%) of South Africa's population live in a limited number of cities and towns, and have well-established local economies that account for 92% of all formal economic activity in the country (Republic of South Africa 2009). It is however also widely acknowledged that South African urban form is characterised by a number of inefficiencies such as unequal access to economic and social opportunities, poorly located lower income settlements, insufficient public transport and spatial structural elements resulting from apartheid-era policies and legislation (Drakakis-Smith 1992; Maylam 1995; Boraine et al. 2006; du Toit 2007). Not surprisingly, the spatial planning policy framework and associated implementing tools have undergone fundamental changes since the onset of the democratic era in 1994. The most prominent of these include the introduction of a system of Integrated Development Planning (IDP) supported by a number of sectoral plans, most notably the Spatial Development Frameworks (SDF) as an instrument for giving spatial expression to the developmental vision and priorities of municipalities. The SDF concept largely replaced the traditional guide plans and structure plans that for many decades formed the backbone of the forward planning process and functioned as the primary tool for guiding the spatial development patterns of South African cities and towns.

The effectiveness and impact of urban spatial planning in the post-apartheid era and its impact on restructuring South African cities are however increasingly being questioned and it has been argued that South African cities remain among the most inefficient urban environments in the world (Du Plessis & Landman 2002). Robins (2002:666) expresses the view that, despite concerted planning efforts aimed at desegregating the apartheid city, the "everyday socio-spatial legacies of apartheid continue to be reproduced". This view is echoed by Pieterse (2004) who is of the opinion that South African cities may be as segregated and fragmented as they were at the dawn of the democratic era. These arguments are also recognised in official policy documents. The National Urban Development Framework (NUDF) states that policies since 1994 have not succeeded in restructuring the apartheid spatial patterns of South Africa's cities and towns (Republic of South Africa 2009). The National Planning Commission (NPC) identified "spatial challenges that continue to marginalise the poor" as one of the critical cross-cutting issues that will influence South Africa's long-term development, and expresses the opinion that although the spatial legacy of apartheid was identified as a particular focus area for attention before 1994, the

situation has probably been aggravated since then (Republic of South Africa 2011a). In the subsequent National Development Plan 2030 (NDP) it is recognised that densities have increased in some urban areas and that partial regeneration of inner cities has been achieved, but that little progress has been made in reversing apartheid geography (National Planning Commission 2012).

In view of this apparent limited impact of spatial planning initiatives, and the growing international trend of introducing evidence-based planning (Alexander 2009; Wong & Watkins 2009), now is the time to reflect critically upon the spatial planning system and its outcomes in South Africa since the dawn of the democratic era in 1994.³⁴ It firstly provides a literature review to synthesise the key challenges in urban spatial planning in South Africa and its implications for the content and quality of spatial plans. It then proceeds to consider the quality of urban spatial plans in response to these identified challenges, through a review of the spatial plans of a cross-section of South African cities. In conclusion, a number of suggestions are offered to address these challenges and pave the way for improved spatial plan quality.

5.2 THE CHANGING URBAN SPATIAL PLANNING CONTEXT IN SOUTH AFRICA

Historically, from an international perspective, spatial planning has been concerned mainly with the relationship between various land uses and infrastructure components and channels (Chapin & Kaiser 1985), and was dominated by the master planning approach in many parts of the world after World War II. This approach was aimed at developing detailed plans focusing on the configuration of various land uses (Todes et al. 2010). From the late 1970s master planning has been widely criticised, especially for its static nature, as being incompatible with rapid urban growth (Clarke 1992). The dominance of ‘control and command’ policies has given way to evolutionary and participatory planning principles (Baycan-Levent & Nijkamp 2008). Important new concepts and approaches, which gained prominence from the 1990s onwards include the concept of networks through the work of Castells, based on the tension between places and flows (Castells 1996), the rise of civil society and the question of power in the production of urban space (Friedman 1998; Amin 2002), dynamic conceptualisations of multiplex places (Graham & Healy 1999), and methods for establishing and invoking a common ‘spatial planning doctrine’ (Faludi 2000). Despite the introduction of these new concepts and approaches, a number of key elements have remained more or less consistent aspects of the spatial planning process. Healy (2007)

³⁴ The inadequate monitoring and evaluation of spatial planning processes (including the resulting spatial plans), as well as the growing perception that spatial planning processes and plans in South Africa are ineffective to guide urban development was identified as important elements of the research problem statement outlined in Chapter 1. In response to these challenges and the requirement of Objective 2 of the research (develop a methodological framework for spatial planning and plan evaluation) a proposed comprehensive spatial planning evaluation methodological framework was developed in Chapter 4. This chapter applies the plan quality evaluation component (as the ‘product’ element of ex ante spatial planning quality evaluation) of the evaluation framework developed in Chapter 4.

summarises these elements as a proper understanding of the physical structure of an urban area and the forces shaping it, orientating goals expressed through policy statements, a framework of principles outlining concepts, projects and programmes, and an inspirational future vision.

The history and evolution of the planning system in the South African context has been widely documented (e.g. Swilling, Humphries & Shubane 1991; Mabin 1992; Beavon 2004; Harrison, Todes & Watson 2008; van Donk et al 2008). The current form and structure of South African cities and towns have probably been most profoundly influenced by the period referred to by Harrison, Todes & Watson (2008) as 'high apartheid', from the late 1940s to the early 1970s, when influential planning policies and instruments such as the Group Areas Act were conceived and implemented (Mabin 1992). On an urban scale this period was characterised by forced removals based on ethnicity and the development of new large-scale townships, in many cases still dominating the form and structure of many South African cities. The main focus of spatial planning was on the physical design of areas through guide plans and later structure plans (Todes et al. 2010). Hindson (1987) argues that the biggest impact of the period from the mid-1970s to 1990 was the creation of 'semi-formal' settlements on the urban periphery, in areas such as Ivory Park in Midrand and Khayelitsha in Cape Town.

Influential work emerged during the 1980s in certain academic circles, with the most renowned being Dewar and Uytendogaardt's *South African Cities: A Manifesto for Change* (1991). Many of these concepts subsequently found their way into post-apartheid spatial planning policies and approaches. The initial phase of the democratic era after 1994 was dominated by the Reconstruction and Development Programme (RDP), which focused on investment in infrastructure and basic services. It introduced some enduring spatial planning concepts such as 'compact cities' and 'densification and unification of the urban fabric' (Republic of South Africa 1994). The Development Facilitation Act (DFA) was also promulgated during this era and, through its provision for the preparation of so-called Land Development Objectives, represented the first step to a new spatial planning framework. The set of normative spatial principles contained in the DFA (Republic of South Africa 1995) introduced a legal source to guide the spatial content of planning. The first municipal spatial plans produced after 1994 were strongly influenced by RDP and DFA principles. Another important policy instrument emanating from this period that impacted directly upon urban structure was the introduction of a new housing policy, providing subsidies from the state to qualifying beneficiaries. In retrospect it became clear that the structure and application of the subsidy mechanism simply did not make provision for the acquisition of well located (but significantly more expensive) land that would facilitate the goal of integration and restructuring of the South African city, and this led to the subsequent revision of this policy in 2004 (Republic of South Africa 2004). The period from 1996 saw a change in focus to a competitive and fast-growing economy, and the introduction of policies such as the Growth, Employment and Redistribution (GEAR) programme (Republic of South Africa 1996). Later there was the announcement of the Accelerated and Shared Growth Initiative for South Africa (ASGISA) in 2006 (Republic of South Africa

2006b), which identified planning and land-use management as key areas requiring institutional reform (Harrison, Todes & Watson 2008).

Great emphasis was placed on integrated planning and service delivery by all spheres of government in the period from 2000 onwards. Important initiatives from this period included the introduction of the National Urban Renewal Programme and the first versions of the National Spatial Development Perspective. The most prominent impact upon spatial planning at an urban level has been the entrenchment of the Integrated Development Planning process, through the promulgation of the Local Government: Municipal Planning and Performance Management Regulations in 2001 (Republic of South Africa 2001). Of particular importance in the regulations is the prescription that the Integrated Development Plans (IDPs) of municipalities must include an SDF, and they provide broad guidelines of what such a framework must contain. According to Watson (2002b) the earlier versions of the IDP viewed spatial plans as playing an important pro-active and synthesising role, a function later replaced by the municipal budget.

After the national elections of 2009, rural development was elevated to one of the key political priorities for the new term of office. This period also saw the release of the National Urban Development Framework (NUDF). The NUDF emphasises that the term 'urban' does not seek to reinforce a divide between urban and rural but that these two concepts are rather viewed as "parts of a continuous regional, national, and international system interrelated through a web of economic, social, political and environmental linkages" (Republic of South Africa 2009:2). The most prominent initiative in the period after 2009 has been the establishment of the National Planning Commission in April 2010. The commission is an advisory body tasked with preparing recommendations to the cabinet on issues affecting South Africa's long-term development. The first step towards a new National Development Plan was a series of Diagnostic Overview Reports. The detailed *Material Conditions diagnostic report* identified the form of future towns and cities as one of the six 'big issues' requiring significant focus in the national plan. The three critical concerns with regard to urban form and density were identified as very low overall densities, in international terms, an inverted density gradient with the highest densities in pockets of low-income settlements along the periphery, and the spatial fragmentation of the labour market, which disperses available work (Republic of South Africa 2011c). Not surprisingly, the transformation of human settlements is identified as one of the key elements in the subsequent NDP, which recognises that many of the elements of its spatial vision were known and accepted in 1994 but that the challenge has been "to translate the vision into implementation and meaningful spatial outcomes" (National Planning Commission 2012:286). The NDP offers a range of recommendations, seen as appropriate measures to reconfigure towns and cities into more efficient and equitable urban forms; it includes aspects such as the need for explicit spatial restructuring strategies in each municipality, and the creation of a robust set of indicators as part of a spatial governance evaluation framework.

5.3 EMERGING CHALLENGES IN SOUTH AFRICAN URBAN SPATIAL PLANNING

5.3.1 Introduction

In response to this changing institutional environment for spatial planning in South Africa, the need for new approaches to planning in general, and spatial planning in particular, have been recognised by academics, government and planning practitioners. Serfontein & Oranje (2008:28), in their evaluation of spatial planning in the Tshwane metropolitan area, identified what they refer to as “the deep disconnection between planning thought and the ‘real, emerging’ spatialities of the 21st century”. One of the possible explanations they offer is the persistence of how planners interpret and act upon space in a manner still based on the nineteenth-century industrial city. Todes et al. (2010) argue that some of the internationally identified principles for new urban planning are also applicable to spatial planning in South Africa, such as a greater focus on sustainability, improved integration and alignment between spatial planning and budgeting processes, and a better understanding of markets and the implications for producing credible plans.

Through a literature review it was possible to synthesise seven key challenges that have been affecting urban spatial planning processes and outcomes since 1994.³⁵ Each of these challenges is summarised in the following subsections, focusing on two interrelated strands of arguments. Each subsection first summarises the key elements of the debates inherent to each of the identified challenges based on the literature that was reviewed. The critical elements of these debates then provide the framework for analysing a cross-section of urban spatial plans of the larger urban areas in South Africa, to establish how municipalities have responded to these identified challenges in their latest generation SDFs. A total of 15 SDFs were evaluated, representing the four largest metropolitan municipalities (Johannesburg, Cape Town, Tshwane and eThekweni), two municipalities that recently obtained metropolitan status (Mangaung and Buffalo City) and four intermediate cities (Msunduzi, Rustenburg, Emalahleni and Mbombela). Many of the larger metropolitan municipalities have introduced a hierarchy of plans dealing with more detailed proposals at lower levels of spatial aggregation. In these instances, both the overall metropolitan level SDF as well as one of the sub-regional spatial plans was evaluated.

³⁵ Chapter 4 identified some generic indicators for evaluating plan quality. It was however also indicated that unique indicators should be identified for the individual components of the evaluation process based on the contextual environment and technical focus of each individual evaluation process. The criteria applied in this chapter for evaluating plan quality was hence primarily identified in response to the South African urban spatial planning challenges since 1994.

Table 5.1: Spatial Development Frameworks analysed

Name of Spatial Development Framework	Date of plan
Johannesburg Spatial Development Framework	2010/11
Johannesburg Regional Spatial Development Framework for Region D	2010/11
Cape Town Spatial Development Framework	2012
Helderberg District Plan: Spatial Development Plan and Environmental Management Framework (Cape Town)	2011
eThekweni Spatial Development Framework (contained in 2010/11 IDP review)	2010/11
eThekweni Municipality Central Spatial Development Plan	2010/11 review
City of Tshwane Spatial Development Strategy 2010 and beyond	2007
Tshwane Regional Spatial Development Framework North Eastern Region	2007
Buffalo City Spatial Development Framework	2003
Bonza Bay Local Spatial Development Framework (Buffalo City)	2008
Mangaung Spatial Development Framework	2010/11
Rustenburg Spatial Development Framework	2011
Msunduzi Spatial Development Framework Review	2009
Emalahleni Local Municipality Spatial Development Framework	2010
Mbombela Spatial Development Framework	2006

In all instances the latest available SDF was used at the time of research, and dates of the plans range between 2003 and 2012.³⁶ The municipal SDFs are normally reviewed in five-year cycles, but this is dependent on the available financial and human resources within individual municipalities and is often reviewed less frequently. The analysis of these plans focused on the identified key issues within each theme and considered both the narrative content and the spatial proposals of the plans. In some instances the responses to the identified issues as reflected in the SDFs were implied rather than explicit (for example referring to other detailed studies without including any specific information) and are reflected under the category ‘implied’ in the analysis tables.

5.3.2 Institutional coordination and alignment

Improved management of urban growth and improved urban governance are two of the strategic outcomes for South Africa’s urban areas identified in the NUDF (Republic of South Africa 2009). The realisation of these outcomes is however impeded by both horizontal and vertical coordination and alignment challenges. At a municipal level, the most fundamental horizontal alignment challenge is the lack of coordination of spatial plans with other sector planning activities within municipalities and with the planning of neighbouring municipalities (Republic of South Africa 2011b). The Gauteng provincial SDF for example notes that the preparation of municipal SDFs “has been undertaken at an isolated local

³⁶ Many of these municipalities have subsequent to the promulgation of SPLUMA in 2013, and the DRDLR SDF guidelines in 2014, prepared updated and revised versions of these SDFs. However, as explained in Chapter 1, the detailed land use and socio-economic data required to evaluate the influence of the SDFs had to reflect time periods as close as possible to the two census periods (1996 and 2011) for which detailed demographic data is available. The plans specified in this table thus represent the spatial plans impacting on urban development subsequent to 1994 and up to the period of more or less 2011.

authority level without cognisance of how they collectively comprise a province-wide development framework” (Gauteng Department of Economic Development 2010:20). One of the main criticisms against the spatial plans in the post-1994 era is that they do not provide sufficient detail and guidance to inform decision-makers. This has resulted in a hierarchical system of planning, allowing for increasingly detailed plans at lower levels of spatial aggregation, now adopted by most of the metropolitan areas (e.g. Johannesburg, Cape Town, Tshwane, Ekurhuleni and eThekweni) and advocated by the draft set of national guidelines for the formulation of Spatial Development Frameworks. This implies that yet another dimension of alignment between the various tiers of spatial plans within individual municipalities is necessary. Recent research on the application of this approach (Todes et al. 2010) indicates that this in effect involves a return to master planning, and therefore calls for debate and exploration of alternative forms of spatial planning. The major challenge for vertical alignment from a city-level perspective is the overlapping responsibilities between provincial government and local municipalities in aspects such as housing and land-use management. This is exacerbated by the range of policies of different national departments responsible for various elements with a spatial dimension. This also complicates the alignment of investment programmes to achieve greater consistency in national priorities such as poverty reduction and employment creation (Turok & Parnell 2009).

Based on these arguments, there are at least three critical aspects of institutional coordination and alignment that need to influence and inform urban SDFs: horizontal coordination with the plans of adjacent municipal entities, vertical alignment with provincial-level spatial frameworks and strategies, and consideration of the national view on spatial development. The responses to these challenges, as documented and reflected in the 15 plans that were evaluated, are summarised in Table 5.2.

Table 5.2: Responses to institutional coordination and alignment

Dimension	Yes	Implied	No
1. Clear horizontal coordination with spatial plans of adjacent municipalities	6	2	7
2. Explicit vertical alignment with provincial spatial plans and strategies	7	3	5
3. Clear consideration of national spatial development plans and perspectives	4	-	11

The information in Table 5.2 reflects mixed results for the horizontal and vertical alignment of spatial planning processes. What is clear is the limited consideration of national spatial development plans and frameworks in urban-level spatial plans. Although it could be argued that the NSDP has been controversial in certain aspects since its inception, one would have expected at least some consideration of the basic principles outlined in this framework. Only four of the plans evaluated showed clear evidence of consideration of the NSDP principles. This may be partly attributed to urban municipalities assuming that alignment with national spatial policies is achieved through Provincial Spatial

Development Frameworks. The extent of horizontal alignment with adjacent urban areas, and the vertical alignment with provincial spatial plans, is more encouraging. Six of the plans revealed clear horizontal coordination with the spatial plans of adjacent municipalities and seven showed explicit vertical alignment with provincial spatial plans or strategies. The further strengthening of this element in urban spatial plans will make a meaningful contribution to what the National Development Plan refers to as the "...development of plans that cross municipal and even provincial boundaries and would promote collaborative action..."(National Planning Commission 2012:286).

5.3.3 Physical and socio-economic integration

It has been argued that spatial governance in places characterised by existing levels of social inequality and racial polarisation will continue to be ineffective (Robins 2002). The concept of integration has been part of the South African spatial planning nomenclature since the early 1990s. As early as 1994 the RDP called for the "densification and unification of the urban fabric," (Republic of South Africa 1994:86) and was soon followed by the Development Facilitation Act (Republic of South Africa 1995), outlining the basic principles and dimensions of integration. The concept was associated with three dimensions: the integration of the various aspects of land development (social, economic, institutional, and physical), the integration of land development in rural and urban areas in mutual support, and the integration of residential and employment opportunities in close proximity to each other. The concept of integration remained central to the spatial planning and policy agenda right up to the current National Development Plan 2030, which contains as many as 88 individual references to the concept of integration (National Planning Commission 2012). The NDP specifically recommends that every municipality should have an "explicit spatial restructuring strategy" including identified "priority precincts for spatial restructuring" and "critical interventions to redress past social segregation" (National Planning Commission 2012:286). Despite this strong focus on the concept of integration, the measurement and quantification of this goal remained vague at best.

The national guidelines for the formulation of SDFs provide some basic clarification and quantification of the concept of integration, and distinguish between functional integration and social economic integration (Republic of South Africa 2011b). Functional integration is advocated through the walking-distance principle, and recommends that at least 50% of urban activities should be within walking distance (approximately 1000m in 20 minutes) of where people live. With regard to socio-economic integration, it pronounced that little progress has been made since 1994, and attributes this to resistance from communities and financial institutions. Research into changes in the socio-spatial landscape in the Tshwane metropolitan area for example indicated that although a number of neighbourhoods experienced significant changes in ethnic composition, overall segregation levels have in fact increased slightly (Badenhorst, van Helden & Schoonraad 2005). The SDF guidelines thus propose the use of a

socio-economic gradient with relatively small differences in income and property value between adjacent communities to mediate this problem (Republic of South Africa 2011b).

Fundamental questions in this context relate to the understanding of integration and segregation and their measurement. Horn (2005:68) is of the opinion that indicators such as the standard segregation index are “blunt, outdated, and misleading” and recommends that socio-economic integration processes be evaluated by combining appropriate quantitative measures with other empirical and qualitative techniques. Elements critical to the spatial planning process and outcomes thus relate to the methodological approach, analysing both functional and socio-economic integration, the formulation of explicit strategies to achieve this integration, and translating these strategies into spatial proposals. The responses to these elements as documented in the urban spatial plans are summarised in Table 5.3.

Table 5.3: Responses to physical and social economic integration requirements

Dimension	Yes	Implied	No
1. Quantitative analysis of physical/functional integration	1	0	14
2. Quantitative analysis of social economic integration	0	1	14
3. Explicit strategies for functional and social economic integration	4	1	10
4. Explicit spatial proposals for functional and social economic integration	3	1	11

The results of the analysis reflected in Table 5.3 largely confirm that, notwithstanding the importance of the integration concept in policy documents, its translation into practical terms remains unclear. Only one of the plans evaluated contained a quantitative analysis of the extent of physical/functional integration, whereas quantitative measures of socio-economic integration clearly remain uncharted waters in spatial plans. Despite the lack of meaningful quantitative analysis, some of the spatial plans do contain explicit strategies and spatial proposals for pursuing the objective of functional and socio-economic integration. In these cases, the strategies and proposals are almost exclusively limited to the location of affordable housing at strategic locations to achieve the objective of improved integration. These results imply that a significant reorientation of urban spatial plans will be required to achieve the NDP recommendation that each municipality has an “explicit spatial restructuring strategy that is linked to instruments for implementation” (National Planning Commission 2012:286).

5.3.4 Understanding the space-economy of cities

One of the key tension points in spatial planning in South Africa is the interplay and associated trade-offs between the need for economic growth and competitiveness on the one hand, and for socio-economic redress on the other. Cities have to compete globally if they wish to develop their local resource base and improve their position (Jenkins & Wilkinson 2002). Not responding to global trends and demands will ultimately lead to reduced international investment, thus limiting available domestic resources and preventing their extension, to the detriment of the poor. Not surprisingly, one of the stated

strategic outcomes of the NUDF (Republic of South Africa 2009) is improved economic competitiveness and resilience. Lemanski (2007) juxtaposes these points, and asks whether it is possible for a city to be simultaneously globally competitive and address domestic socio-economic redistribution and argues that in the case of cities with increasing global success this has not necessarily been spread equally throughout the city.

One of the key factors underlying the inability of cities to address these tensions effectively is the limited understanding of their space economy. Although some advances have been made with the spatial economic analysis at a national and regional level in South Africa through the development of a set of mesozone units (Van Huysteen et al. 2009), the application at an urban level still remains a challenge. Todes (2008) suggests that planners need a deeper understanding of urban economic space and mechanisms through which planning relates to markets. Serfontein & Oranje (2008:28) hold a similar view and note that “any references to where the [real] potential of the economic landscape lay, were conveniently ignored and hence no logical connection could be found between urban potential and the planner’s view of the future shape and form of the [future] economic landscape.” More recently, the NDP cited a lack of understanding of economic principles, market forces and commercial realities amongst planners and other built-environment professionals, as one of the difficulties facing the planning system in South Africa and its ability “... to negotiate better development outcomes...” (National Planning Commission 2012:275). This challenge is not unique to the South African situation, and Harris (1990) pointed out that comprehensive metropolitan spatial plans in developing countries are normally devoid of analysis of the real economy. Critical elements of urban spatial plans should therefore include an appropriate and comprehensive analysis of urban economic space and market and investment trends. Planners also need to reflect upon the extent to which the spatial strategies and proposals make provision for both economic competitiveness, as well as socio-economic development and redress.

Table 5.4: Responses to understanding the urban space economy

Dimension	Yes	Implied	No
1. Comprehensive spatial analysis of urban economic space	1	3	11
2. Spatial analysis of market and investment trends	1	0	14
3. Spatial strategies and proposals for economic competitiveness	3	2	10
4. Spatial strategies and proposals for social economic development	7	1	7

The results reflected in Table 5. 4 indicate that the majority of urban spatial plans which were evaluated remain devoid of any comprehensive spatial analysis of the urban economic space and the spatial analysis of market and investment trends. It may be argued that some of this data is contained in the local economic development strategies of the cities, but they have certainly not been integrated with the spatial development plans. There are isolated examples of progress on this front, with a city such as

Cape Town having made significant strides in innovative spatial economic analysis techniques, such as their Economic Areas Management Programme. As far as balancing the need for economic competitiveness and growth on the one hand and social development and redress on the other are concerned, the focus has largely been on the socio-economic development component. Seven of the plans reviewed contained clear spatial strategies and proposals for socio-economic development, whereas only three plans included strategies and proposals dealing with economic competitiveness and growth. Spatial economic analysis at the urban level therefore appears to remain an area that would require significant attention in future urban spatial planning processes. There are however indications that some city-visioning processes are starting to make inroads into the challenge of entertaining both economic growth and service delivery on the other (Robinson 2008).

5.3.5 Infrastructure development and capital investment

Infrastructure provision is one of the most powerful forces shaping urban areas. This notion is not entirely new and Doxiadis concluded in 1970 that the complex problems of cities cannot be solved through the development and official recognition of a physical plan alone. Instead he argued for a development programme which is expressed in space by physical development plans, but also supported by economic, social, political, administrative, technological, and aesthetic programmes (Doxiadis 1970). More recently, Healy (2004:46) confirmed the critical role of infrastructure and investment in the realisation of spatial planning goals, by describing spatial planning as “self-conscious collective efforts to reimagine a city, urban region or wider territory and to translate the results into priorities for area investment, conservation measures, strategic infrastructure investment, and principles of land use regulation.” This view is further emphasised by Todes (2008:11) who states that “infrastructure planning with its own spatial logic was more powerful in shaping the spatial structure of cities than spatial planning.” The NUDF also identified improved urban infrastructure and service delivery systems as one of the strategic outcomes for South Africa’s urban areas (NUDF 2009). Specific issues that have a negative influence on the integration of infrastructure development and capital investment with spatial planning is the dominant influence of public-sector driven low-income housing projects funded by the Department of Human Settlements, the shaping of cities through up market private-sector commercial and residential development (Harrison, Todes & Watson 2008), and the emphasis on ‘mega-projects’ disjointed from spatial planning (Todes 2008). Turok & Parnell (2009) therefore call for the replacement of the traditional piecemeal pursuit of capital projects with a more coherent long-term view focused on selected areas and policy themes.

The integration of spatial planning with capital and infrastructure investment programming at the municipal level is intended to be achieved through the IDP process. In considering the response of municipal spatial plans to this challenge it is therefore imperative to determine whether the IDP capital programme has been interpreted from a spatial perspective and integrated with the spatial development

framework proposals. It is also necessary to determine whether key infrastructure projects resulting from the SDF proposals are identified and whether the investment implications associated with these infrastructure requirements have been quantified.

Table 5.5: Responses to the need for integrating infrastructure development and capital investment with spatial planning

Dimension	Yes	Implied	No
1. Clear spatial interpretation of IDP capital projects	3	1	11
2. Integration of IDP capital projects with SDF proposals	1	2	12
3. Key infrastructure projects required for implementation of SDF proposals identified	6	2	7
4. Investment implications resulting from the SDF proposals quantified	1	-	14

The results portrayed in Table 5.5 confirm that the integration of infrastructure development and capital investment strategies with spatial development planning remains largely unsatisfactory. Only three of the plans provided a clear spatial interpretation of the capital projects contained in the IDP, and only a single plan contained a clear reflection of the IDP capital projects in their spatial development proposals. A more positive element is that six of the evaluated plans included clearly identified key infrastructure projects resulting from the SDF proposals. An important observation is that four of these six plans were sub-regional metropolitan spatial plans. It can therefore be inferred that in the case of larger metropolitan municipalities the scope and complexities of infrastructure planning associated with spatial proposals are excessive at an overall metropolitan level, and are generally addressed at the levels of sub-regional spatial plans, at a lower tier of spatial aggregation. Only in a single instance were the identified infrastructure projects translated into a quantified estimate of the investment requirements to put the spatial proposals into effect. Although some of the larger metropolitan municipalities such as Johannesburg, Cape Town and eThekweni have developed innovative and comprehensive systems for evaluating and prioritising capital projects, the results of these processes and their incorporation into the spatial plans remain unclear.

5.3.6 Spatial planning and sustainability

The concept of sustainability has received particular prominence in development and spatial planning since the 1992 Earth Summit, where the important role that indicators can play in assisting informed decisions concerning sustainable development was recognised (Winston & Eastaway 2008). The National Strategy and Action Plan for Sustainable Development in South Africa articulate the national vision for sustainable development, and indicate strategic interventions to reorientate South Africa's development path in a more sustainable direction (Republic of South Africa 2010). Despite this recognition of the need for greater alignment of sustainability criteria in all levels of integrated and

spatial planning, some challenges and shortcomings still remain. Some of the key concerns are the lack of integration of sustainability principles, and the limited use of environmental information in the IDP and related processes (Sowman & Brown 2006). This may in part be ascribed to the fact that the introduction of the concept of sustainability into the field of urban and regional planning has emerged largely from outside the national departments in control of planning (Harrison, Todes & Watson 2008). Other contributing factors include the provision of basic services, the primary delivery focus and often the most prominent criterion of political accountability at municipal level. Under these circumstances, the environmental dimensions are often perceived as subservient to the improvement of basic services and housing conditions. Moreover, the Performance Management Systems of municipalities have a very strong operational and project-level focus, and seldom assist in measuring and monitoring overall development sustainability within a municipal area, particularly from a spatial planning viewpoint. A review of the effectiveness of Strategic Environmental Assessment (a tool often used to improve the sustainability aspects of spatial planning) concluded that SEAs generally failed to inform or influence decision-making and is ultimately failing to achieve their objectives within the South African context (Retief 2007).

Based on these arguments, the evaluation of the SDFs focused on the following elements:

- Is there a clearly defined set of sustainability principles included in the SDF?
- Is there explicit and clear integration of the spatial development framework with a strategic environmental assessment (SEA) or environmental management framework (EMF)?
- Are the SDF strategies and conceptual proposals informed by ecological or environmental sensitivity mapping?
- Do clearly defined sustainability indicators and targets form part of the SDF?

Table 5.6: Responses to sustainability issues in spatial planning

Dimension	Yes	Implied	No
1. Is there a clearly defined set of sustainability principles included in the SDF	8	-	7
2. Is there explicit and clear integration of the SDF with a strategic environmental assessment (SEA) or environmental management framework (EMF)	4	6	5
3. Are the SDF strategies and conceptual proposals informed by ecological or environmental sensitivity mapping	4	3	8
4. Are there clearly defined sustainability indicators and targets forming part of the SDF	1	1	12

The results portrayed in Table 5.6 show varying levels of response and commitment to the need for addressing sustainability issues in spatial planning. As a fundamental point of departure, slightly more than half of the plans evaluated contained, at the very least, a clearly defined set of sustainability principles to guide the SDF proposals. However, moving to the implementation of these principles at a

more practical level, the results indicate that techniques such as Strategic Environmental Assessments and ecological sensitivity mapping were much less widely applied. A number of the evaluated plans seemed to have used these techniques, judging by references to these plans in related municipal planning processes, but without any clear evidence of the application or integration of these processes in the spatial plan. More important, only one of the plans evaluated contained clearly defined sustainability indicators and targets for measuring the impact and success of the SDFs.

5.3.7 Spatial planning and informality

Informality in the urban landscape can extend to various dimensions such as infrastructure provision, land and housing, and decision-making processes (Roy 2005). In the South African context the concept of urban informality is associated with informal economic-sector activities and informal housing and services, both often including some measure of illegality. South Africa has a vibrant and growing informal economy (Ligthelm & Masuku 2003) and it is estimated that approximately 10% of potential retail trade, amounting to approximately R38 billion, is channeled through informal outlets, and that approximately 1.25 million people owe their existence to informal retail business activities (Ligthelm 2004). In 1996 approximately 403 000 households resided in informal back-yard structures and 1.05 million households in informal structures in freestanding settlements (Statistics South Africa 1996). Despite the noble intentions of the government to eradicate informal housing within a period of 20 years, the sobering reality is that the number of households living in informal back-yard structures has nearly doubled, increasing to approximately 713 000, and the numbers in informal settlements risen to 1.25 million by 2011 (Statistics South Africa 2011). These trends are also prevalent elsewhere in Africa with many governments accepting the growing poverty and informality of their towns and cities as inevitable (Turok & Parnell 2009).

From a planning and policy perspective the informal sector has received considerable prominence. In economic terms it has often been referred to as the ‘second economy’, engendering a preoccupation among policy-makers to develop and formalise this sector. Within the housing context the focus has remained consistently on the eradication of informal settlements. In Levebian terms the contrast between the reality of informal activities and localities on the one hand, and the abstract spaces of the planned city with spatial and land-use plans on the other (Levebre 1991) poses the challenge of how planning and policy-making in general, and spatial planning in particular, should respond to this dichotomy. The NDP recognises that informal settlements provide the poor with affordable access to urban land and housing, and expresses the view that there is insufficient understanding in policy of the informal strategies and livelihoods of the poor (National Planning Commission 2012). Harrison, Todes & Watson (2008:225) however note that “despite stated policy claims that the informal sector is an important source of jobs, income and shelter for the poor, it is still subject to spatial marginalisation and

control at the level of cities...”. Consequently, the analysis of the urban spatial plans sought to establish the extent to which the role of the informal sector is recognised in spatial strategies and proposals.

Table 5.7: Responses of spatial planning to informality

Dimension	Yes	Implied	No
1. Explicit strategies for the informal sector in spatial plan	2	6	7
2. Explicit spatial proposals for the informal sector	1	1	13

The review of the SDFs clearly indicates that informality largely remains unrecognised in spatial planning. Only two of the plans reviewed contained explicit strategies relating to the informal sector, with a further six reflecting some strategies that at least imply consideration of some informal sector aspects. Those plans that did include strategies relating to the informal sector dealt almost exclusively with the upgrading of informal housing settlements and broad strategies for the management and control of informal trading areas. The interchangeable use of the terms ‘informal trading’ and ‘Small, Medium and Micro Enterprises’ (SMMEs) also suggests a limited understanding of the precise nature and operation of the informal economic sector. While some of the plans contained a spatial analysis of the location and extent of informal settlements as part of the analysis component, only one of the plans reviewed reflected any clear spatial proposals for the informal sector in its future spatial development plan. It could possibly be argued that the urban municipalities believe their spatial development plans are of a visionary nature, and that the informal sector generally has negative connotations, hence their reluctance to recognise and accommodate it in their future spatial development plans. The official statistics on the extent of informal housing and recent research on informal traders in four South African cities (Horn 2011) suggest however that the informal component of South African cities is likely to remain an inherent component of the urban landscape in the foreseeable future, and will require more than a fleeting reference in the spatial plans of these areas. The recognition in the National Development Plan of the role played by informal settlements also suggests the need for a much stronger focus on this element in future spatial planning.

5.3.8 Monitoring the influence and impact of spatial plans

The guidelines for the formulation of SDFs (Republic of South Africa 2011b) identified the establishment of targets to measure the success of plans as one of the key challenges in creating practical SDFs. In view of the importance attached to redirecting the form and structure of South African cities and the processes guiding this redirection, there is a surprising paucity of empirical evidence to evaluate and compare changes in both South African city structure and the role of new spatial policy and planning instruments since 1994. The extent of support for SDFs, which would improve their status and role in guiding decisions made by municipalities, is also questionable. A critical component determining the

level of success of spatial plans is their ability to position informed intellectual arguments, so that they have significance in political contexts (Healy 2007). A key element of the ability to formulate and communicate these arguments is clear and easily understandable indicators reflecting the objectives and progress of spatial strategies and proposals. This suggests the need for a stronger analytical and technical basis for planning than has generally been the case in the past (Todes 2008). Despite the increasing availability of GIS and other data, the required statistical, analytical and planning support capabilities are generally still poorly developed and used (Van Huysteen et al. 2009).

The guidelines for the formulation of SDFs (Republic of South Africa, 2011b) have taken the first tentative steps in this regard and identified some aspects of spatial plans that should be monitored and for which key performance indicators need to be developed.³⁷ These include indicators for evaluating the desired spatial form, progress in addressing issues and needs, and decision-making in development applications. However, apart from illustrative density factors and their potential application, no quantified guidelines or spatial statistical indicators are provided. Specific elements of urban spatial plans that must be evaluated to respond to this challenge include the use and application of spatial statistical techniques for analysis purposes and informing strategies, the identification of monitoring indicators and the inclusion of a set of quantified spatial development targets.

Table 5.8: Responses to the need for spatial impact monitoring

Dimension	Yes	Implied	No
1. Use and application of spatial statistical analysis techniques	1	7	7
2. Indicators for monitoring the implementation and impact of the SDF	2	2	11
3. Inclusion of quantified targets for evaluating the impact of the SDF	1	6	8

The use of appropriate spatial statistical analysis techniques is implicit to any approach where quantifiable indicators and targets are required to measure and evaluate the impact of spatial development strategies and proposals. Only one of the urban spatial plans reviewed contained results and proposals based on the application of these techniques. The narrative discussion in seven other plans suggests that some of these techniques may have been applied, although the SDFs do not contain clear outputs or results of these analytical processes. The identification and use of indicators and the inclusion of quantified targets to monitor the implementation and impact of spatial plans remains largely unresolved; these elements were only addressed comprehensively in two of the plans reviewed. In those instances where the use of indicators or targets was implied through brief references in the narrative component of the plans, the focus was mainly on residential density targets for specific areas or proposed land use budgets for new development areas. Indicators and targets to evaluate the aggregate impact of

³⁷ A more detailed and revised set of guidelines were published in 2014 (DRDLR 2014). However, despite a seemingly comprehensive process for evaluation and monitoring, only limited details are provided regarding the monitoring and evaluation methods, techniques and indicators to be applied.

spatial strategies and proposals at an urban level is therefore still an element absent from most urban spatial plans. The recommendation of the National Development Plan suggesting the development of “...a robust set of indicators as part of a spatial governance and evaluation framework,” (National Planning Commission 2012:289) will require significant augmentation in the future review of spatial plans.

5.4 CONCLUSION

The findings of this research identified seven key challenges impacting the effectiveness of urban spatial planning in the democratic era since 1994. The NDP recognises that planning instruments have to be sharpened to enable the necessary reconfiguration of cities and towns, and devised a range of specific recommendations to achieve this goal. A summary of the potential impact (either directly or indirectly) of the seven identified challenges on the recommendations of the NDP is outlined in Table 5.9, and indicates substantial relevance to the NDP recommendations for transforming human settlements. This suggests that appropriate responses to these challenges will be required to enable successful implementation of the NDP recommendations.

The latest generation of spatial plans indicate moderate progress in several aspects - the horizontal and vertical alignment of spatial planning processes between adjacent municipalities, and between different spheres of government, as well as the integration of sustainability principles into spatial planning processes. Some limited progress was noted in the larger metropolitan municipalities in the analysis and understanding of the urban space economy, and some of these municipalities have introduced innovative measures to improve the alignment of infrastructure development and capital investment with spatial planning. However, very little progress is evident with the other challenges. Despite the principle of physical and socio-economic integration remaining central to the spatial planning policy agenda since 1994, it has been one of the identified areas of concern where very little substantial progress has been made. This also applies to the informal sector, which still remains largely marginalised from the mainstream spatial planning processes, and the use of indicators and quantified targets to monitor implementation and impact being absent from most urban spatial plans.

Table 5.9: Implications of identified challenges for NDP recommendations

NDP recommendation	Institutional coordination and alignment	Physical and social economic integration	Understanding the space-economy of cities	Infrastructure development and capital investment	Spatial planning and sustainability	Spatial planning and informality	Monitor influence and impact of plans
1. Reform current planning system	■						□
2. Review grant and subsidy regime for housing		□	□	□			□
3. Land markets that work more effectively for the poor			■			□	□
4. Establish a national spatial restructuring fund		■		■	□		□
5. Instruments to support transition to environmental sustainability					■		□
6. Develop clear enabling legal and institutional framework	■		□	□			□
7. Recognise the role played by informal settlements			□			■	□
8. Support to rural spatial development							□
9. Give necessary attention to implementation	□						■

■ = Direct impact □ = Indirect impact

These spatial and statistical techniques must address all three dimensions of urban form and function (density, diversity and spatial structure pattern). Density measures refer to the degree of activity intensity within a defined space (such as various types of density measures) whereas diversity refers to the composition and manner in which a variety of land uses interact. The third category of urban form measures the spatial structural patterns of cities and can refer both to the overall spatial structure of an urban area (e.g. monocentric versus polycentric, centralised versus decentralised), or more detailed patterns expressed by spatial geometry, and quantified through spatial metric concepts such as compactness and centrality. Generally, far less knowledge exists on urban form at an overall metropolitan level than at intermediate or lower levels of spatial aggregation (Tsai 2005). For analysis and monitoring purposes it is therefore imperative to include appropriate measures of overall urban form ('global statistics') in addition to the more widely used indicators at lower levels of spatial integration ('local statistics'). The full impact of spatial policies and plans on urban form can only be judged based on a comprehensive and multi-dimensional evaluation of all three of these dimensions.

The results presented in this chapter should also be interpreted within the context of the limitations of the study. The reflections on the responses to the key challenges identified from the literature review and contained in the SDFs of cities are based on a sample of 15 of these plans. The sample may be too limited to generalise the findings to all urban areas in South Africa. However, the cities that were included as part of the evaluation represent approximately 50% of the total urban population of South Africa, and is therefore representative of those plans affecting a substantial proportion of the country's urban population. A further consideration is that the results only reflect the documented outcome and not the planning processes that led to these plans. It therefore does not offer insights or explanations of the institutional and procedural aspects contributing to the identified challenges. It is recommended that this aspect be more fully explored as part of the comprehensive methodology outlined in Chapter 4 to understand the underlying causes and factors resulting in these challenges. An improved understanding of these factors, together with the insights and recommendations from this research, could make a significant contribution to improving the urban spatial planning process and realising the vision for the NDP to transform human settlements in South Africa.

6 CHAPTER 6: THE EVOLVING SPATIAL STRUCTURE OF SOUTH AFRICAN CITIES: A REFLECTION ON THE INFLUENCE OF SPATIAL PLANNING POLICIES

6.1 INTRODUCTION

Many of the contemporary debates over the efficiency of urban form have focused on the two opposing concepts of monocentric forms normally associated with compact development (characteristic of many European cities) and urban sprawl associated with decentralized development patterns often ascribed to the character of cities of the United States (Brueckner; 2000; Johnson; 2001; Frenkel & Ashkenazi, 2008) . The debates over the merits of compact or decentralized cities are however far from settled (Ewing 1994³⁸; Soja 2000³⁹; Dieleman & Wegener 2004⁴⁰; Bruegman 2005⁴¹; Cox 2006⁴²; Geurs & Van Wee 2006⁴³) and the emergence of polycentric urban forms as an alternative model somewhere between these two extremes have

³⁸ According to Ewing (1994), any form of policy debate on urban structure must proceed from a comprehensive understanding of the concept of sprawl in terms of three dimensions: the physical characteristics, the causes, and the effects of sprawl. The physical dimensions of sprawl can be characterised by the two basic dimensions of density and land use. Low-density suburban development is the consequence of a combination of factors including rising incomes (increased disposable income for travel), technological changes (agglomeration economies becoming less important), increased travel speeds and lower travel costs (provision of high-speed highways), and market forces (flattening of bid-rent curves).

³⁹ Soja (2000) in Part II of his "Postmetropolis" examined urban restructuring processes that reshaped the modern metropolis since the 1960s. Central to these changes and new developments are what he identified as polycentric regional urbanization process. This regional urbanization process blends together urban, metropolitan and subnational-regional scales and is driven by a growing convergence between urban and suburban densities where the steep metropolitan density gradients extending outwards from the old downtowns are decreasing in slope as densities increase in low-density suburbs.

⁴⁰ Dieleman & Wegener (2004) in their study on compact cities and urban sprawl concluded that that the most likely (but not necessarily the only) scenario for future urban development is continued spatial dispersal. This scenario is based on socio-economic and lifestyle trends such as increasing incomes, cheaper transport, more multi-earning households, and more leisure time. These factors influence housing and neighbourhood preferences that is easier to realise at urban peripheral locations and retail and service facilities are likely to follow their market to the suburbs. From an urban planning perspective, they found that that the absence of strong planning interventions at the regional and local level will likely result in further urban deconcentration. They also found that although policies such as 'new urbanism' and 'smart growth policies' prevalent in North America and 'compact city' and 'multi-functional land use policies' in Europe are difficult to implement, they do have the potential to stem urban sprawl and further growth in car use (Dieleman & Wegener 2004).

⁴¹ Bruegmann (2005) found that in many fast-growing American urban areas the process of decentralization has actually been reversed and that, although density gradients are still flattening, it is no longer decreasing. The densities in many cities are actually rising sharply at both the centre and at the edges, and suburban development in most American cities are significantly denser than in the decades after World War II. These trends are partly the result of anti-sprawl policies impacting on land availability and land prices, and partly the result of the cultural and social stimulation provided by high density urban areas such as Manhattan and Tokyo. Bruegmann also claims that short term urban growth trends suggesting one particular scenario may in fact often disguise larger trends that could possibly point to quite different scenarios. From an urban planning perspective he argued that sweeping diagnoses and remedies of 'urban sprawl reformers' calling for more public planning and more regulations at higher levels of government may have unintended consequences and may not be a wise approach.

⁴² Cox in his book "War on the dream" (Cox 2006) critically examines anti-suburban policies and reviews the general claims of anti-suburbanists primarily (but not exclusively) from a North American perspective. These anti-suburban policies are often based on arguments relating to the impact of urbanization on valuable farmland and open space, the contribution of suburbanization to traffic congestion and air pollution, and the governance cost of suburbanization. Using empirical data Cox provides compelling counter arguments to these claims and outlines the potential negative consequences of ill-considered anti-suburban land-use strategies. These policies are shown to contribute to increasing housing costs and resulting lower rates of home ownership, reducing individual mobility impacting negatively on economic growth, and higher consumer prices by restricting commercial and retail development.

⁴³ Geurs and van Wee (2006) conducted a detailed study to determine the effect of compact urbanisation policies implemented in the Netherlands. In contrast to some of the findings of Cox, the results of Geurs and van Wee concluded that without compact urban development policies urban sprawl is likely to have been greater resulting in less compact urbanisation patterns, higher levels of car use would have been prevalent at the cost of alternative modes, higher emissions and noise levels would have occurred in residential and nature areas, higher congestion and lower accessibility levels would have been prevalent, and a stronger fragmentation of wildlife habitats would have occurred. They concluded that the compact urban development policies implemented over the period 1970 to 2000 have contributed to open space conservation and have resulted in less car use and fewer related environmental impacts than under a more liberal land use policy.

contributed a further range of arguments to enrich this discourse (Tsai 2005). Despite the vigour of these arguments, comprehensive comparative studies are less abundant and quantitative measures have only relatively recently started to influence these debates (Galster et al. 2001). These studies traditionally focused on cities of the global North (e.g. Burton 2002⁴⁴; Kasanko et al. 2006⁴⁵; Griffith & Wong 2007⁴⁶; Guerois & Pumain 2008⁴⁷; Schwarz 2010⁴⁸) and although these types of studies has gained some momentum in developing countries (e.g. Lopez et al. 2001; Barredo et al. 2004), comparisons of urban form between the Global North and South has however not been intensively researched (Huang, Lu & Sellers 2007).

These debates on urban form also remained central on the urban spatial planning policy agenda in South Africa since the dawn of the democratic dispensation in 1994. Nearly three-quarters (71%) of South Africa's population live in a limited number of cities and towns, and have well-established local economies that account for 92% of all formal economic activity (Republic of South Africa 2009) and these policy directions thus influence a significant proportion of the population and space economy of the country. The unique elements of the structure and morphology of South African cities are one of the most visible and lasting legacies of the planning ideology during the apartheid era and its characteristics have been well researched and documented (e.g. Simon 1989; van der Merwe 1993; Maylam 1995; Christopher 2001; du Toit 2007).

South African urban form is generally characterised by distorted spatial patterns, underdeveloped public transport infrastructure, unequal access to economic and social opportunities, and poorly located lower income settlements. In an attempt to redress these shortcomings, the spatial planning policy framework has undergone fundamental changes since 1994. Central to these policy objectives is a more compact urban form, higher densities, the promotion of mixed land uses, and integrated transport and spatial planning

⁴⁴ Burton (2002) investigated the urban compactness and social sustainability outcomes in 25 English towns and cities. The results from the analysis of the compactness indicators revealed the importance of considering the individual components of compactness. The study found that cities perform differently for different indicators, and the analysis of compactness in terms of one or two aspects only might be misleading. Sustainability research based on these indicators also revealed that different aspects of compactness are associated with widely different outcomes.

⁴⁵ Kasanko et al. (2006) analysed the relationship between urban land use development and population density in 15 European urban areas. They found that in half of the studied cities more than 90% of all new housing areas built after the mid-1950s represent discontinuous urban development. They concluded that European cities have become less compact since the 1950s. They also found that different indicators of land use dynamics have different strengths and weaknesses and should ideally be used in parallel.

⁴⁶ Griffith & Wong (2007) applied a spatial regression approach to model population density gradients in the 20 largest metropolitan areas in the US according to the 2000 census. One of their important findings is the moderate-to-strong positive spatial autocorrelation detected across the 20 cities indicating the role of positive spatial externalities in shaping the geographic distributions of population density across each of the urban areas. This implies that forces such as zoning, location rent, economies of scale in housing and infrastructure provision, congestion, and accessibility tend to influence the concentration of households in such a way that relative density only increases in a few locations, while decreasing in many other locations.

⁴⁷ Guerois & Pumain (2008) investigated the spatial organisation of urban densities from centre to periphery according to decreasing gradients. One of their key findings is that the best fit for built-up surfaces are provided by two linear functions that strongly differentiate between a central and peripheral gradient (instead of the more well-known exponential or power functions). Their analysis of 40 European cities established a convergence in the trend of urban spread between Northern and Southern European cities. They also found that European cities are still characterised by strong centre-periphery gradients of their built-up urban areas and that the geographical form of these cities are still shaped by the attractive power of city centres.

⁴⁸ Schwarz (2010) used landscape metrics and population related indicators to analyse the urban form of 231 European cities. Through the application of a factor analysis six main factors describing urban form were identified: size, density, clustering, evenness in size, edge density and compactness. The further application of a cluster analysis resulted in the identification of eight clusters of European cities with statistically significant differences based on the identified minimum indicator set.

decisions (Turok & Parnell 2009). The National Urban Development Framework (NUDF) identified greater urban integration and densification as one of its outcomes to improve urban form and sustainability (Republic of South Africa 2009). These concepts are also echoed in the official guidelines for the formulation of spatial development frameworks (Republic of South Africa 2011a) which include a set of good principles for spatial planning. These include amongst others efficient urban structure, compaction and densification. The concepts of ‘compaction’ and ‘densification’ of urban form thus became entrenched in the South African spatial planning policy and approach since the early 1990’s, and can be viewed as a key element of the overarching South African “spatial planning doctrine” as described in Chapter 3.

The effectiveness and impact of urban spatial planning policies and plans in the post-apartheid era and its impact on restructuring South African cities are however increasingly being questioned. Both Robins (2002) and Pieterse (2004) contends that despite the substantial planning resources aimed at restructuring the apartheid city structure, South African cities “may be as segregated and fragmented as they were at the dawn of the democratic era”. These viewpoints also found resonance in official policy documents. The National Urban Development Framework states that policies since 1994 have not succeeded to restructure the apartheid spatial patterns of South Africa’s cities and towns (Republic of South Africa 2009). The National Planning Commission (NPC) subsequently also expressed the opinion that the spatial legacy of apartheid has probably been aggravated since then (Republic of South Africa 2011b). The National Development Plan 2030 recognizes that densities have increased in some urban areas and that the partial regeneration of inner cities have been achieved, but states that little progress has been made in reversing apartheid geography (National Planning Commission 2012).

The apparent limited impact of spatial planning processes and plans can be attributed to a number of factors. This range from problems relating to institutional coordination and alignment of spatial planning (Turok & Parnell 2009; Republic of South Africa 2011b), to the integration of spatial planning with infrastructure and capital investment (Harrison, Todes & Watson 2008; Todes 2008), and a lack of understanding of the space economy of South African cities (Serfontein & Oranje 2008; van Huysteen et al. 2009). Despite the fact that the concepts of compaction, densification and integration have been part of the South African spatial planning nomenclature since 1994, the actual implementation of these concepts in a quantifiable sense remained vague. Although the guidelines for the formulation of Spatial Development Frameworks (Republic of South Africa, 2011a) identified the monitoring of spatial form through the application of key performance indicators, no clear guidelines or spatial statistical indicators are provided (apart from illustrative density factors and their potential application). There is also a surprising paucity of comprehensive cross city comparative empirical evidence to evaluate the changes of South African city structure since 1994, and critically reflect on the impact of the new generation spatial policy and planning instruments. This suggests the need for a much stronger analytical and technical basis for spatial planning than has generally been the case up till now (Todes 2008). These challenges are not unique to South Africa and the lack of consensus on the exact interpretation of concepts such as compact cities and quantitative

indicators for measuring these aspects have also been identified elsewhere (Burton 2002⁴⁹; Pratt & Larkham 2010⁵⁰).

This chapter contributes to an improved understanding of changes to the urban form and density of South African cities since 1994 against the background of spatial plans and policies influencing these aspects. The fundamental aspects in the measurement of urban form and density is firstly described as a basis for identifying and selecting appropriate techniques and spatial indicators for evaluating density patterns and trends. These indicators are then applied to a cross section of eight South African cities with the aim to answer four questions:

- Does the range of basic population density indicators reflect an increase in density since 1994?
- Is the double density gradient model applicable to South African city structure and are there specific variations between larger metropolitan areas and smaller intermediate cities?
- Are the changes in the double density gradient model parameters since 1994 indicative of compact growth and densification?
- Does the evolution of urban spread over time since 1994 provide any indication of densification or compaction of the urban structure in relation to the city centre?

These results provide the basis for reflecting on the potential influence of relevant spatial plans and policies on urban form and density since 1994.

6.2 INDICATORS FOR MEASURING URBAN FORM AND DENSITY

6.2.1 Approaches to the statistical measuring of urban form

Many urban form indicators and models have been introduced within the wider contextual debates on the efficiency of urban form and arguments based for and against the opposing concepts of urban sprawl and compact city form influenced by the factors described in Chapter 2. The emergence of modern computing technology added a further dimension to the science of modelling urban form and changed this field of study beyond recognition over the last two decades. This opened up avenues for alternative measures of urban form at both a global and local level using geospatial statistics and the simulation of urban development patterns making use of cellular automata and agent-based models (Batty 2007).

⁴⁹ Burton (2002) identified one of the key challenges in research on the structure and the compactness of cities as the lack of consensus on the meaning of the term ‘compact city’ and the absence of recognized indicators for measuring it. The empirical analysis of the compactness of 25 English cities and towns found that cities perform differently for different indicators, and the analysis of compactness focussing on one or two aspects alone might be misleading. A further important finding is that most indicators measure overall density, and may in fact conceal internal distributions of density that are more significant in urban planning terms.

⁵⁰ One of the key problems of analysing the concept of ‘compact cities’ as identified by Pratt & Larkham is that it brings together very diverse concepts “...under a potentially misleading banner” (Pratt & Larkham 2010:279). They identified considerable differences in opinion regarding the desirability of a ‘compact city’ approach, the extent and rate at which it should be encouraged, appropriate policies to enforce compactness, and empirically testing the sustainability thereof.

In a general sense the analysis of urban form can be classified into three main categories: density, diversity, and spatial-structure pattern (Tsai 2005). The first category (density measures) refers to the degree of activity intensity within a defined space and includes various indicator types such as built-up areas, residential land use, land consumed by urban expansion, population density, and urban density (Kasanko et al. 2006). The second category (diversity) refers to the spatial scale, composition and manner in which a variety of land uses interact (Cervero & Kockelman 1997; Douglas 1998). It has been argued that various land use mix indicators can reflect on the economic, social and economic aspects of urban sustainability (Song & Rodriguez 2005). The third category of urban form measures deals with the spatial structural patterns of cities. This concept can refer both to the overall spatial structure of an urban area (e.g. monocentric versus polycentric, centralised versus decentralized), or more detailed patterns expressed by spatial geometry and quantified through spatial metric concepts such as compactness, centrality, and porosity (Herold, Scepan & Clarke 2002; Huang, Lu & Sellers 2007; Schwarz 2010). This category also includes measures of the level of spatial clustering by applying techniques such as the global Moran and Geary coefficients (Anselin & Getis 1992; Zhang & Lin 2006; Anselin 2012). It is claimed that far less knowledge exists on urban form at an overall metropolitan level than at intermediate or lower levels of spatial aggregation (Tsai 2005). For comparative studies of urban form it is thus imperative to include appropriate measures of both overall urban form ('global statistics') and the more widely used indicators at lower levels of spatial integration.

6.2.2 Measuring Urban Density as One of the Three Main Components of Urban Form

The availability of appropriate data and the delimitation of urban areas are two of the most fundamental aspects influencing comparative urban density studies and models (Coombes & Wong 1994; Antrop 2004; Guerios & Pumain 2008). Where data is available, there is often the further complicating matter of a lack of agreement on the appropriate definition and approach to the delimitation of urban units (Brezzi et al. 2012). The definition of what constitutes urban areas differs significantly between countries (Ballas, Kalogerisis & Labrianidis 2003⁵¹; Champion 2009⁵²) and complicates cross country comparisons. Schwarz

⁵¹ Ballas et al. (2003) in a European level study to devised alternative settlement typologies used the European NUTS (Nomenclature of territorial units for statistics) classification system. The NUTS classification distinguishes between three categories of regions described as major socio-economic regions (NUTS 1) with populations of between three and seven million, basic regions (NUTS 2) with populations of between 0.8 and three million, and small regions (NUTS 3) with populations of between 150000 and 800000. The NUTS 3 regions are further classified into Predominantly urban, Intermediate, and Predominantly Rural areas.

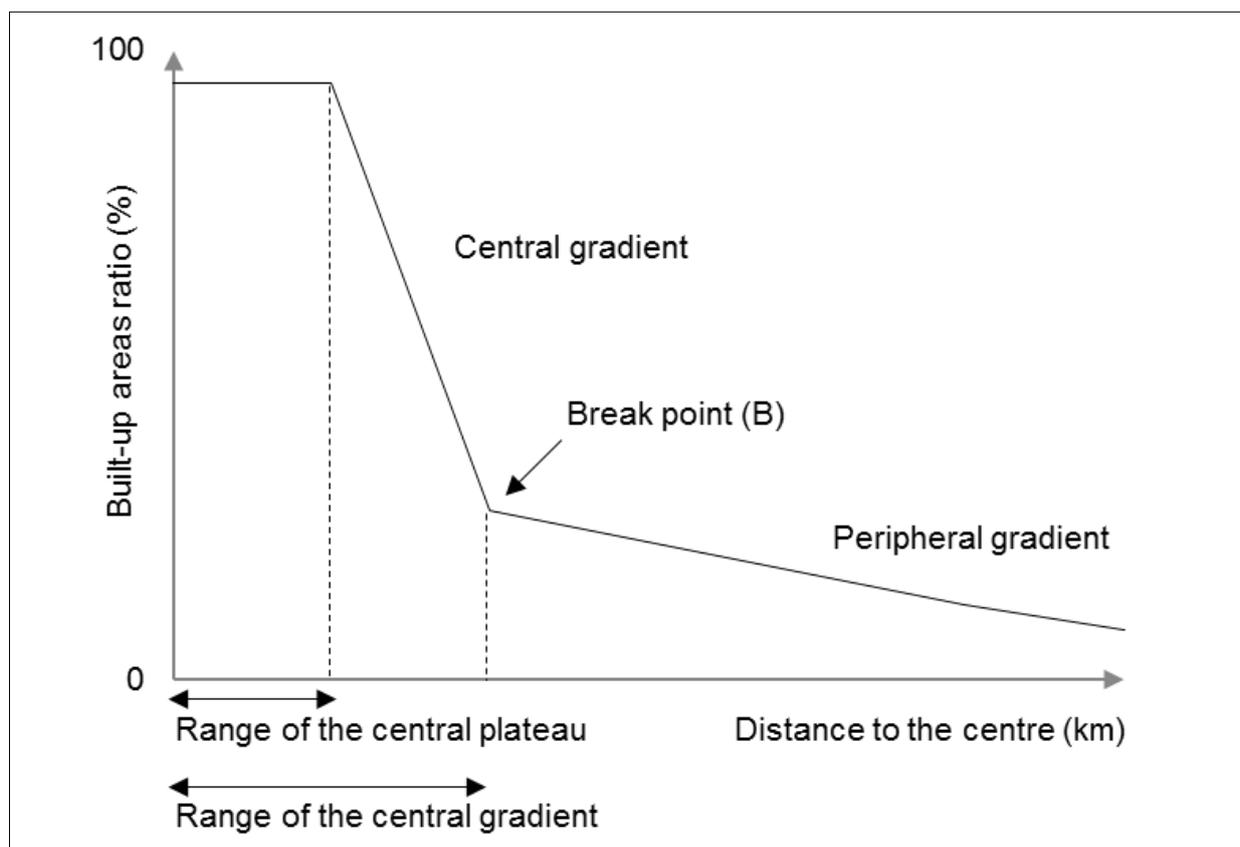
⁵² Champion (2009) in a study of commuting patterns in England used the classification of the UK Department for Environment, Food and Rural Affairs that classified local authorities into three rural and three urban categories. The three 'urban' categories are described as:

- Major urban: Districts with 50% or more of their population or at least 100 000 living in one urban area with a population of more than 750 000.
- Large urban: Districts with 50% or more of their population or at least 50 000 living in one urban area with a population of between 250 000 and 750 000.
- Other urban: Districts (that are not major urban or large urban) with less than 26% of their population or fewer than 37 000 living in rural settlements and market towns.

(2010) found that analysis based on the data of the administrative urban area and the sealed urban area resulted in different behavior with population related indicators.

The quantitative analysis of urban density patterns is also closely associated with the notion of 'compact cities'. The most common interpretation associated with the ideal of compact cities is associated with the concept of high densities (McLaren 1992) and with travel behaviour and the provision of sustainable public transport infrastructure (Stead & Marshall 2001; Kenworthy 2006). The related concept of mixed used cities in spatial planning terms is often associated with the creation of a lattice structure consisting of high intensity nodes linked by activity corridors focused around public transport routes (Newman 1992; Nijkamp & Rienstra 2010). In the South African context, the NUDF identified measures that will promote greater urban integration and densification (particularly along the major transport corridors) as an important element to improve urban form and sustainability (Republic of South Africa 2009). The processes leading to the compaction of urban form at different scales (intensified cities) is often supported by spatial policies that generally take the form of either measures for limiting lateral growth or incentives for infill development and consolidation Burton (2002).

Quantitative indicators for measuring the size and density of urban form should address a number of related elements. The first element includes various measures of population density and is regarded as the most common measure of urban form (Burton 2002; Guerios & Pumain, 2008). The strength of these basic indicators is that it is normally relatively easy to obtain data and that it provides a useful baseline for comparative cross city analysis. A shortcoming of traditional density measures is its sensitivity to methodological issues around the delimitation of urban areas and population figures based on administrative boundaries. It is also inadequate for describing spatial variation of intensity within a given urban area. Indicators falling within this dimension include gross population density, net population density, housing stock composition, and measures of the spatial variation of population density. The second element focusses on built-up densities and is generally measured by exponential or power functions based on the principle of a continuous gradient of decreasing built-up densities (Bertaud & Malpezzi 2003). Guerios & Pumain (2008) identified two areas of criticism against these traditional exponential or power functions. Firstly, the urban form of many cities is characterized by a significant break in the value of built-up densities instead of a progressive decrease. Secondly, abrupt breaks in the built-up density profiles of cities can be more adequately described by a double linear adjustment than negative power or exponential fits. They introduced a double linear function as an alternative measure of urban built-up density to account for this problem. This double linear function differentiates between central and peripheral gradients of built-up surfaces (Guerois & Pumain 2008) and is based on the notion of a strong urban centre and its influence on the organisation of space at different gradients from centre to periphery. Its basic unit of measurement is the ratio of the built-up surface area to the total surface area of consecutive 1 km concentric rings from historic city centres to provide an estimation of the mean built-up density within each zone.



Source: Guerois & Pumain (2008)

Figure 6.1: Basic concepts of double linear density model.

The key characteristics of this model as described by Guerois & Pumain (2008) include a central plateau represented by the first few kilometres around the urban centre with a highly saturated built up pattern (which can extend up to 10 km from the urban centre), followed by a central gradient beyond this threshold with a rapid decrease of built-up form in urban space. The peripheral gradient from the breakpoint towards the periphery reflects a fairly gradual and uniform decrease in built-up form. This breakpoint between the central and peripheral gradient is of specific interest as it reflects a change in the urban built-up pattern. The advantages of this double density gradient model are that it enables comparisons between cities in the absence of standardised definitions of urban boundaries and it is not dependent on the size of basic statistical units. This model is however less accurate for measuring the intensity of the urban field than population figures. In the absence of the third dimension (building heights) it will generally underestimate the occupation of the most dense zones containing the tallest buildings (Guerois & Pumain 2008). The double density gradient model is most appropriate for evaluating the urban structure which generally conforms to the European tradition of historically strong monocentred cities, and may be less applicable to polycentred urban areas. Griffith & Wong (2007) in their study of density across major US cities emphasized the importance of introducing multiple centres and alternative distance measures in the modeling of urban population densities in polycentric cities.

The third element of measuring urban density patterns also utilises the basic concentric type of analysis of built-up form to measure the evolution of urban spread over time. This analysis measures the increase in

built-up surface areas within constantly defined parameters and provides a clear indication of densification of built-up areas in relation to distance from the city centre.

6.3 A COMPARATIVE ANALYSIS OF SOUTH AFRICAN CITIES

The concepts of ‘compaction’ and ‘densification’ of urban form became entrenched in the South African spatial planning policy and approach since the early 1990’s. These overarching urban spatial planning principles and objectives can be directly related to the three main elements of the analysis of urban form including size and density, land use diversity and complexity, and spatial structure and geometry. The analysis presented in this chapter is specifically focused on the size and density measures of the selected cities and the potential influence of the relevant spatial policies and plans.

6.3.1 Spatial Policy and Planning Imperatives

The initial phase of the democratic era in South Africa between 1994 and 1996 was dominated by the Reconstruction and Development Programme (RDP) focused on investment in infrastructure and basic services to address inequalities resulting from the apartheid era. It introduced a number of prominent spatial planning concepts such as “more compact cities” (South Africa 1994:83) and “densification and unification of the urban fabric” (South Africa 1994:86). The subsequent Development Facilitation Act (South Africa, 1995) provides a set of normative spatial principles to guide the spatial content of planning, including principles to discourage urban sprawl and promote densification. The most prominent impact on spatial planning at an urban level has however been the entrenchment of the Integrated Development Planning process through the promulgation of the Local Government: Municipal Planning and Performance Management Regulations in 2001 (South Africa 2001) requiring municipalities to prepare Integrated Development Plans including a spatial development framework.

Despite these national level policy guidelines, the response at an urban level has been varied. The Department of Rural Development and Land Reform undertook a countrywide evaluation of all spatial development frameworks in South Africa during 2008. The results indicated that the quality of the spatial development frameworks was generally not of an appropriate standard and subsequently embarked on an initiative to prepare a set of standard guidelines for the formulation of spatial development frameworks aimed at improving the quality of these plans. These guidelines include a set of good principles for spatial planning, amongst others, socioeconomic and functional integration, efficient urban structure, and compaction and densification. The principle of efficient urban structure is primarily seen to be achieved through appropriate densification (guided by density targets) and the limitation of the lateral growth of settlements through the use of an urban edge (South Africa 2011a).

Table 6.1: Summary of spatial planning principles and priorities identified in Spatial Development Frameworks

Spatial principles/priorities	Johannesburg	Cape Town	Ethekwini	Tshwane	Bloemfontein	Pietermaritzb	Witbank	Nelspruit
Spatial and land use integration	√	√		√	√	√	√	√
Densification, intensification, and infill development	√	√	√	√	√	√	√	
Strategically located economic growth			√	√	√	√	√	
Improved access to economic opportunities		√	√					
Sustainable development	√	√	√	√	√	√	√	√
Inclusiveness		√						
Create opportunities for the poor			√	√				
Optimum use of current capacity			√					√
Efficient movement system	√	√		√				

This national level policy framework provides the parameters within which the broad principles can be translated into more detailed implementation proposals at an urban level. A summary of how these principles have been translated into spatial planning principles and priorities at an urban level as part of the municipal spatial planning process of the selected cities is summarized in Table 6.1. The three spatial planning elements common amongst almost all these plans are spatial and land-use integration, densification and intensification, and environmentally sustainable development.

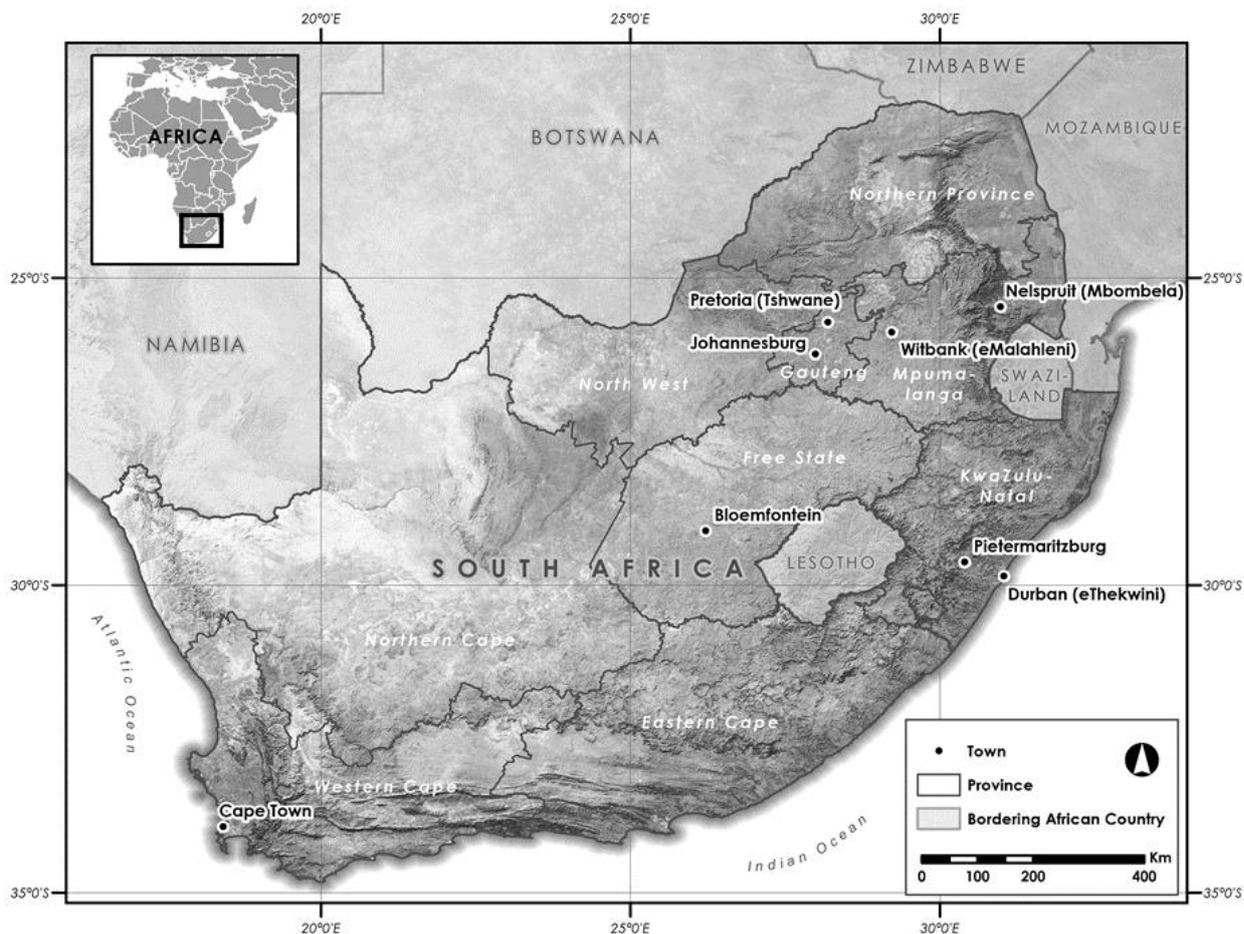


Figure 6.2: Location of study area cities

6.3.2 Methodology

There is a surprising paucity of comprehensive multi-year and cross city analysis of urban form and structure in South Africa. Studies that have been conducted are focused on specific individual cities or time periods and does not allow for cross city comparisons based on a common point of departure and consistent data sources. One of the main reasons is the absence of a common set of land use or landcover data at an appropriate scale for multiple time periods (du Plessis 2015). As with any set of indicators, the identification and selection of indicators should be a pragmatic process based on criteria of robustness, relevance, independence, transparency, comparability, longevity and spatial flexibility (Booyesen 2002; McMahon 2002; Spangenberg et al. 2002; Russel & Thomson 2009). The criteria of robustness and comparability were key considerations in the selection of appropriate indicators from the potential candidates available and the selection of cities to form part of the study. Eight cities were selected for the purposes of the comparative analysis including the four largest metropolitan areas of Johannesburg, Cape Town, Durban (eThekweni) and Pretoria (Tshwane), as well as four smaller intermediate sized cities of Bloemfontein (Mangaung), Pietermaritzburg (Msunduzi), Nelspruit (Mbombela), and Witbank (eMalaheni).

The selected cities are representative of different geographical regions in South Africa and from a practical point of view the selection was influenced by the availability of comparative detailed land use data for the

purposes of spatial and statistical analysis. The selected indicators had to be available for multiple time periods for all cities forming part of the analysis and include measures from all three elements inherent to the measuring of urban density (Table 6.2).

Table 6.2: Selected indicators for measuring density patterns

Indicator	Unit	Sources
1.1 Gross population density	No people per ha within urban boundary	Burton 2002 Kasanko et al. 2006 Schwarz 2010
1.2 Population per built-up urban surface area (net density)	No people per ha built-up footprint	Bertaud 2004 Burton 2002 Huang, Lu & Sellers 2007 Schwarz 2010
1.3 Net density per residential built-up area	No people per ha residential footprint	Burton 2002 Kasanko et al. 2006
1.4 Density of most dense ward	Persons per ha	Burton 2002
1.5 Average density of four most dense wards	Persons per ha	Burton 2002
1.6 Variation in density across city	Variance calculated using statistical software	Burton 2002
2.1 Extent and growth of built-up surface area	Annual percentage growth of built-up area	Kasanko et al. 2006 Guerois & Pumain 2008
2.2 Annual growth of residential built-up areas	Percentage annual growth of residential built-up areas	Kasanko et al. 2006
2.3 Ratio residential areas to total built-up area	Percentage residential of total built-up footprint	Kasanko et al. 2006
2.4 Ratio population growth: built-up area growth area	Population growth rate/built-up footprint growth rate	Kasanko et al. 2006
3.1 Density gradient models	Functions relating density to distance from the city centre	Alonso 1964 Edmonston, Goldberg & Mercer 1985 Guerois & Pumain 2008
3.2 Densification of built-up surface areas according to city radius	Percentage growth of built-up area with distance from city centre	Guerois & Pumain 2008

All information relating to the built-up form of urban areas is based on a commercially available set of land use data (GeoTerraImage 2012). The Building Based Land Use[©]™ dataset contains buildings, structures and other area specific land uses as identified and mapped from high resolution orthophoto's as point data. The land uses are mapped using manual image interpretation techniques and classified into a standardised 70 class land use classification using supplementary datasets and fieldwork. This data undergoes extensive quality control and validation to provide accurate and detailed land use for selected urban areas within South Africa. Two data sets were used in each city: one as close as possible to 1994 and one for the most recent time period for which data is available. The point data format is however not suitable for application to the selected indicators and was thus integrated with the latest available cadastral data for each city to produce a set of land use data at the level of individual stands or land parcels as spatial unit of analysis. A Python script was developed in ArcMap 10 to integrate the land use points and the erf boundaries and to consolidate the 70 land use classes to 13 main classes. These classes include multiple residential, single

residential, informal residential, mixed residential, commercial, industrial, transport and utilities, institutions, sport and recreation, mining, mixed land use, parks and conservation, and agriculture and forestry (du Plessis 2015). The two classes of parks and conservation, and agriculture and forestry were not considered as part of the urban built-up footprint and excluded from the analysis. For the purposes of the double density gradient model, a multiple ring buffer of 1km increments was created around historical city centres for each individual city. This buffer was overlaid with the reclassified erf boundaries to calculate built-up areas of various land use categories per 1km buffer ring.

The population data is based on the results of the 1996 (municipal and enumerator area level) and 2011 (municipal level and ward level) national census. In the metropolitan areas of Johannesburg, Cape Town, Durban and Pretoria the urban footprint covers the entire municipal area and the total municipal population was applied. In the case of Bloemfontein, Pietermaritzburg, Nelspruit and Witbank the municipal area consist of a main urban centre, as well as a number of smaller towns and/or dense traditional settlement areas scattered across the area of jurisdiction of the municipality. In this instance, the urban built-up footprint and population figures were only applied to the main central urban area and not the isolated and scattered settlements. In these cases the population figures are based on the enumerator areas and wards falling within these urban centres only.

6.3.3 Analysis Results

6.3.3.1 Does the range of basic city level population density indicators reflect an increase in density since 1994?

The total population of the eight cities forming part of the study increased significantly from 10.3 million in 1996 to 15.5 million in 2011, representing a total growth of more than 50% (3.4% per annum).

Table 6.3: Summary of cities analysed

City	Population (1996)	Population (2011)	Built-up footprint data used
Johannesburg	2 638 233	4 434 827	1994, 2009
Cape Town	2 563 095	3 740 026	1993, 2009
Durban (eThekweni)	2 745 926	3 442 361	1994, 2009
Pretoria (Tshwane)	1 665 391	2 675 701	1994, 2009
Bloemfontein (Mangaung)	249 646	362 351	1994, 2008
Nelspruit (Mbombela)	45 707	100 701	1992, 2009
Pietermaritzburg (Msunduzi)	258 266	507 736	1994, 2009
Witbank (Emalahleni)	143 861	266 664	1994, 2010

The average annual increase of the total built-up area in the four larger metropolitan areas varied between 1% and 1.5% in the case of Pretoria, Durban and Cape Town, to a much higher figure of 3.2% per annum in Johannesburg. To put these figures into perspective, the average annual growth of total built-up areas in

15 European cities from the 1980's to the 1990's ranged from 0.4% per annum (Bilbao and Palermo) to higher figures of 2.4% (Munich) and 2.5 % in the case of Dublin (Kasanko et al. 2006). The growth rates of the residential built-up footprint generally far exceed the growth of the total built-up footprint. The average annual growth rate of the residential footprint ranged from 1.7% in Cape Town and Durban, to 2.6% in Pretoria and a significantly higher figure of 5.4% in Johannesburg. This trend in Johannesburg is also clearly depicted in the spatial analysis of the built-up footprint change (Figure 6.3) showing large scale urban expansion in the northern and northwestern parts of the city. The composition of the urban footprint can be expressed as the ratio of the residential footprint to the total urban footprint. This ratio ranges from as low as 37.2% in the case of Witbank, to much higher figures in excess of 70% in Johannesburg, Durban and Pietermaritzburg (Table 6.4). These ratios fall within the same general range as the figures reported by Kasanko et al. (2006), ranging from 45% in Bilbao and 48% in Bratislava, to much higher ratios of 75% in Brussels and 79% in Palermo.

This rapid growth of the residential footprint is also reflected by the increase in this ratio in all eight cities. This trend is particularly noticeable in Johannesburg and Pretoria where the residential footprint as a proportion of the total footprint increased by 12.7% and 10.2% respectively between 1994 and 2009. International comparisons of population densities based on the relationship between population figures and built-up surface areas revealed three distinct density categories: American cities with low densities generally below 25 persons per hectare, European cities generally ranging from 30 to 100 persons per hectare, and Asian cities generally in excess of 100 persons per hectare and often above 200 persons/ha (Bertaud 2004). In the study of 15 medium-sized and large European urban areas, Kasanko et al. (2006) reported population densities between 5 and 55 persons/ha, while Burton (2002) found densities between 30 and 63 persons/ha in a study of 25 English towns and cities. The 2011 population density of the eight South African cities (persons per built-up area) ranges from 35 to 40 persons/ha in the intermediate sized cities to between 40 and 70 persons/ha for the Metropolitan areas (Table 6.4).

Table 6.4: Overall city level density indicators

	Annual total built-up growth (1994 - 2009)	Annual residential built-up growth (1994 - 2009)	Population density 2011 (persons/ha)	Population density change 1996-2011 (persons/ha)	Pop density per residential footprint 2011 (persons/ha)	Pop density per residential footprint change 1996-2011 (persons/ha)	Residential footprint as % of total footprint (2009)	Residential footprint as % of total footprint change (1994-2009)	Ratio pop growth/total footprint growth (1994-2009)
Johannesburg	3.2	5.4	55.6	6.8	79.3	-5.8	70.1	12.7	1.4
Cape Town	1.2	1.7	70.6	13.0	135.5	16.8	52.1	3.5	2.6
Durban	1.5	1.7	50.3	1.4	71.6	0.1	70.2	1.9	1.2
Pretoria	1.0	2.6	41.3	11.9	72.9	9.6	56.6	10.2	4.2
Pietermaritzburg	0.7	0.8	34.5	15.1	47.0	20.1	73.5	1.3	9.2
Bloemfontein	2.2	3.5	35.2	3.6	56.6	-1.4	62.1	7.7	1.4
Nelspruit	3.5	5.1	42.0	11.5	67.1	10.0	62.5	9.2	2.3
Witbank	1.6	2.8	34.2	11.0	92.0	20.0	37.2	4.9	3.5

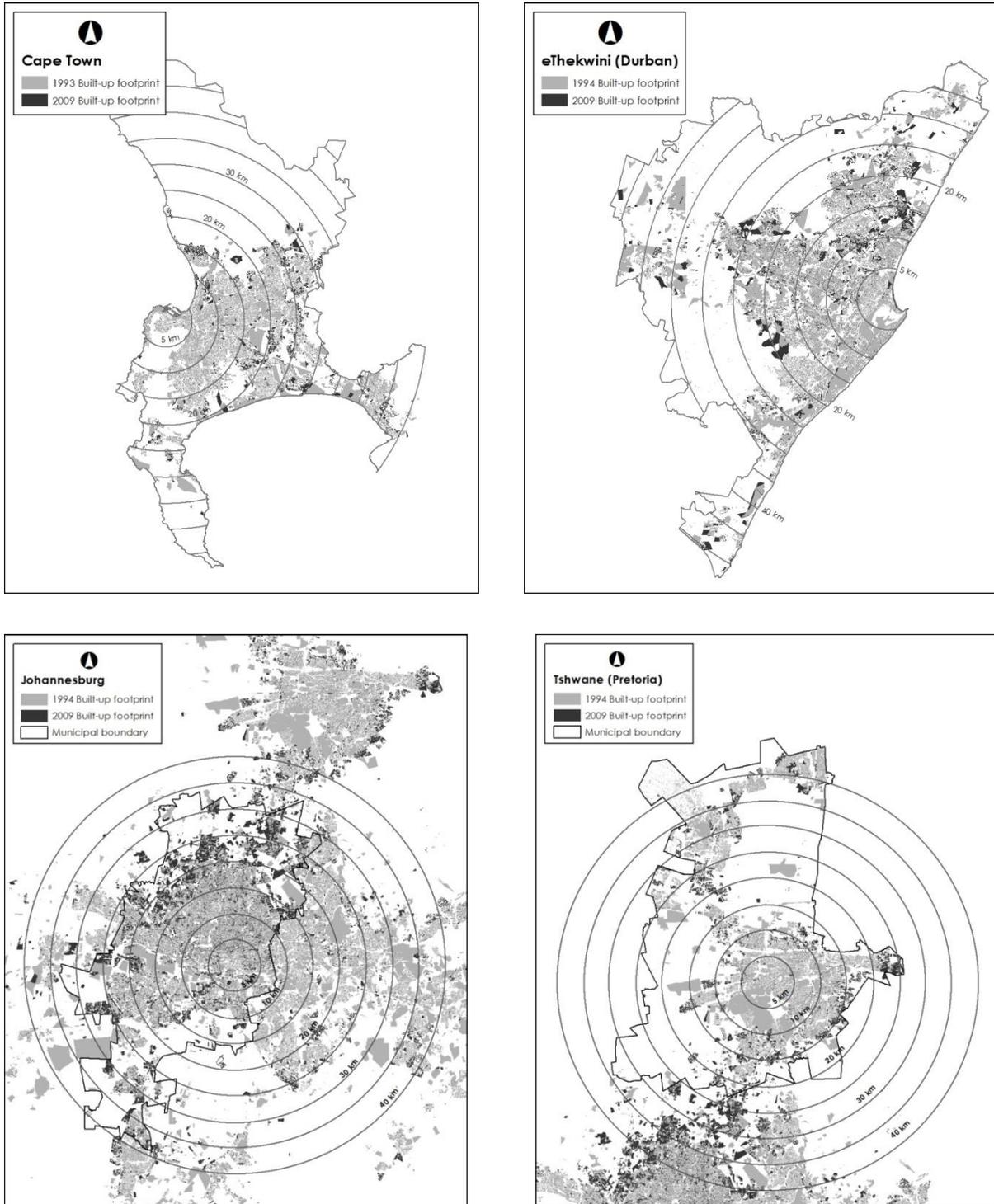


Figure 6.3: Changes in urban built-up footprint – Cape Town, Durban, Johannesburg & Pretoria

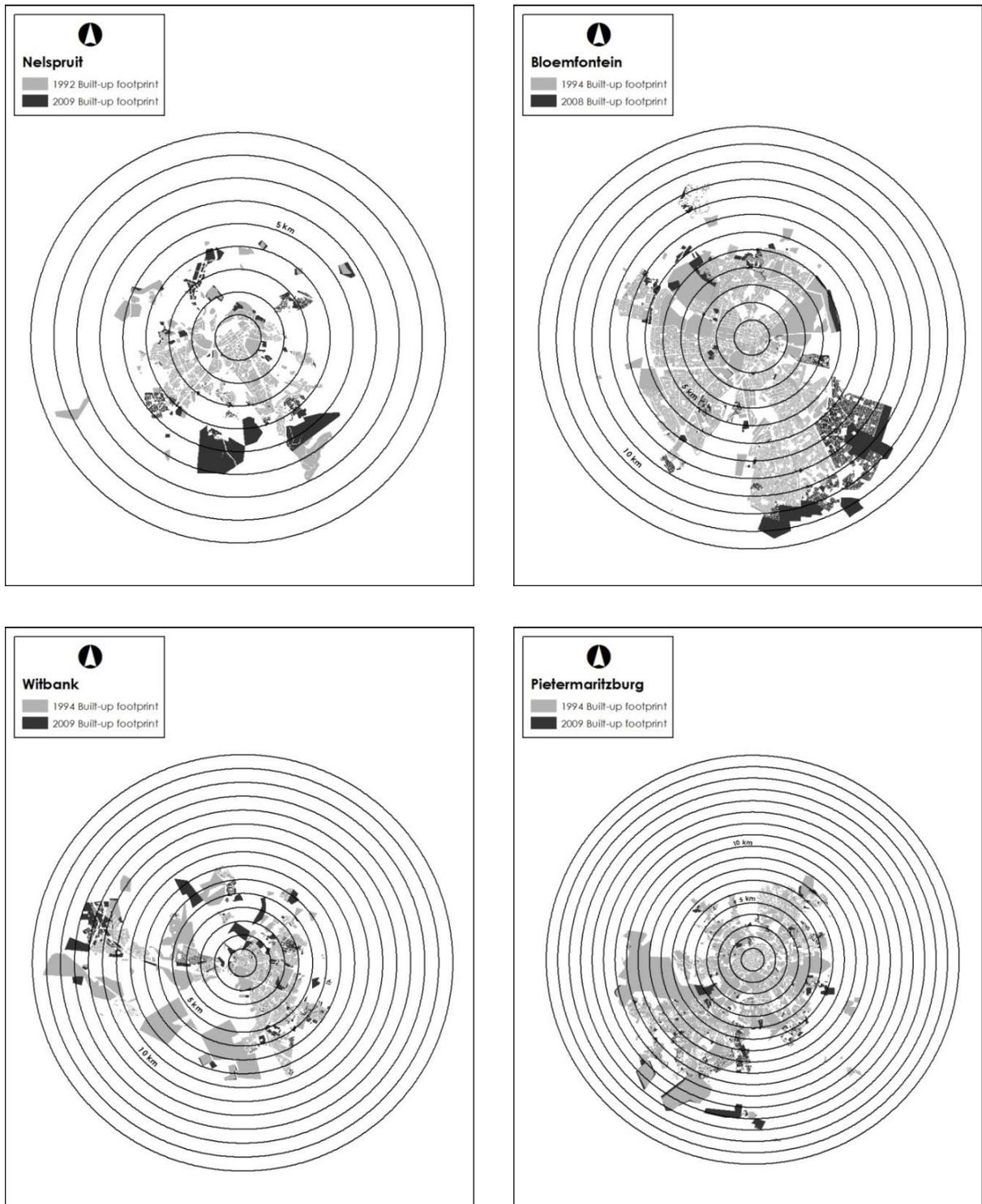


Figure 6.4: Changes in urban built-up footprint – Nelspruit, Bloemfontein, Witbank & Pietermaritzburg

The overall population density has increased in all eight cities, ranging from a marginal increase of 1.4 persons/ha in the Durban Metropolitan area to more substantial increases of up to 13 persons/ha in Cape Town and 15 persons/ha in Pietermaritzburg. This increase in density in Cape Town is the result of a substantial population increase averaging 3.1% over the period 1996 to 2011, while the overall city built-up footprint only increased by 1.2% per annum over the period 1993 to 2009. The opposite trend was experienced in Johannesburg characterized by a high population growth rate of 4.5% per annum between 1996 and 2011, accompanied by a city built-up footprint also increasing at a rapid rate of 3.2% annually over this period. The net effect is only a modest increase in net density from 48.8 persons/ha in 1996 to 55.6 persons/ha in 2011.

When relating urban population to only the residential footprint of the city, Cape Town reflects a substantially higher population density of 135 persons/ha compared to figures of between 70 and 80 persons/ha in the other three large metropolitan areas. Cape Town also shows the largest increase in net density relative to the residential footprint (an increase of 16.8 persons per hectare between 1996 and 2011). The rapid increase in the residential footprint of the city of Johannesburg resulted in a net population density decrease (measured relative to the residential footprint), despite substantial population increases. This trend is also evident in Bloemfontein where the growth rate of the residential built-up area outpaced the population growth rate.

A further reflection on population densities at a lower level of spatial aggregation is depicted in Table 6.5. These densities are based on the population figures resulting from the 2011 South African census of which the first results at a spatially disaggregated level were released towards the end of 2012 at ward level. The highest population densities measured at ward level is prevalent in Johannesburg with a figure in excess of 1000 persons/ha for the most dense ward. The comparative figures in the other three large metropolitan areas range from 184 persons/ha in Pretoria to 307 persons/ha in Cape Town, while those for the intermediate sized cities are substantially lower. The average density of the four most dense wards in each city show similar characteristics with the highest figure in Johannesburg (704 persons/ha on average in the four most dense wards) and much lower figures in the other cities ranging from as low as 9 in Nelspruit to 286 in Cape Town. The ward level density patterns in Johannesburg are however highly variable with standard deviation values well in excess of the average ward level density. In most other cities, the levels of variation in density are less pronounced with the standard deviation in all instances lower than the average density value for all wards. A study of 25 English cities and towns reported the average density of the four most dense wards to range between 36 and 83 persons/ha (Burton, 2002).

Table 6.5: Ward level population density comparisons

	Density of most dense ward 2011 (persons/ha)	Avg density of four most dense wards 2011	Avg ward level density (all wards)	Ward density standard deviation
Johannesburg	1019.2	704.2	94.0	139.9
Cape Town	306.7	286.6	73.5	69.1
Durban	272.1	161.8	45.0	40.6
Pretoria	184.1	147.6	37.7	35.8
Pietermaritzburg	68.8	62.3	27.4	18.9
Bloemfontein	81.3	79.1	46.9	26.7
Nelspruit	22.5	9.1	6.3	8.9
Witbank	122.6	96.7	43.5	34.0

6.3.3.2 Is the double density gradient model applicable to South African city structure and are the changes in the model parameters indicative of compact growth and densification?

The results of the double density gradient model applied to the eight South African cities reveal a number of important characteristics. The first category is cities with no distinctive double linear pattern (as described in Section 6.2.2 and Figure 6.1.) and where the density structure is best described by a single negative linear relationship (Figures 6.5 and 6.6). This category includes Johannesburg and Pietermaritzburg. The second category roughly corresponds with the traditional double density gradient type model characterized by a steep central gradient and a peripheral gradient with a gradual decrease in built-up density. Pretoria, Durban, Witbank and Nelspruit falls in this category. However in the case of Pretoria and Durban the peripheral gradients have positive values of 0.1 and 0.3 respectively. This signifies a gradual increase in density from the breakpoint towards the periphery instead of the normal further gradual decrease in density. This pattern can be explained by the spatial structure (Figures 6.3 and 6.4) dominated by large and growing low income settlements on the periphery of these two cities. The third category (Cape Town and Bloemfontein) can best be described as an ‘inverse double density gradient model’. Both cities exhibit a bi-modal density pattern characterized by a relatively gradual decrease in density on the central gradient, followed by the more rapid decrease in the peripheral gradient. This is indicative of high levels of saturation of the urban built-up pattern in close proximity to the traditional city centre.

The average gradient of the central slope of the eight cities (including the values of the linear slopes of Johannesburg in Pietermaritzburg) implies a 4.3% decrease in built-up density for each kilometre outwards from the centre and a 1.4% decrease (excluding Johannesburg in Pietermaritzburg) on the peripheral gradient. Research in 40 urban areas in Europe found that the average slope of the central gradient represents a decrease of 9% in built-up density for each kilometre outwards from the centre, while the average slope of the peripheral gradient is only 0.3% per kilometre (Guerois & Pumain, 2008). The average value of the central slopes of the eight South African cities is thus less than half the value of the European cities. The break point distances of the four larger metropolitan areas (with their urban field extending to approximately

40 km) varies from 14 km in Cape Town to 20 km in Pretoria and 31km in the case of Durban. The average distance to the breakpoints in the European study was found to be 12.5 km ranging from minimum values of 6.7 km to a maximum value of 33.2 km.

Table 6.6: Values of double density model parameters

City	Central slope 1994	Central slope 2009	Peripheral slope 1994	Peripheral slope 2009	Distance of breakpoint from centre 1994	Distance of breakpoint from centre 2009	R^2 Global (1994)	R^2 Global (2009)
Johannesburg	-1.4	-1.7	NA	NA	NA	NA	0.95	0.96
Cape Town	-1.2	-0.7	-1.8	-1.9	14	14	0.93	0.94
Durban	-2.3	-2.4	0.3	0.3	31	31	0.95	0.95
Pretoria	-4	-4	0.3	0.1	20	20	0.97	0.98
Pietermaritzburg	-4.7	-4.9	NA	NA	NA	NA	0.93	0.94
Bloemfontein	-2.9	-3.8	-9	-8.9	4	5	0.92	0.9
Nelspruit	-15.9	-9.6	-0.31	-0.2	4.5	6.5	0.95	0.91
Witbank	-5.4	-6.9	-0.4	-1.3	10	9	0.87	0.94

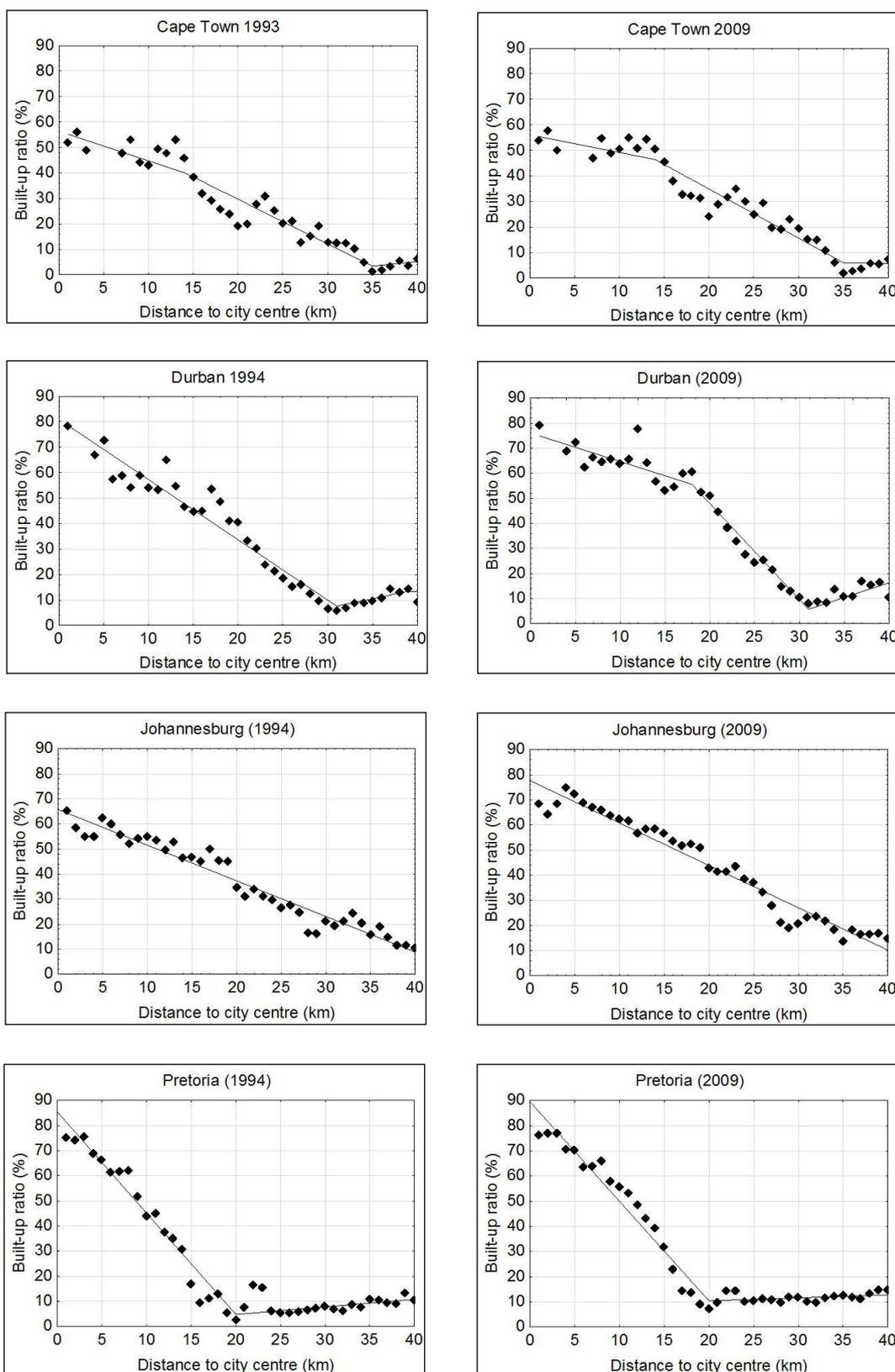


Figure 6.5: Double density gradient models – Cape Town, Durban, Johannesburg & Pretoria

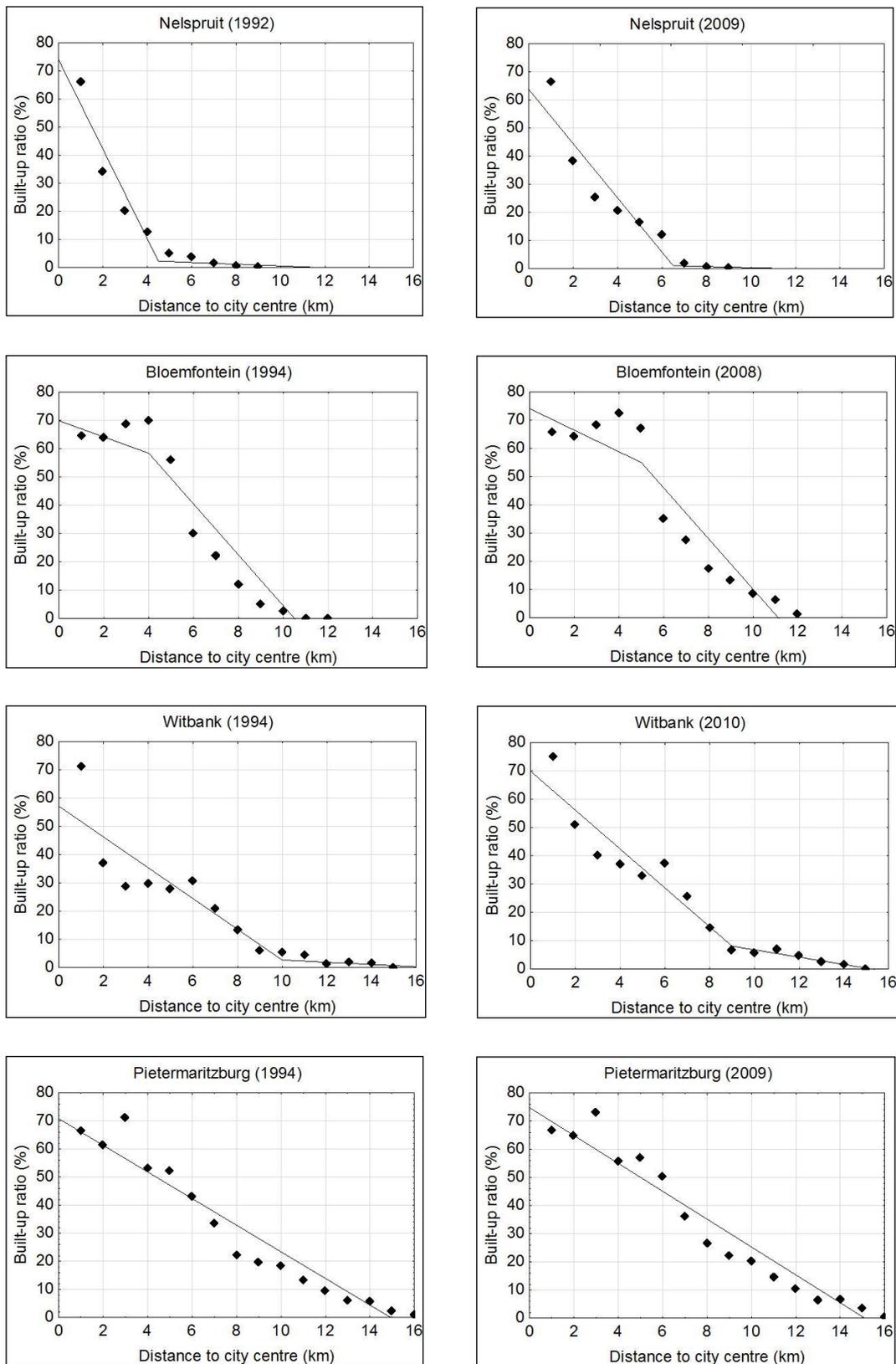


Figure 6.6: Double density gradient models - Nelspruit, Bloemfontein, Witbank, Pietermaritzburg

From a policy implication perspective the changes to the key values of the parameters of the double density model over time are probably more important than the absolute values. Theoretically, the movement of the breakpoint either further away from the city centre or nearer to the centre may be indicative of the spread of the built-up urban footprint of the cities. Movements closer to the city centre and associated with an increase in the central gradient may be indicative of the impact of efforts to densify the urban footprint in proximity to the city centre. On the other hand, the movement of the breakpoint away from the city centre and a decrease in the central gradient would signify dominant deconcentration forces further away from the city centre. Changes in the slope of the peripheral gradient are also indicative of either the reversal or persistence of entrenched historical spatial patterns (characterized by significant concentrations of high density low income population in peripheral areas). The most prominent trend between 1994 and 2009 is that the distance from the city centre to the breakpoint has remained largely unchanged over this 15 year period, with only marginal changes recorded in the intermediate sized cities. The slopes of the central gradients have intensified somewhat in Johannesburg, Durban, Pietermaritzburg, Bloemfontein and Witbank. This can be indicative of some intensification of the physical footprint in the area between the central saturated zone and the breakpoint. The change in these values are however marginal and does not reflect a discernible trend. The gradient of the peripheral slopes have remained relatively unchanged over the 15 year period.

6.3.3.3 Does the evolution of urban spread since 1994 provide any indication of densification or compaction of the urban structure in relation to the city centre?

The built-up footprint increase relative to distance from the city centre can provide some indication of the extent of influence of policy measures to achieve improved levels of urban compaction. Comparatively higher annual growth rates closer to the city centre could be indicative of the influence of densification and compaction policies whereas high growth rates at increasing distances from the city centre could signify more dominant deconcentration forces. The four larger metropolitan cities generally reveal similar growth patterns characterised by relatively low levels of physical growth (generally below 2% per annum) at distances up to 20km from the city centre. The areas of most rapid physical growth are located between 20km and 30km from the city centre at growth levels between 3% and 4% per annum. In the case of Pretoria and Durban the maximum increase occurred at distances of 20km and 26km from the city centre, and in Cape Town and Johannesburg at 32km and 38km respectively. In the smaller intermediate sized cities, physical growth is dominated and largely concentrated in the peripheral locations of the urban structure. The limited extent of the urban field of these cities (generally less than 15 km) implies that the friction of distance plays a much smaller role in location decision-making with less benefits to be gained from development closer to city centres and hence the dominance of physical growth at peripheral decentralised locations.

The study of European cities found that the average annual increase in built-up density ranges from 1.3% per annum in the case of cities with a radius of up to 40 km and increases of up to 2% per annum in cities with city radius up to 60 km. It also found that in cities with a maximum range of 40 km (comparable to the four metropolitan areas in South Africa) the largest increase in the built-up ratio occur at a distance of 5 km from the city centre, while the most significant increases in the larger cities (cities with a range of 50 km) were prevalent at 8 km from the city centre (Guerois & Pumain, 2008). This is in stark contrast to the distances well in excess of 20 km dominating the physical growth of the four largest South African cities in the study⁵³.

⁵³ As indicated in Section 6.3.3 the only spatially disaggregated data available at the time of the empirical analysis informing this article was the municipal ward level data released towards the end of 2012 and during 2013. However, population figures subsequently also became available at a more spatially disaggregated Enumerator Area (EA) level. EAs represent the smallest units of analysis used in the South African censuses. This enabled subsequent further analysis of density patterns in the cities being studied at a more detailed level providing additional spatial analysis results (Figures B1 to B3 in Appendix B). This further analysis was specifically aimed at providing more nuanced patterns of density change across the cities under investigation and to compare these trends with the SDF focus areas for future development identified in the SDFs of these cities.

Figures B1 and B2 provide interpolated surfaces of population density change based on the EA level densities of the 1996 and 2011 censuses. The SDF focus areas for development as identified in the SDFs described in Chapter 5 were also compared with these population density changes to obtain an indication of the level of conformance between the SDF focus areas and population density increases. The patterns reflected on Figures B1 and B2 indicate generally low levels of conformance between the SDF focus areas and the areas with highest population density increase. The percentage population growth between 1996 and 2011 in the identified SDF focus areas only exceeded the total overall city population growth rate in the case of Cape Town. Furthermore, only three of the eight cities studied (Cape Town, eThekweni and Nelspruit) experienced higher population density increases within the SDF focus areas compared to the overall city level figures. Although the population densities in the other five cities did also increase somewhat within the SDF focus areas, these increases were lower than the comparative city level figures and represent only very modest increases ranging from 1 person/ha in the case of Pietermaritzburg to 8.1 persons/ha in Tshwane.

Table 6.7: Comparative density indicators at overall city level and within SDF focus areas

City	Population growth 1996-2011 (%)		Net density increase 1996 to 2011 (persons/ha)	
	SDF focus areas	Total city	SDF focus areas	Total city
Cape Town	49.4	47.1	23.2	16.3
Johannesburg	30.6	76.8	3.0	11.5
Tshwane	61.3	68.3	8.1	10.3
eThekweni	36.0	52.8	10.0	9.8
Bloemfontein	7.6	62.0	2.8	8.9
Pietermaritzburg	6.7	85.0	1.0	11.9
Witbank	58.9	99.6	6.6	19.9
Nelspruit	122.5	127.8	16.0	12.0

The information depicted on Figure B1 further indicates that the changing population density trends in the four largest metropolitan cities analysed cannot exclusively be viewed as decentralization, with some indications of population density increases also occurring in and around the traditional CBD areas of these four cities. In the case of Johannesburg, Tshwane and eThekweni there is clear evidence of increases in population density in and around the traditional CBD areas together with widespread increases in decentralised suburban locations. These trends are not evident in the four intermediate sized cities analysed. These trends in the four largest metropolitan cities support Soja's (2000) argument of a growing convergence between urban and suburban densities and monocentric metropolises transformed into polycentric regional cities, as well as Bruegmann's (2005) argument that densities in many cities are actually rising at both the centre and at the edges.

In order to further investigate the statistical significance of the observed spatial patterns, the Anselin Local Moran I technique ('cluster-outlier analysis') was applied to the data. The purpose of this spatial analysis technique is to determine whether the identified spatial patterns exhibit statistically significant clustering or dispersion, and would provide evidence of significant underlying spatial processes (Du Plessis 2016). High positive local Moran I values imply that the unit under analysis has similar

high or low values as its neighbours, and these can therefore be regarded as spatial clusters. A high negative local Moran I value means that the value of the unit under analysis is different from the values of their surrounding locations and that the location under study is a spatial outlier (Zhang & Lin, 2008). Figure B3 reflects the results of a cluster-outlier analysis of population density change between 1996 and 2011 for the four largest metropolitan cities analysed. Two important observations are clearly distinguishable from these results. Firstly, in the case of Tshwane, Johannesburg and eThekweni it confirms the occurrence of spatial clusters of high population density increase occurring in the both the historical city centres (CBDs), as well as in a number of clearly defined suburban nodes. This confirms the statistical significance of the observations referred to above pointing to rising densities at both urban centres and suburban locations. Secondly, it reveals low levels of conformance between the SDF focus areas and the spatial clusters of high population density increase (Category HH in Figure B3) in the case of Tshwane and Johannesburg, and only moderate levels of conformance in the case of Cape Town and eThekweni.

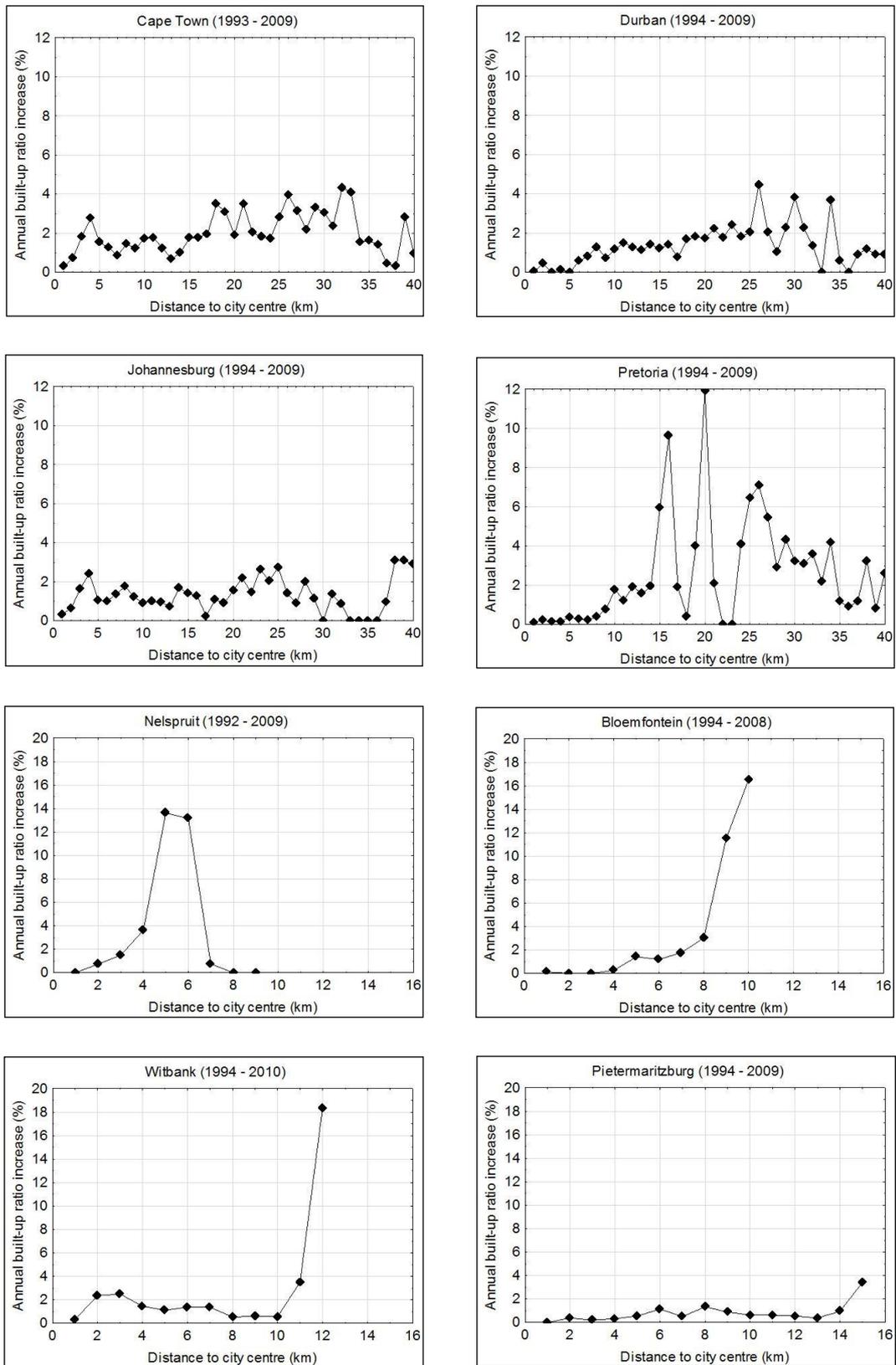


Figure 6.7: Annual built-up ratio increase

6.4 CONCLUSIONS AND IMPLICATIONS

The research results confirm modest increases in densities and changes to urban form since 1994 with overall net population density increases in all eight cities, ranging between 1.4 persons/ha and 15 persons/ha. The growth rates of the residential built-up footprint generally far exceeded the growth of the total built-up footprint and continued to increase as a proportion of the total footprint. The growth patterns of the four larger metropolitan cities are distinctive with relatively low levels of physical growth (generally below 2% per annum) at distances up to 20 km from the city centre, and areas of most rapid physical growth at distances between 20km and 30 km from the city centre at levels between 3% and 4% per annum. In the smaller intermediate sized cities, physical growth is largely concentrated at the peripheral locations of the urban structure and will have to be critically reviewed within the context of the relevant spatial development frameworks. Cities that achieved the most success were able to limit the extent of the residential footprint growth, although not necessarily always at the idealized locations closest to the historical city centres. These results seem to suggest that, although historical city centres still dominates the South African urban landscape, a more decentralized structure is emerging with the focus areas of most significant physical growth at increasing distances from the historical city centres.⁵⁴

The results imply varying levels of relevance of the double linear density model to the South African cities with two distinct variations identified. The first variant roughly corresponds with the traditional model characterized by a steep central gradient, but with a gradual increase in density from the breakpoint towards the periphery instead of the normal decrease. This can be indicative of the persistence of spatial patterns dominated by higher densities at peripheral locations. The second variant of the model can best be described as an ‘inverse double density gradient model’ characterized by a relatively gradual decrease in density on the central gradient, followed by the more rapid decrease in the peripheral gradient. A comparison of the 1994 and 2009 models confirmed that the distance from the city centre to the breakpoint has remained largely unchanged over this 15 year period and that the slopes of the central gradients displayed some marginal increases over the same period. Complex intermediate zones can result in an uneven central gradient that obscures the transition between the central and peripheral gradients. Some aspects of this type of complex intermediate zones are also present in South African cities and can partly explain the occurrence of the ‘inverse double density gradient model’. An example is large scale high density low income settlements originally planned at peripheral locations now increasingly being assimilated in the urban structure as a result of a rapidly growing urban footprint.

⁵⁴ This more detailed disaggregated level of analysis however also identified a number of further more nuanced patterns of density change across the cities under investigation (Figures B1 to B3 in Appendix B). These findings indicate that the changing population density trends in the larger metropolitan cities analysed cannot exclusively be viewed as decentralization, with some indications of population density increases also occurring in and around the traditional CBD areas. The cluster-outlier analysis results (Figure B3) confirmed the statistical significance of these patterns in the case of Tshwane, Johannesburg and eThekweni and substantiate the occurrence of spatial clusters of high population density increase occurring in the both the historical city centres (CBDs), as well as in a number of clearly defined suburban nodes. These trends are not evident in the four intermediate sized cities analysed.

The range of the central saturated zone can also influence the slope of the central gradient and cross city comparisons of these gradients should take caution in the interpretation of this variable.

A number of observations are also relevant from a methodological perspective. Firstly, the measuring of the density gradients in terms of the built-up footprint in two dimensions only partly describes development intensity without also considering the third dimension of the height of individual structures. It will generally underestimate the occupation of the most densely populated zones. Population figures may provide a more accurate reflection of the intensity in various parts of the urban field, and experimental applications in Cape Town confirmed that population increases are possible without any major changes in the physical footprint of the city.

Secondly, the results would suggest that urban form is resilient and does not change dramatically over a period of 15 years. This corresponds with the opinion expressed by Burton (2002) that an extended time period of 20 to 30 years may be most appropriate for the investigation of intensification trends. It may thus be somewhat premature to express a definitive opinion on the levels of influence of the spatial planning policies in South Africa since 1994.

Thirdly, undevelopable areas within the greater urban structure (drainage, topography, geological conditions) are in many instances not accounted for in urban density models. These areas may be excluded in calculating metropolitan urban form and density indicators to better reflect the effect of land use policy only and discounting the fragmenting effect of natural constraints (Tsai 2005). The delimitation of the urban area can also influence the outcome of the results. The impact of this aspect was tested in Pretoria and Johannesburg. One set of analytical data has limited the extent of the urban field to the municipal administrative boundary, while the second extend the analysis to a distance of 40km across adjacent municipal boundaries. Although the patterns of the results were broadly similar it did reveal significant differences between the two sets of parameter values.

Due to the complex nature of urban growth management strategies and spatial plans, it is difficult to isolate the impacts of any one instrument or to answer the question of which specific instruments of an urban growth management programme are connected to specific urban form changes (Song and Knaap 2004). The full impact of the spatial policies and plans can only be judged based on a comprehensive and multi-dimensional evaluation of all three dimensions of urban form measurement. The findings of this research do not suggest causality between spatial policies and plans on the one hand and changes in urban form and structure on the other. From the perspective of density indicators and models, the spatial policies and principles seem to have at least contributed to some overall increases in population density⁵⁵. The results of this study may be sobering for the overall spatial planning and policy direction

⁵⁵ The patterns reflected on Figures B1 to B3 indicate generally low levels of conformance between the SDF focus areas and the areas with highest population density increase.

in South Africa and may indicate the need to further refine the local spatial plans and policies taking into consideration the full range of perspectives impacting on generic concepts such as ‘densification’ and ‘compaction’.

7 CHAPTER 7: LAND-USE MIX IN SOUTH AFRICAN CITIES AND THE INFLUENCE OF SPATIAL PLANNING: INNOVATION OR FOLLOWING THE TREND?

7.1 INTRODUCTION AND BACKGROUND

Many of the contemporary debates over the efficiency of urban form tend to juxtapose the concepts of compact development alongside urban sprawl, the latter often associated with decentralised development patterns (Brueckner 2000; Johnson 2001; Frenkel & Ashkenazi 2008). Despite the wide range of arguments in this ongoing debate (eg. Ewing 1994; Soja 2000; Dieleman & Wegener 2004; Bruegmann 2005; Cox 2006; Geurs & Van Wee 2006) comprehensive comparative studies are scarce, and quantitative measures have only started to influence this discourse relatively recently (Galster et al. 2001:682). These debates on urban form also remained central to the urban spatial planning policy agenda in South Africa in the post-1994 era and concepts such as ‘compaction and densification’, ‘socio-economic and spatial integration’ and ‘spatial restructuring’ have become entrenched in the South African spatial planning policy and approach since the early 1990s.

In the South African context the notion of mixed land uses in particular has remained prominent on the spatial planning agenda since the early nineties, and was most profoundly influenced by Dewar and Uytenbogaardt (‘South African cities: A manifesto for change’) in which they argued that “The multifunctional use of space and facilities is not only desirable: it is economically essential.” (1991:59). They also identified the integration of urban activities and land uses as one of five central conceptual changes required for the transition of South African cities onto a more positive urban developmental path. These principles have subsequently been institutionalised by the inclusion of mixed-use development as part of a set of normative spatial principles contained in the Development Facilitation Act (Republic of South Africa 1995) which was introduced as a legal source to guide the spatial content of planning in South Africa. More recently the concept of ‘functional integration’ was included in the Guidelines for the Development of Spatial Development Frameworks (SDFs) (Republic of South Africa 2011:21) as one of the basic principles of good spatial planning practice. Despite this strong focus on functional integration, the quantification of this goal however remained vague, and the National Development Plan 2030 (NDP) as part of its recommendations for the reform of the current planning system calls for the introduction of incentives and regulations to support compact mixed-use development within South African cities. These ideals of compaction, functional integration and mixed use development areas were however influenced by the reality of historic South African city structure. This structure includes elements of both the global North and South, as well as unique characteristics resulting from the peculiar spatial development history during the apartheid era as described in Chapter 3. It is characterized by unequal access to economic opportunities, social segregation, poorly located lower income settlements, and insufficient public transport systems (Drakakis-Smith 1992; Harrison, Todes & Watson, 2008). The arguments for the transformation of this structure are also influenced by

broader spatial trends at national and local level. While the national scale spatial settlement trend in South Africa has been towards spatial concentration (driven by agglomeration benefits), local urban level spatial patterns are showing increasing signs of a polycentric form or a polycentric network of cities in the case of the metropolitan regions (Van Huysteen et al. 2010:37). These realities compelled local authorities to adopt spatial planning concepts such as transport corridors and development nodes to give effect to the spatial planning principles.

Despite these clear policy guidelines there remain a surprising paucity of comprehensive cross-city comparative empirical evidence to evaluate the extent of changes to South African city structure since 1994 and to objectively review the impact of the new generation of spatial policy and planning instruments. The aim of this chapter is to investigate the patterns and trends of land-use mix in a number of South African cities, as well as the possible influence of spatial development plans on these patterns. The novelty of the approach and the findings of this study lie in three important contributions. Firstly, it provides a multi-year and cross-city analysis of urban form and structure with a specific focus on urban land-use mix patterns to address the paucity of information in this field in South Africa. Quantitative urban form studies have generally focused on individual cities (or pairs of cities) or single time periods and do not allow for comprehensive cross-city comparisons (e.g. Kotze & Donaldson 1998; Turok 2001; Horn 2005; Donaldson & Kotze 2006; Lemanski 2006; Sinclair-Smith & Turok 2012). The results presented in this article compare a range of land use mix indicators for eight different cities in South Africa since 1994. Secondly, it attempts to provide a comprehensive view of land-use mix in South African cities through the application of a range of indicators reflecting both intensity and pattern-based land-use mix measures. Thirdly, it compares the land-use mix patterns and trends with the main spatial principles and structuring elements contained in the SDFs of the eight cities, to review the appropriateness and effectiveness of these measures.

An overview of the various approaches and indicators of land-use mix and diversity is outlined as point of departure and provides the framework for a comparative spatial and statistical analysis of land-use diversity in the eight cities. The analysis results highlight the land-use mix patterns and trends in the study areas and are also interpreted within the context of the spatial planning concepts and principles applied in the urban spatial plans of the various cities. The conclusion highlights a number of key findings on the patterns and trends of land-use mix in South African cities, and the potential implications for future urban spatial planning practices.

7.2 APPROACHES TO THE MEASURING OF LAND-USE MIX AND DIVERSITY

7.2.1 Defining the concept of land use mix

The relationship between land-use mixtures and developmental outcomes has attracted interest from various fields including landscape ecology, environmental management (e.g. air quality), transportation (e.g. automobile ownership, travel behaviour), and even health sciences (physical activity behaviour, obesity). Arguably the area of most attention has been the relationship between land-use mix and travel patterns. There has been a mushrooming body of empirical studies focused on arguments in support of higher levels of density and mixed land use, mostly associated with benefits such as reducing car travel, travel distances, and transport costs (Owens 1986; Newman & Kenworthy 1991; Stead & Marshall 2001; Zhang & Guindon 2006; Barret 2010; Nijkamp & Rienstra 2010; Gakenheimer 2011).⁵⁶

The analysis of land-use mix requires a clear distinction between the related concepts of land-use mix and land-use diversity. The notion of mixed land use implies the location of compatible land uses in close proximity to one another. Fulford (2010:130) describes mixed-use development as "... residential, employment and leisure uses brought together where feasible...". Burton (2002:224) further clarifies this definition and identifies three dimensions of the concept of mixed land use. The first refers to the supply of facilities and services and the balance between residential and non-residential land uses; the second dimension extends this understanding to the geographical spread of these facilities across the city, and the third refers to the mix of land uses within individual buildings on separate floors. These interpretations of the concept of mixed land use can be further expanded to incorporate elements rooted in landscape ecology, including dimensions such as the degree of diversity of land-use type (land-use diversity), the extent to which the land use is dominated by one or two types (land-use dominance), homogeneity of land-use types in a land-use pattern (land-use homogeneity), and the degree of fragmentation of land-use pattern (land-use fragmentation) (Liu, Jiao & Liu 2011:349).

The broader concept of the diversity of cities was popularised by the work of Jane Jacobs (1961). Despite her arguably romanticised notions of diversity and city life, many of these concepts have subsequently been adopted by a variety of planning approaches such as new urbanism. Although there are similarities between diversity and mixed land uses, diversity can be described as a "multi-dimensional phenomenon," (Turner, Robyne & Murray 2001:320) that also promotes other desirable urban features such as a variety of housing types, building densities, household sizes, ages, cultures and income.

⁵⁶ As discussed in Chapter 6 there are however also various counter arguments to these motivations for increased densities such as it contributing to increasing housing costs and resulting lower rates of home ownership, reducing individual mobility, impacting negatively on economic growth, and disregarding the neighbourhood preferences of households (Gordon & Richardson 1997; Dieleman & Wegener 2004; Cox 2006). This chapter argues that the general (and largely unchallenged) acceptance of the goal of establishing a greater mix of land uses in South African cities as part of the post-1994 South African spatial planning doctrine as described in Chapter 3 should be critically analysed and its relevance be reviewed through the consideration of a broader range of influencing factors.

Diversity can therefore be seen to represent the social and cultural context of the urban form (Jabareen 2006).⁵⁷

7.2.2 Measures of land-use mix

In its simplest form, measures of land-use mix normally concentrate on a broad type of mixes, such as proximity of residential uses and commercial facilities. There is, however, a much broader range of measures of land-use mix that can be classified into three categories: accessibility (or proximity), intensity (or magnitude), and distribution pattern. Song & Rodriguez (2005:9) describe these concepts as follows: “Accessibility is the degree to which mixed land activities are easy to reach by residents; intensity is the volume or magnitude of mixed land uses present in an area, and pattern is the way in which different types of land uses are organised in an area.” From a longitudinal perspective, the indicators in each of these three categories can further be distinguished as either ‘product indicators’ reflecting on the situation at a specific point in time, or ‘process indicators’ looking at changes over time (Burton 2002:227). A comparative summary of various measures of land-use mix and their interpretation is outlined in Table 7.1.

As with any set of indicators, the identification and selection of indicators for application should be a pragmatic process based on the criteria of availability, robustness, relevance, independence, transparency, comparability, and spatial flexibility (Booyesen 2002; McMahon 2002; Spangenberg et al. 2002). Coombes & Wong (1994:1304) rightly asserts that “data availability is perhaps the most fundamental problem restricting the eventual set of indicators.”

⁵⁷ In this chapter the term land use mix is used and interpreted in line with the definition of Burton (2002) as outlined above.

Table 7.1: Measures of land-use mix

Indicator	Unit of measurement	Interpretation	Sources
1. Intensity based land use mix measures			
a. Land use count (frequency)	Number of land uses present in specified units of analysis	Higher number implies a higher intensity of land uses	Song & Knaap (2004), Song & Rodriguez (2005)
b. Area properties	Percentage of each land use category	High percentage would imply a larger dominance by a single land use	Frenkel & Ashkenazi (2008), Forsyth et al. (2012)
c. Number of key facilities for every 1000 residents	Number / 1000 residents	Higher number implies a higher intensity of facilities	Burton (2002), Schwarz (2010)
d. Percentage of spatial units containing specified number of facilities (eg. fewer than 2; four or more, etc.)	Percentage of units	Higher number implies a higher intensity of facilities	Burton (2002)
2. Pattern based land use mix measures			
a. Ratio of residential to non-residential land use	Ratio residential to non-residential (km ²)	Values > 1 imply higher levels of homogeneity dominated by residential land uses	Burton (2002), Kasanko et al. (2006)
b. Mix of non-residential land uses in the neighbourhood	Area of commercial, industrial, and public land uses in the neighbourhood divided by the number of housing units	The higher the ratio, the greater the land use mix	Song & Knaap (2004)
c. Land Use Balance Index	The degree to which two different types of land uses exist in balance to each other within a neighbourhood	If all occurring land use types are distributed evenly, the index is 1. The smaller the value, the greater the unevenness.	Song & Rodriguez (2005)
d. Herfindahl-Hirschman index (HHI)	Sum of squares of the percentages of each type of land uses in the user-defined neighbourhoods	Scale of 0 to 10 000. If there is only one land use type in the neighbourhood, HHI index will equal 10 000. The higher the value of HHI Index, the higher the level of dominance by a single land use type.	Song & Rodriguez (2005), Forsyth et al. (2012)

e. Dissimilarity index	Degree to which different land uses exist within the smaller unit of analysis (e.g. grids or neighbourhood) and this distribution pattern is typical throughout the larger unit of analysis (e.g. neighbourhood or the city)	Scale 0 to 1. Values closer to 1 imply higher levels of dissimilarity.	Massey & Denton (1988), Forsyth et al. (2012)
f. Land use diversity index	Degree of diversity of land use types and proportional distribution on a normalised index (0 to 100)	The higher the value, the higher the land use mix. Index value increases as number of land use types increases or proportional distribution of land use types increases.	Song (2005); Liu, Jiao & Liu (2011) ⁵⁸
3. Accessibility based land use mix measures			
a. Distance measures	Linear or street network distance between residential land use and another given non-residential land uses.	Shorter distance implies higher levels of proximity to specified facility	Song & Rodriguez (2005), Forsyth et al. (2012)
b. Gravity based measures of land use mix	Sum of accessibility of residential land use to all other given type of non-residential land uses, discounted by the distance decay function between these two points.	Lower values imply higher accessibility	Song & Rodriguez (2005), Forsyth et al. (2012)

⁵⁸ Liu, Jiao & Liu also provides further variations of this index termed the “index of land use dominance” and the “Index of land use homogeneity”

The use of a wide range of indicators can be perceived to represent a more ‘comprehensive’ analysis of urban land-use mix. The challenge associated with the application of such a wide range of indicators (if not highly correlated as referred to above) is that it often reveals varying performance against different indicators (‘compensability’) and can lead to results of little use to policy-makers (Booyesen, 2002).⁵⁹ The use of a core set of indicators thus represent a more pragmatic approach and as argued by Song & Knaap (2004) a core set of indicators of direct relevance and concern to both citizens and policy-makers is most likely to influence decision-making processes. Song & Rodriguez (2005) identified three important considerations to guide the selection of appropriate core indicators of land-use mix capturing the different dimensions of how land uses are distributed in space. Firstly, the choice of measure is dependent on the extent to which a measure captures the presence and configuration of land uses in space (in other words, is the pattern of several land uses more or less of interest, rather than merely the presence of those uses in the study area). Secondly, the choice of measure should be influenced by practical considerations such as data collection and management, computational burden, and ease of communicability. Thirdly, the purpose of the investigation should drive the measures selected (for example is the investigation primarily concerned with travel behaviour, accessibility to social facilities, environmental considerations such as pollution, or the impact of planning instruments and policies).

7.3 AN ANALYSIS OF LAND-USE MIX IN SOUTH AFRICAN CITIES

7.3.1 Data and methodology

In South Africa there is a surprising paucity of comprehensive multi-year and cross-city analysis of urban form and structure generally, and urban land-use mix patterns specifically. One of the main reasons is the lack of a common set of land-use data for different cities at an appropriate scale for multiple time periods. The criteria of availability and comparability were therefore key considerations in the selection of indicators from the potential candidates available and the selection of cities in this study. Data for the selected indicators had to be available for at least two similar points in time for all cities forming part of the analysis, the former as close as possible to 1994, and the latter to the date of the latest population census in 2011. The latest available set of land-use data from GeoTerraImage (2012) was the only available source that satisfied these criteria with data for periods ranging from 1993 to 2010 available for a number of cities. In addition, detailed SDFs also had to be available for these cities to enable an analysis of the impact of spatial policies and proposals on land-use mix patterns. As described in earlier chapters eight cities could thus be selected for the purposes of this comparative analysis, including the four largest metropolitan areas of Johannesburg, Cape Town, Durban (eThekweni) and Pretoria (Tshwane), as well as four smaller, intermediate-sized cities of Bloemfontein (Mangaung), Pietermaritzburg (Msunduzi), Nelspruit (Mbombela), and Witbank (eMalahleni).

⁵⁹ The challenges of applying seemingly extensive indicator lists under the pretence of being more ‘comprehensive’ is the distinct problem of either highly correlated indicators or differential performance resulting in the problem of compensability (especially in the use of composite indices), or both.

The building Based Land Use^{©™} dataset is widely used in industry (e.g. ESKOM, Telkom, City of Johannesburg, Gauteng City Region Observatory, CSIR) and has been applied in research and academic work (eg. Geyer et al. 2012, OECD 2012). This Building Based Land Use^{©™} dataset contains buildings, structures and other area-specific land uses, as identified and mapped from high-resolution orthophotos as point data. The land uses are mapped using manual image interpretation techniques and classified into a standardised 70-class land-use classification using supplementary datasets and fieldwork. This data undergoes extensive quality-control and validation to provide accurate and detailed land use for selected urban areas within South Africa. Two datasets were used in each city: one as close as possible to 1994 and one for the most recent period closest to the date of the latest population census in 2011⁶⁰. This data was integrated with the latest available cadastral data for each city to produce a set of land-use data at the level of individual stands or land parcels. An automated GIS-based procedure was applied to integrate the land-use points and erf boundaries, and to consolidate the 70 land-use classes to 13 main classes. These land use classes include multiple residential, single residential, informal residential, mixed residential, commercial, industrial, transport and utilities, institutions, sport and recreation, mining, mixed land use, parks and conservation, and agriculture and forestry.

The resulting land use data at the level of an individual stand or land-parcel can however not be applied meaningfully to the type of indicators outlined in Table 7.1 required for strategic level comparison of land-use mix measures. Enumerator Areas (EAs) represent the smallest unit of spatial analysis⁶¹ used for census purposes by Statistics South Africa, and were deemed an appropriate unit of spatial analysis. Its use also allows for comparative data analysis with official census population data. The land-use data at individual stand level for both the base year and the end year was then aggregated to the 2011 EA boundaries for the purposes of spatial and statistical analysis. This resulted in a land-use mix classification for each EA within the various cities using the same 13 main land-use classes. To account for the modifiable areal unit problem (where larger neighbourhoods are prone to more land-use types than smaller ones) only enumerator areas less than 100ha in size were included in the statistical and spatial data analysis (less than 2% of the total EAs in the study areas are larger than 100ha)⁶². In the

⁶⁰ The available base year data in all cities is 1994 except for Nelspruit (1992) and Cape Town (1993), and the end year 2009 except for Bloemfontein (2008) and Witbank (2010).

⁶¹ EAs typically contain between 100 and 250 households.

⁶² The vast majority of EAs larger than 100ha are located outside the urban footprint as reflected on the detailed land use analysis results in Appendix A. These include areas such as protected areas and urban open spaces (e.g. Table Mountain National Park in Cape Town) and other parts generally not suitable for urban development. The remainder of the EAs in the study areas comprises of 24 471 individual EAs with the following size distribution:

- Smaller than 20ha: 77.4%
- 20-40ha: 16.3%
- 40-60ha: 3.9%
- 60-80ha: 1.5%
- 80-100ha: 0.9%

metropolitan areas of Johannesburg, Cape Town, Durban and Pretoria, the analysis covers the entire municipal areas of jurisdiction as defined in 2011. In the case of Bloemfontein, Pietermaritzburg, Nelspruit and Witbank, the municipal area consists of a dominant urban core, as well as a number of smaller towns and/or dense traditional settlement areas scattered across the jurisdiction of the municipality. In these four cities, only the urban core areas were included, and not the isolated and scattered settlements.

An important aspect in the analysis of the data and interpretation of results is how the addition of new developments subsequent to 1993/4 is handled. In the case of the intensity based indicators in Table 7.3, the values are expressed in proportional terms including all areas of both the base and end years (including new developments) of the analysis. The situation is however somewhat more complicated in the case of the spatial analysis of the pattern based indicators reflected on Figures 7.3 and 7.4. Two methods of spatial analysis were thus undertaken. The first method only used the areas of development that existed in 1994 and compared the change between 1994 and 2009/10 in these areas only (excluding any new development). The second method also included all new developments subsequent to 1994 and the indicator values of these areas for 1994 were thus taken as zero. The two methods yielded spatial patterns that were broadly very similar although the areas influenced by greenfield development were somewhat emphasized in the results of the second method. The second method was deemed to resemble the current reality more accurately and was thus used for the analysis results presented here.

Table 7.2: Selected land-use mix indicators

Indicator	Rationale	Unit of measurement	Interpretation
1. Intensity based land use mix measures			
% EA's containing only one land use	Provides indication of number of spatial units characterised by complete homogeneity of land use	Percentage of EA's (0 to 100)	Higher percentages are indicative of urban areas characterised by a larger proportion of units of complete homogeneity of land use
% EA's containing four or more land uses	Provides indication of the proportion of spatial units containing one third of all potential land use classes used in the study	Percentage of EA's (0 to 100)	Higher percentages are indicative of urban areas characterised by a larger proportion of units of moderate levels of land use mix
% EA's containing six or more land uses	Provides indication of the proportion of spatial units containing at least half of all potential land use classes used in the study	Percentage of EA's (0 to 100)	Higher percentages are indicative of urban areas characterised by a larger proportion of units of high levels of land use mix
2. Pattern based land use mix measures			
Ratio of residential to non-residential land use	Provides a measure of the balance between residential and non-residential land uses	A ratio of either larger or smaller than 1.	Ratio >1 indicative of the larger degrees of dominance by residential land uses Ratio = 1 indicative of perfect equality between residential and non-residential uses Ratio <1 indicative of larger degrees of dominance by non-residential land uses
Land use balance index	A measure of balance between the various land uses present in a unit of analysis.	Index on a scale of 0 to 100.	Values = 0 indicate existence of only one land use Values closer to 0 indicate low levels of balance and larger degrees of dominance by the main land use category Values = 100 indicates perfectly equal distribution between all land use categories present within unit of analysis
Land use mix index	A combined measure taken cognisance of both the number of land use types and the balance of distribution of those land use types as expressed by the land use balance index referred to above	Index on a scale of 0 to 100 expressed as the product of the number of land uses and the land use balance index relative to the theoretical maximum value if all land use categories were present in the unit of analysis in equal proportions	Value = 100 if all land use categories are present in perfectly equal proportions. Values closer to 100 indicate higher levels of land use mix and closer to 0 lower levels (both in terms of intensity and diversity of land uses).

The aim of this chapter implies a focus on intensity and pattern-based land-use mix measures, as summarised in Table 7.1, and not the measuring of accessibility patterns of specific facilities or land uses.⁶³ The selected indicators thus include three intensity-based land-use mix measures and three

⁶³ The primary objective of this chapter is to analyse and compare the levels of land use mix across different cities and the trends within these cities across different time periods, and to determine the levels of influence of spatial plans in influencing land use mix in predefined spatial areas. These objectives are thus focussed on intensity and

pattern-based land-use mix measures as described in Table 7.2. The analysis is based on a two-dimensional view of land-use mix only and do not include the third dimension which accounts for the vertical mix of land uses on the same footprint or within the same buildings. Consequently, the levels of land-use mix in areas such as the central business districts of the cities will generally result in an underestimation of land-use mix values in these areas. The limited availability of land-use data for South African cities in three dimensions however limits the possibility of this application within the current context.

7.3.2 Intensity based and pattern based land-use mix indicators of selected cities

A comparative overview of the intensity-based land-use mix measures is outlined in Table 7.3. This information compares the occurrence of different land-use types (the 13 land-use categories used in this research) within EAs according to three categories: percentage EAs within each city containing only a single land use (low levels of land-use mix), percentage EAs containing four⁶⁴ or more types of land uses (moderate levels of land-use mix) and EAs containing six or more types of land uses (high levels of land-use mix). The characteristics of the four larger metropolitan cities, and the four intermediate-sized cities represent two very distinct profiles with high levels of similarity within each of the two groups. In the case of the four large metropolitan cities the proportion of EAs containing only one land-use type (2009/10) ranges between 27.7% and 38.8% , with the comparative figures for the four intermediate cities much higher between 38.5% (Bloemfontein) and 49.9 % (Witbank). Conversely, the percentage of EAs containing four or more land-use types are notably higher in the four metropolitan cities (between 13.4% and 20.4%) compared to the intermediate-sized cities (between 4.8% and 11.7%).

pattern based land use measures as described in Categories 1 and 2 of Table 7.1. The mere counting or proportional distribution of different land uses or facilities as described in the first three indicators (1a to 1c) of Table 7.1 will not provide sufficiently nuanced information for the purposes of the objectives of this chapter, and the selected indicators hence focussed on the percentage of spatial units with defined land use intensity thresholds (indicator 1d). The principle of achieving a greater balance between residential and non-residential uses at various scales is an inherent principle of the spatial planning doctrine described in Chapter 3 and the residential to non-residential ratio (indicator 2a) was thus selected for application. The land use balance index and the Herfindahl-Hirschman index (indicators 2c and 2d in Table 7.1) essentially measures the same attributes and are based on the same information. The land use balance index was selected due to the final measure being more intuitively understandable than the Herfindahl-Hirschman index. The dissimilarity index (indicator 1e in Table 7.1) compares the extent to which land use distribution patterns within smaller units of analysis is typical of the occurrence at larger units within a particular study area and is thus not ideal for cross-city comparative purposes. Land use diversity as a combined reflection of number of land uses and proportional distribution of those uses (indicator 1f in Table 7.1) is a key element of analysis required by the objectives of this chapter.

⁶⁴ A sensitivity analysis was undertaken to evaluate the impact of using different numbers of land uses (three, four and five uses) to determine the cut-off point for this category. The percentage EAs containing three or more uses varies between 19.7% and 43.4%, those with four uses between 4.8% and 20.4%, and those with 5 or more uses between 1.3% and 8.9%. Although the values differ for the various categories, the overall comparative patterns between the various cities remain largely similar. The rank order of only two cities differed by one position amongst the three alternative measures. In addition, as indicated in footnote 5, as much as 97.7% of all EAs below the cut-off point of 100ha is 60ha or less in size (as much as 94% less than 40ha). The vast majority of EAs included in the analysis are thus of similar size categories and a change in the upper cut-off point of 100ha would have very little impact on the proportional distribution within the various categories.

This implies generally higher levels of land-use mix in the larger cities. At the level of individual cities, Cape Town represents the highest levels of land-use mix, with 20.4% of EAs in 2009 containing four or more land uses. Pietermaritzburg clearly stands out amongst the intermediate cities with 11.7% of EAs with four land-use types or more with the lowest value recorded in Bloemfontein (4.8%). When shifting the attention to the extent of changes that occurred between 1994 and 2009/10, the results indicate that there were no significant changes in the intensity of land-use mix between 1994 and 2009/10 in any of the eight cities, with the most significant increase in Johannesburg with a modest 3% increase in EAs with more than four land-use types.

Table 7.3: Intensity based land-use mix indicators for eight cities.

City	Percentage EAs containing 1 Land use			Percentage EAs containing 4 or more land uses			Percentage EAs containing 6 or more land uses		
	1994	2009/10	Change	1994	2009/10	Change	1994	2009/10	Change
Cape Town	27.6	27.7	0.1	21.6	20.4	-1.2	3.0	3.0	0.0
Johannesburg	32.9	27.3	-5.6	15.2	18.2	3.0	1.6	2.0	0.4
Tshwane	35.7	38.8	3.1	14.4	13.4	-1.0	1.4	1.2	-0.2
eThekwini	30.2	30.3	0.1	18.0	18.6	0.6	2.5	2.4	-0.1
Bloemfontein	45.6	38.5	-7.2	5.1	4.8	-0.3	0.2	0.3	0.1
Pietermaritzburg	43.9	43.2	-0.7	12.3	11.7	-0.6	1.7	1.4	-0.3
Witbank	49.3	49.9	0.6	5.9	7.4	1.5	0.4	0.3	-0.1
Nelspruit	47.3	44.3	-3.0	9.7	8.2	-1.5	1.1	0.8	-0.3

These intensity measures of land-use mix are conceptually simple to communicate but sensitive to different levels of aggregation, and reveal relatively little about the pattern, diversity and distribution of the various uses. The selected pattern-based land-use mix measures (Table 7.4) add a further dimension to this analysis. The ratio between residential and non-residential land uses provides a measure of the balance between residential and non-residential land uses. Cape Town, Tshwane, Bloemfontein and Nelspruit show a roughly equal distribution of residential and non-residential land uses in 2009/10, with some marginal increases in the ratio between 1994 and 2009/10 in favour of residential uses. In the case of Johannesburg, eThekweni and Pietermaritzburg, residential land uses substantially dominate non-residential land uses in a ratio of 2:1 or more. This ratio also increased substantially in favour of residential uses, especially in Johannesburg (from 1.31 in 1994 to 2.27 in 2009). Witbank is the only city where non-residential land uses dominate (ratio of 0.51 in 2010) and should be interpreted against the background of the urban structure of Witbank, characterised by large areas of mining and industry-related activities interspersed with other land-use types.

Table 7.4: Comparative pattern-based land-use mix indicators

City	Res-Nonres ratio			% EAs low Land-use Balance Index (<10) ⁶⁵			Mean Land-use Balance Index			% EAs high LUMI (>15) ⁶⁶			Mean LUMI value		
	1994	2009/10	Change	1994	2009/10	Change	1994	2009/10	Change	1994	2009/10	Change	1994	2009/10	Change
Cape Town	0.96	1.07	0.11	41.6	40.3	-1.4	26.5	27.5	1.0	15.4	15.7	0.3	6.7	6.9	0.2
Johannesburg	1.31	2.27	0.96	48.6	43.9	-4.7	23.9	26.0	2.1	10.8	13.4	2.6	5.5	6.2	0.7
Tshwane	0.91	1.14	0.23	50.6	51.1	0.5	22.6	23.1	0.5	10.6	11.1	0.5	5.2	5.3	0.1
eThekweni	2.14	2.33	0.19	44.4	44.7	0.4	25.9	25.6	-0.3	13.7	13.9	0.2	6.2	6.2	0.0
Bloemfontein	1.18	1.33	0.15	64.0	57.8	-6.2	16.9	18.2	1.3	4.9	5.2	0.3	3.4	3.6	0.2
Pietermaritzburg	3.41	3.72	0.31	58.0	57.3	-0.7	19.1	19.3	0.2	7.3	7.3	-0.1	4.4	4.4	0.0
Witbank	0.48	0.51	0.03	59.8	59.8	0.0	19.0	18.5	-0.5	7.4	7.6	0.2	3.8	3.9	0.1
Nelspruit	1.11	1.09	-0.02	60.2	59.0	-1.2	18.3	18.5	0.2	5.4	5.7	0.4	4.1	4.1	0.0

⁶⁵ Cut-off value selected based on comparative values of a 5 category natural break classification of each city based on Jenk's algorithm (1967)

⁶⁶ Cut-off value selected based on comparative values of a 5 category natural break classification of each city based on Jenk's algorithm (1967)

The second pattern-based indicator is the land-use balance index which measures the level of balance between the various land-uses present in a unit of analysis (or put differently the level of dominance of the main land-use category in each EA in relation to the other categories). A value equal to 0 indicates the occurrence of only one land-use category, lower values closer to 0 imply larger degrees of dominance by the main land-use category, and a value equal to 100 would indicate a perfectly equal distribution between all land-use categories present within a specified unit of analysis (perfect balance). The results depicted in Table 7.4 imply relatively similar patterns across all eight cities albeit with slightly higher percentages of EAs in the intermediate-sized cities with low land-use balance index values. The figures for the four metros range between 40.3% of EAs with low levels of land-use balance in Cape Town to 51.1% in Tshwane. The comparative figures for the four intermediate-sized cities are somewhat higher, with levels ranging from 57.3% in Pietermaritzburg to 59.8% in Witbank. The changes between 1994 and 2009/10 have generally been modest with slight decreases in the percentage EAs with low land-use balance values in five of the cities, ranging from a 6.2% decrease in Bloemfontein to 0.7% in Pietermaritzburg. The mean land use balance index value of all EAs provides an aggregate summary measure at city level and largely mirrors the patterns as reflected by the percentage of EAs with low land-use balance index values. The mean land use balance index values for the four metros range between 23.1 and 27.5, with comparative figures for the four intermediate cities somewhat lower at levels between 18.2 and 19.3. This implies higher levels of balance between different land uses in the four larger metropolitan areas. This indicator confirms marginal increases in the land-use balance index between 1994 and 2009/10, with the most notable changes in Johannesburg (+2.1), Bloemfontein (+1.3) and Cape Town (1.0).

The third and most versatile pattern-based indicator is the Land Use Mix Index (LUMI). This index represents a combined measure taking cognisance of both the number of land-use types (intensity) and the balance of distribution of those land-use types (diversity) within a specified unit of spatial analysis. It is expressed as an index value between 0 and 100 normalised relative to the theoretically perfect land-use mix value, if all 13 land-use categories were present in perfectly equal proportions within a specific unit of analysis. The results in Table 4 show a clear distinction between the four metropolitan cities and the four intermediate-sized cities. The percentage of EAs in the four metropolitan cities with high LUMI values in 2009/10 ranges between 11.1% in Tshwane to 15.7% in Cape Town, and the mean LUMI values between 5.3 and 6.9. The comparative figures for the four intermediate cities are much lower with values between 5.2% in Bloemfontein and 7.6% in Witbank and with mean LUMI values between 3.6 and 4.4. The land-use mix patterns remained relatively unchanged between 1994 and 2009/10 with the percentage of EAs with high LUMI values increasing marginally in seven of the eight cities, and the mean LUMI showing small increases in five cities. The most substantial increase occurred in Johannesburg with a 2.6% increase in EAs with high LUMI values and an increase of 0.7 in its mean LUMI value. These changes in Johannesburg mostly occurred in the northern parts of the city and

outside the identified spatial development focus areas. These changes were mostly the result of large scale market driven development with limited influence from the spatial proposals.

7.3.3 Spatial analysis of land-use mix

A spatial analysis of the LUMI values is reflected in Figures 7.1 and 7.2 respectively. Two prominent spatial patterns are emerging from this analysis. Firstly, the structuring influence of the centripetal forces along the main transport routes in the four metropolitan areas is clearly evident. The accessibility, visibility and other benefits attract a high concentration of different land uses along many of these major routes, especially in the larger metropolitan areas. Secondly, high levels of land-use mix are prevalent in the fringe areas around the Central Business Districts, and some of the emerging decentralised nodes.

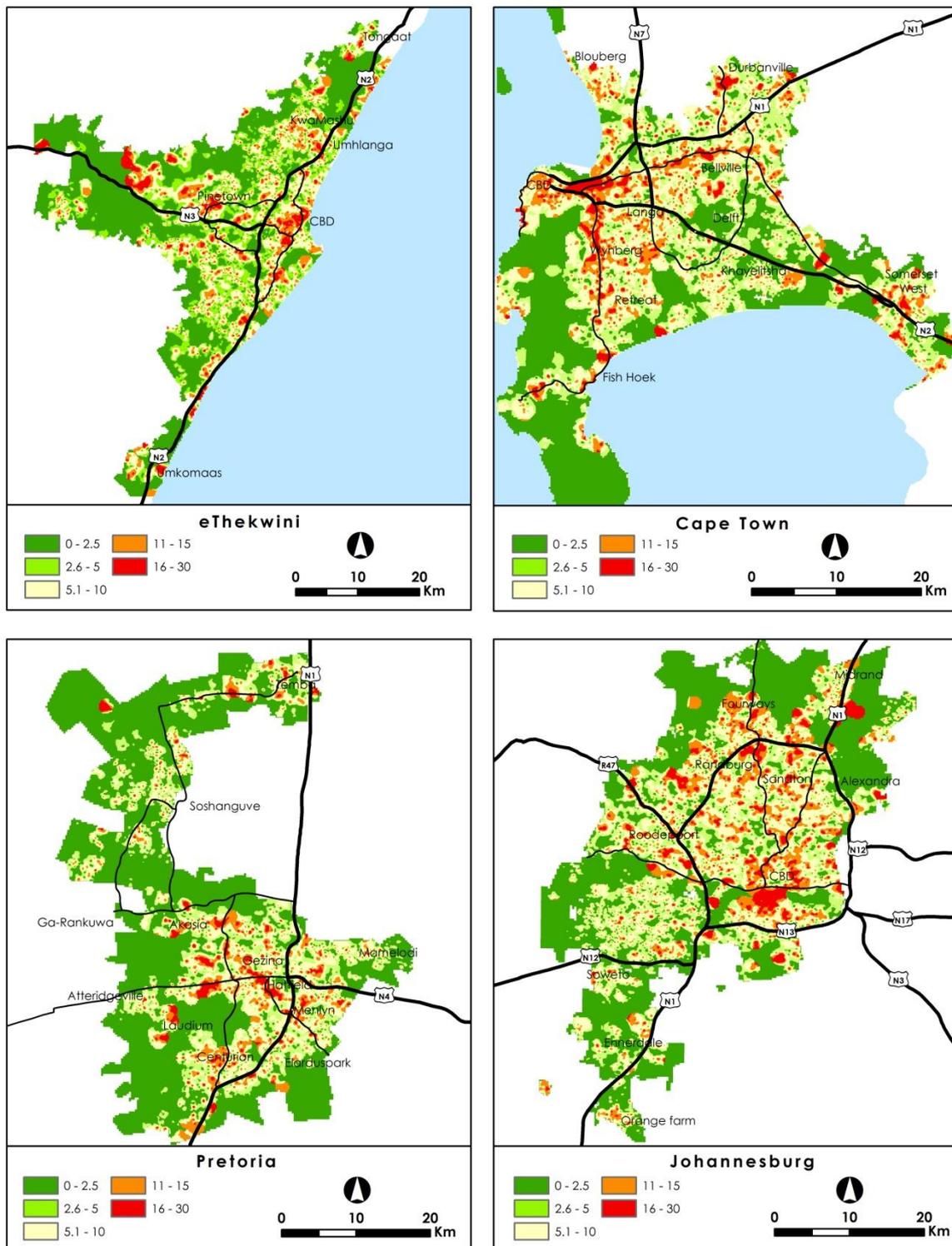


Figure 7.1: Spatial analysis of Land Use Mix Index values (2009) – eThekweni, Cape Town, Pretoria & Johannesburg

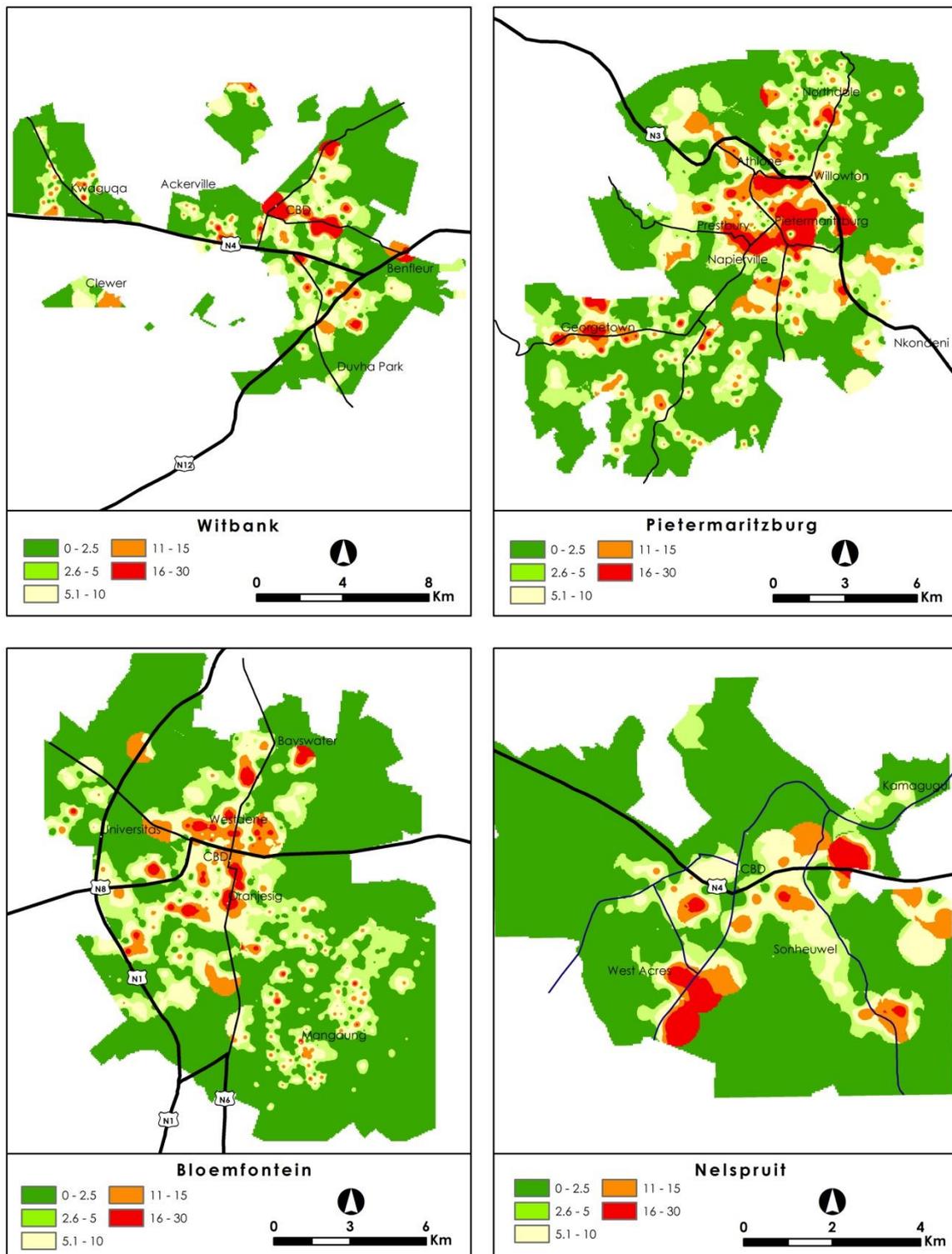


Figure 7.2: Spatial analysis of Land Use Mix Index values (2009) – Witbank, Pietermaritzburg, Bloemfontein & Nelspruit.

Arguably more important from a spatial planning and policy perspective is the changes in land-use mix that occurred between 1994 and 2009/10. The most significant increases between 1994 and 2009/10 occurred at prominent decentralised nodes, such as Umhlanga in eThekweni, Centurion and Menlyn in Tshwane, and Fourways and Midrand in Johannesburg, as well as along major transport routes such as the N2 in Durban and the N1 in Johannesburg and Tshwane (see Figure 7.3). This pattern is also evident at a smaller scale in the four intermediate-sized cities. A second significant emerging pattern is the increases in land-use mix in some historically low-income suburbs, particularly in Khayelitsha and Mitchells Plain in Cape Town and KwaMashu in eThekweni. Interestingly, these three areas all formed part of the national Urban Renewal Programme (URP) launched in 2001 as part of a nationally initiated policy to renew eight urban nodes of deprivation in South African cities. This may be indicative of the positive influence of this area-based programme in the post-1994 era, resulting in the provision of a wider range of social and institutional facilities and supporting at least some private sector investment in commercial development. This observation is also confirmed by detailed assessments of the impact of the URP programme in the City of Cape Town (Donaldson et al. 2013). These changes in land-use mix are however not equally prominent in other large low-income suburbs such as Soweto in Johannesburg and Mamelodi and Atteridgeville in Pretoria not forming part of this programme.

7.4 THE INFLUENCE OF SPATIAL PLANNING PRINCIPLES AND CONCEPTS ON LAND-USE MIX

7.4.1 Spatial planning context and principles

One of the objectives of this study is to establish whether the key spatial structural elements of the SDFs represent focal points of higher levels of spatial land-use mix patterns based on the indicators used in this study. Due to the complex nature of urban growth management strategies, Song & Knaap (2004:223) noted that it is difficult to isolate the impacts of any one instrument, or to determine which specific instruments of an urban growth management programme are connected to identified urban form changes. Within the confines of the existing available data and evidence presented in the preceding sections, an attempt was made to isolate the key principles and spatial planning concepts contained in the SDFs of the eight cities, and then through a simple spatial analysis, evaluate the relationship between these concepts and the patterns and trends in land-use mix. This does not imply a rather naïve assumption that spatial planning is the only or even dominant process determining land-use mix and diversity patterns. Todes (2008:11) clearly articulated the opinion that “infrastructure planning with its own spatial logic was more powerful in shaping the spatial structure of cities than spatial planning”. However, at the same time it must be recognised that substantial resources and attention aimed at transforming the spatial patterns of South African cities have been allocated to spatial planning and related processes since the dawn of the democratic era (Pieterse 2004). Moreover, recent research confirmed considerable alignment between the key elements of SDFs and the public sector capital

investment patterns in cities such as Johannesburg and Cape Town (Laldaparsad, Geyer Jr, & du Plessis 2013). Their findings indicate that SDFs did significantly influence municipal budgetary capital spending patterns between 2007 and 2012. Although the prominent role of market processes and other triggers and processes identified in Chapter 3 in the evolving structure of South African cities is recognised, the extent of resources directed at spatial planning processes over a period of nearly 20 years and its growing influence on public sector capital spending patterns confirm a clear case to be made for considering the potential influence of spatial planning processes on land-use mix patterns.

The priority spatial development principles of the eight urban SDFs were summarised in Table 6.1 in Chapter 6 and clearly highlight the consistent prominence of three elements across most of these plans: spatial and land-use integration, densification and intensification, and environmentally sustainable development. The dominant spatial-structuring concepts applied in the overall strategic level Spatial Development Frameworks (or metropolitan SDFs in the case of the four metros) include elements such as development or activity corridors, mobility corridors, mixed-use nodes or areas, urban nodal structure and hierarchy, future strategic urban development areas, and urban regeneration or renewal zones. Three of these concepts in particular are applied consistently in all the SDFs. These are development or activity corridors (used as a structuring element in all eight SDFs), urban nodal structure and hierarchy (applied in seven of the plans), and mixed-use nodes or areas (applied in six of the plans). The use of these concepts is in line with the vision for South African cities as articulated in the National Development Plan 2030. The NDP identified two elements of this vision: new urban development and infrastructure investment focused on mass-transit corridors and existing and emerging economic nodes, and the linking of the urban poor into the mainstream of city life through investments in connecting corridors of development (National Planning Commission 2012).

The level of detail provided in the overall metropolitan or municipal-level spatial plans of the selected cities differs widely and ranges from only broad conceptual indications to more refined proposals aligned with cadastral entities. In cities where the boundaries of the corridors and nodes were clearly defined, these boundaries were used for the purposes of spatial analysis. In those cases where the nodes and corridors were only conceptually indicated, the guidelines for Spatial Development Frameworks (Republic of South Africa 2011b:21) were used as a point of departure, using a distance of 1km around nodes to implement the principle of economic and functional integration and a distance of 500m either side of the primary road defining the activity corridors. It should be noted that the dates of the SDFs from which these elements have been synthesised range between 2006 and 2011, and it could be argued that there was limited scope for these plans to have influenced the land-use mix patterns between 1994 and 2009/10. However, many of the key spatial principles and concepts (such as densification, integration, diversity and compaction) and structuring elements (corridor and nodal structure) remained largely consistent through the various versions and revisions of these plans since 1994.

7.4.2 Influence of spatial planning concepts on land-use mix patterns and trends

The land-use mix patterns and trends within these nodes and corridors were compared with the total overall city level indicator values of each of the eight cities, based on three land-use mix indicators. It can be hypothesised that if the identified spatial principles and concepts contributed to increased levels of land-use mix, higher average values can be expected within these defined areas relative to the overall figures for the city as a whole. Secondly, and more importantly, the intuitive expectation is that the land-use mix trajectories between 1994 and 2009/10 within these defined focus areas will show higher levels of change compared to the total overall trends of each city.

The information portrayed in Table 7.5 validates the first element of the hypothesis and confirms higher levels of land-use mix within the defined spatial focus areas. The values within the defined focus areas are in most instances notably higher than the comparative figures for the entire city, both in terms of the intensity-based indicator (percentage of EAs containing four or more land-use types) and the pattern-based indicators (land-use balance and land-use mix indices). The largest difference between the spatial focus area values and the overall city-level figures is in Pietermaritzburg, where the values within the defined focus areas are double that of the entire city. The spatial planning focus areas in eThekweni also show significantly higher values for all three indicators compared to the overall city-level figures. The spatial distribution of the LUMI values reflected in Figures 7.1 and 7.2 confirm that the development focus areas outlined in the SDFs do largely correspond with areas of historically high land-use mix.

Table 7.5: Comparison of land use mix values inside and outside SDF focus areas.

City	Percentage EAs \geq 4 land uses						Mean Land-use Balance Index						Mean LUMI value					
	Entire city			Within SDF focus areas			Entire city			Within SDF focus areas			Entire city			Within SDF focus areas		
	94	09/10	Change	94	09/10	Change	94	09/10	Change	94	09/10	Change	94	09/10	Change	94	09/10	Change
Cape Town	21.6	20.4	-1.2	28.1	25.2	-2.9	26.5	27.5	1.0	32.0	32.0	0.0	6.7	6.9	0.2	8.6	8.4	-0.2
Johannesburg	15.2	18.2	3.0	16.8	21.8	5.0	23.9	26.0	2.1	29.2	30.4	1.2	5.5	6.2	0.7	6.7	7.4	0.7
Tshwane	14.4	13.4	-1.0	12.9	12.9	0.0	22.6	23.1	0.5	26.2	27.8	1.6	5.2	5.3	0.1	5.8	6.1	0.3
eThekweni	18.0	18.6	0.6	28.2	28.6	0.4	25.9	25.6	-0.3	36.3	35.9	-0.4	6.2	6.2	0.0	9.3	9.2	-0.1
Bloemfontein	5.1	4.8	-0.3	8.6	8.5	-0.1	16.9	18.2	1.3	22.8	23.4	0.6	3.4	3.6	0.2	4.8	4.9	0.1
Pietermaritzburg	12.3	11.7	-0.6	31.9	33.1	1.2	19.1	19.3	0.2	31.5	31.0	-0.5	4.4	4.4	0.0	8.6	8.5	-0.1
Witbank	5.9	7.4	1.5	5.1	15.2	10.1	19.0	18.5	-0.5	23.3	25.7	2.4	3.8	3.9	0.1	4.4	5.9	1.5
Nelspruit	9.7	8.2	-1.5	8.0	8.6	0.6	18.3	18.5	0.2	22.5	25.5	3.0	4.1	4.1	0.0	5.2	5.8	0.6

However, more important from a planning and policy perspective is the changes in the spatial patterns of land-use mix that occurred between 1994 and 2009/10. The results reflected in Figures 7.3 and 7.4 and outlined in Table 7.5 do not support the second element of the hypothesis, and instead reveal that the areas with the most significant increases in LUMI values do not necessarily coincide with the focus areas defined in the SDFs. None of the cities revealed any increases in LUMI values in these focus areas that are notably higher than the overall city-level figures. Only in the case of the intermediate-sized city of Witbank is the increase in land-use mix within the defined spatial focus areas significantly higher than the city-level figures. This trend is also spatially reflected on Figures 7.3 and 7.4, which illustrate the levels of correspondence between the land-use mix change patterns and the key elements of the SDFs.

These results confirm two important but somewhat contradictory conclusions. On the one hand it confirmed significantly higher levels of land-use mix (2009/10) within the defined spatial focus areas compared to the overall city level figures. On the other hand there is no clear evidence of any significant increases in land-use mix in the spatial planning focus areas between 1994 and 2009/10. This suggests that these spatial focus areas largely follow established historical patterns of land use mix and reflects the outcome of market forces and other trigger factors rather than reflecting planning responses aimed at specifically pursuing the need for spatial restructuring.⁶⁷

⁶⁷ In order to further investigate the statistical significance of the observed spatial patterns, the Anselin Local Moran I technique ('cluster-outlier analyses) was applied to the data. The purpose of this analysis is to determine whether the identified spatial patterns of changes in land use mix exhibit statistically significant clustering or dispersion (see Maps in Appendix C). Figure C1 reflects the results of a cluster-outlier analysis of the land use mix index (LUMI) changes over the study period for the four largest metropolitan cities analysed. Spatial coincidence between the high-high clusters of LUMI change and the SDF focus areas would be indicative of the potential influence of these focus areas in influencing the spatial patterns of LUMI change. However as indicated in Figure C1 there is only limited spatial concurrence between the high-high clusters of LUMI change and the SDF focus areas in Tshwane, Johannesburg, and eThekweni. The levels of spatial coincidence in Cape Town is somewhat higher than in the other three metros but can still at best only be described as moderate. As indicated in Figure C2 the levels of concurrence in the four intermediate sized cities are generally also very limited. However, when specifically focussing the analysis on the growth of economic activity density (activities classified as commercial or industrial uses in the land use categories used in the analysis and depicted on the maps in Appendix A) over the study period a very different pattern emerges. Figure C3 reflects the results of a cluster-outlier analysis on the change in economic activity density over the study period for the four largest metropolitan cities. In this instance there is clearly high levels of coincidence between the identified SDF focus areas and the high-high clusters of growth in economic activity density. This would suggest that the SDF focus areas had a clearly recognisable positive influence on the location of new economic activities over the study period.

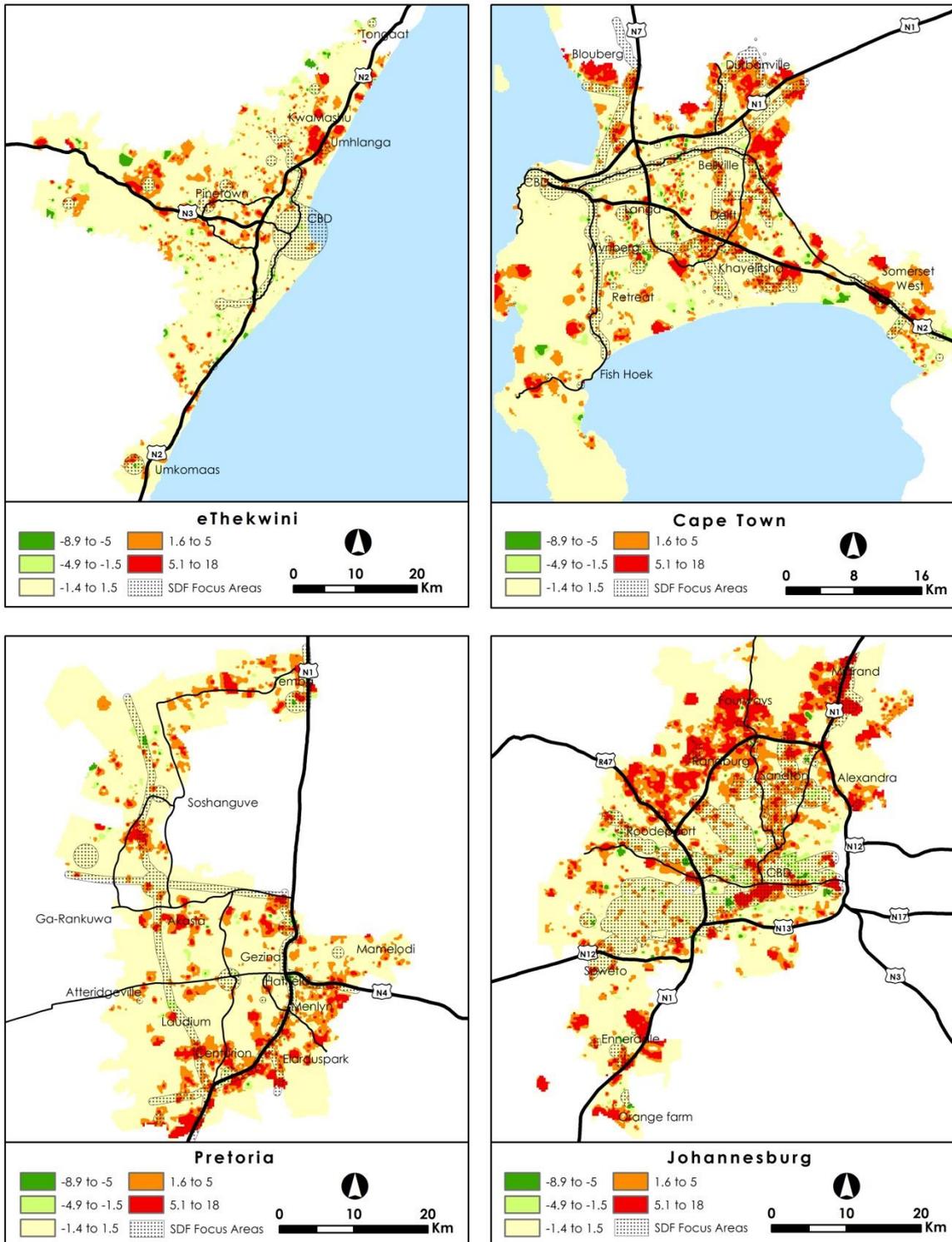


Figure 7.3: Change in Land-Use Mix Index values between 1994 and 2009 – eThekweni, Cape Town, Pretoria & Johannesburg⁶⁸

⁶⁸ The primary purpose of the spatial analysis reflected on Figures 7.1 to 7.4 is to provide a multiple city comparison of the spatial patterns and trends of the Land Use Mix Index (measured on a scale between 1 and 100). The class breaks could thus not purely be based on the natural break classification of each city based on Jenk's algorithm (which will result in a unique set of class breaks for each of the eight cities analysed). This would have been of limited value for the purposes of intercity comparisons. The class breaks were thus determined by considering the natural breaks

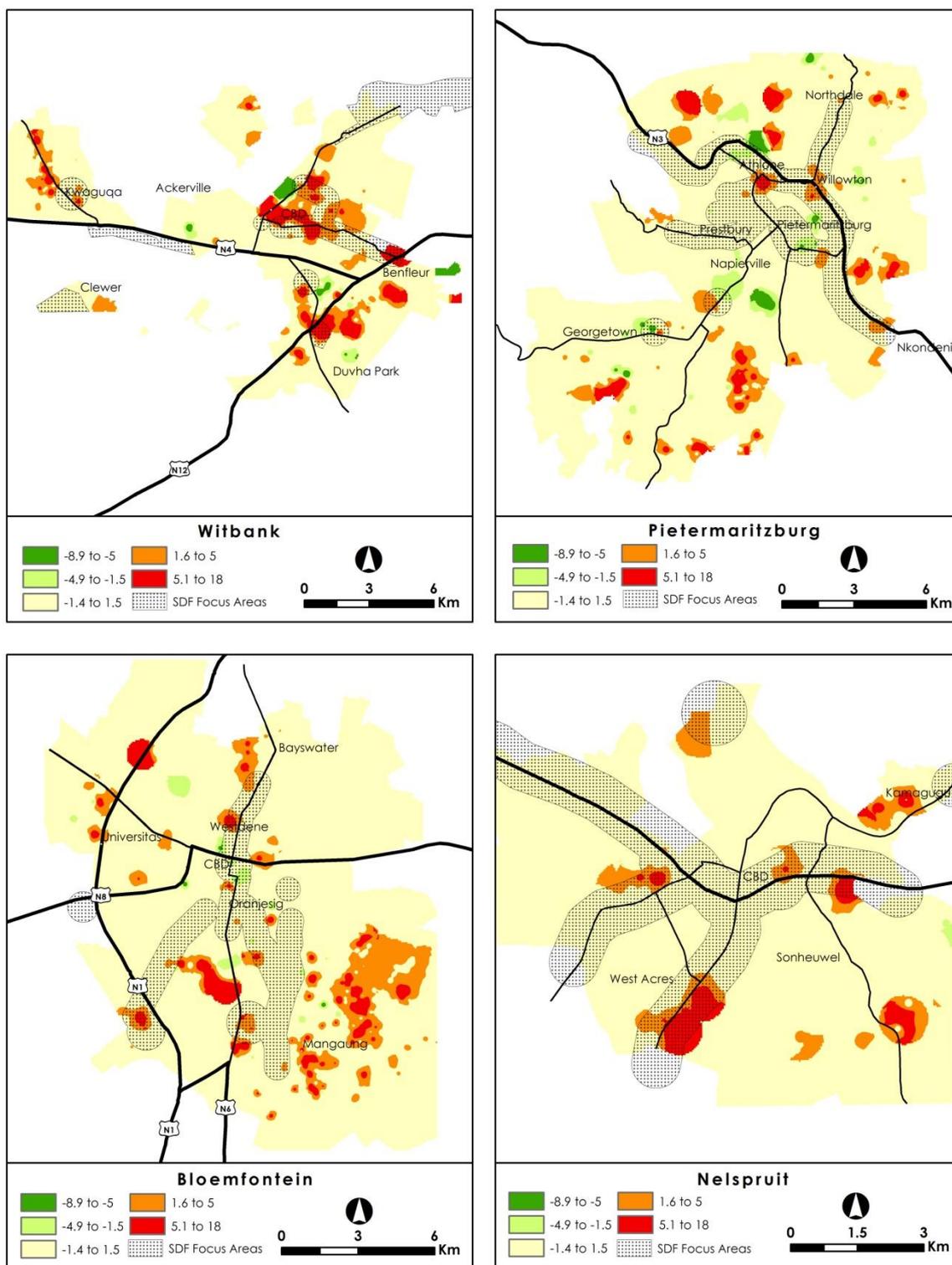


Figure 7.4: Change in Land-Use Mix Index values between 1994 and 2009 – Witbank, Pietermaritzburg, Bloemfontein & Nelspruit.

(using 5 categories) for each of the eight individual cities and, based on the distribution of these values for the individual cities, then selecting a logical class break representative of the distribution of the various individual values. For example, the class break value between categories 1 and 2 for the eight cities (for Figures 7.1 and 7.2) include the following values: 0.96; 1.67; 1.85; 2.15; 2.47; 2.85; 3.02; and 3.43. The class break value used in this instance was hence determined as 2.5.

7.5 CONCLUSION

Although the findings presented in this chapter confirm a number of traditional views on land-use mix patterns in South African cities, it however also provided some evidence to suggest a much more limited influence of spatial planning principles and concepts on the land-use mix characteristics of South African cities than generally believed. These results can be summarised in terms of five key findings. The first aspect confirmed higher levels of land-use mix in larger metropolitan cities compared to the intermediate-sized cities, both in terms of intensity-based and pattern-based land-use mix indicators. The study also revealed that the land-use mix characteristics of the four cities within each of these two groups are very similar. Secondly, the results indicated that there were only marginal changes in the overall levels of land-use mix between 1994 and 2009/10 in the eight cities. This implies that city structure as expressed by land use mix indicators changes relatively slowly over time. A third notable trend over this period has been the increase in land-use mix in some historically low-income suburbs that formed part of the national URP. This may be indicative of the positive influence of this area-based programme on these areas in the post-1994 era, facilitating the provision of a wider range of social and commercial facilities in these areas resulting from both focused public-sector intervention and increased private-sector investors' confidence. The changes in land-use mix are however not equally prominent in other large low-income suburbs not benefitting from this programme. Fourthly, both the intensity and pattern-based indicators revealed generally higher levels of land-use mix within the SDF focus areas compared to overall aggregate city-level figures. The levels of change in land-use mix between 1994 and 2009/10 however indicate that the areas with the most significant increases show only limited correlation with the focus areas defined in the SDFs.⁶⁹

A number of observations are also relevant from a methodological perspective. Firstly, the methodology and analysis results presented in this article are based on a two-dimensional view of land-use mix and do not include the third dimension, which accounts for the vertical mix of land uses on the same footprint or within the same buildings. Consequently, the levels of land-use mix in areas such as the central business districts of the cities will generally result in an underestimation of land-use mix values in these areas. The limited availability of land-use data for South African cities in three dimensions limits the possibility of this application within the current context. Secondly, the question of classification of detailed land-use categories into higher-level aggregated land-use classification schemes also presents some challenges that are in principle related to the modifiable areal unit problem of different levels of spatial aggregation. Thirdly, there is no official or commonly accepted definition of land-use categories deemed appropriate or suitable for inclusion in mixed land-use areas or nodes. The LUM index as applied in this article assumes that all land-use categories used in the analysis are deemed acceptable in mixed land-use areas. From a

⁶⁹ Fifthly, the results of the cluster-outlier spatial statistical analysis indicate that there is only limited spatial coincidence between the high-high clusters of increase in land use mix and the SDF focus areas, but high levels of coincidence between the SDF focus areas and the high-high clusters of growth in economic activity (commercial and industrial) density.

practical point of view it may however be necessary to exclude certain land-use categories such as some types of industrial, transport or utility uses from consideration in the measurement of land-use mix patterns. The definition of 'appropriate' land uses may also differ between cities, and from area to area within an individual city. Fourthly, it is recognised that any empirical analysis of urban structure, specifically land-use diversity, generally under represents the qualitative aspects within the range of indicators. There is a strong subjective element in the perceptions involved in the experience of density and land-use mix at a specific location (Burton, 2002:246). These subjective perceptions are not accounted for in the indicators used in this research.

Despite these methodological challenges, it is believed that the results presented in this chapter provide a robust point of departure for debate and a more rigorous analysis of land-use mix patterns and trends in South African cities. The findings suggest that the spatial focus areas largely follow established historical patterns of land use mix and conform more closely to the outcome of market forces and other trigger factors as described in Chapter 2 than reflecting planning responses targeted at the requirement for spatial restructuring as described in Chapter 3. The study results provide the foundation for relevant role-players such as city planning and management officials, policy-makers, academics, and other actors involved in city building to reflect critically upon the use and application of the objective to achieve increased levels of land-use mix in South African cities.⁷⁰ The type of land uses suitable for these identified mixed use areas will differ between cities and at different scales and localities within the same city. At least some indication is required of the intended dominant nature of the identified nodes and corridors (e.g. mixed residential focus, institutional focus, or commercial focus). In addition, at least some broad indications of the ideal balance between the various uses deemed appropriate within each type of node or corridor is required (e.g. what is the ideal proportion of different residential density types, social facilities, and commercial activities

⁷⁰ The first aspect is the relevance of the overall goal of increased levels of land use mix in predefined spatial areas. As described in Chapter 4, goal evaluation has been identified as one of the elements of a comprehensive spatial planning evaluation process. This evaluation of the relevance of spatial planning goals should be informed by diagnostic results, theoretical underpinnings in planning discourse, and its relevance at various spatial scales. The results outlined in this section reflect varied results in the achievement of increased levels of land use in the different cities analysed, and the role of spatial planning in influencing the location of these areas. The concept of land use mix implies a greater variety and equality in distribution of different land uses in spatially defined units. However, as discussed in Chapter 3, the locational decision making for different individual urban land uses is determined by a unique combination of triggers and processes. These triggers and processes operate in different combinations for different land uses and the same factors have different influences on alternative land uses. There are thus theoretically only a limited number of locations within cities where these forces and triggers operate in harmony to result in the co-location of a specified mix of land uses. Such areas thus have to be identified with a sufficient understanding of how these forces and triggers operate for each of the individual land uses earmarked for inclusion in these mixed land use areas. As illustrated by the results presented in this chapter, the mere spatial demarcation of mixed land use areas in spatial plans are unlikely to result in the planned land use mix within these targeted areas. The relevance of the goal of increased land use mix is also influenced by the scale of spatial planning. From a planning perspective it is likely to have the most significant impact at the level of detailed spatial planning and urban design of individual properties (or groups of properties) or street blocks where compatible land uses could be incorporated through detailed urban design. At increasing levels of spatial aggregation (such as neighbourhood, precinct, or city levels) the concept becomes increasingly difficult to operationalise due to the factors explained above. At these levels it will be necessary to provide a clear differentiation between different types of 'mixed use' envisaged at specific locations such as identified nodes or corridors.

within a specific node). This will also enable a normative evaluation of the levels of success of these instruments, based on a robust set of indicators as part of a spatial governance evaluation framework, suggested by the NDP.

8 CHAPTER 8: SUMMARY AND CONCLUSIONS

8.1 RESEARCH PROBLEM

South Africa's urban system accounts for 86.5% of the formal national economic activity, and by 2050 80% of the South African population will be living in urban areas. Although urban areas are the drivers of economic and population growth, they are characterised by a number of spatial characteristics mainly ascribed to historical colonial and apartheid urban policies. The notion of 'spatial transformation of cities' hence emerged as a key element of evolving spatial planning and policy after the transition into democracy in 1994. The key instrument embedded in spatial planning policy is SDFs at various scales. A multitude of SDFs and related spatial policies and plans were hence prepared and revised at municipal level since 1994. The quality and influence of these plans were however never adequately monitored and evaluated, and their influence remain unclear. This has led to claims that South African cities are continuing to reflect the spatial legacies of the past and that SDFs as the principal policy instrument to guide urban spatial development are not sufficiently effective to pursue the overall spatial planning goals as outlined in the NDP, SPLUMA and the IUDF. Despite these claims there is a paucity of empirical evidence to review the successes and failures of spatial plans, and hence a reliance on assumptions and anecdotal evidence. It is difficult for planners and decision makers to determine if the alleged lack of impact of spatial planning processes and spatial plans are the result of inappropriate processes and methods, pursuing the wrong goals and concepts, inadequate plan quality, or in fact failed implementation of the plans itself. The overall aim of this research is to establish the influence of spatial planning and spatial plans on urban structure in South Africa since 1994 through empirical analysis across a range of metropolitan and intermediate sized cities.

8.2 SUMMARY OF FINDINGS AND REFLECTION ON THE STUDY OBJECTIVES

8.2.1 Factors and processes influencing evolving urban form (Objective 1)

The literature review in Chapter 2 clearly indicated that the form and character of cities throughout the world are the result of the interaction of a range of interconnected demographic, social, cultural, economic, and ecological forces. These forces are influenced by the institutional and governance framework within which it functions and involve various resources such as land, natural resources, finance, and human capacity. These forces do not operate in isolation but within a system of interactions that are diverse and complex, and differ across time and at different spatial scales. At an urban scale demographic transitions such as the 'fourth migration' and the 'fifth migration' resulted in various intra-city population movements. The locational decisions of individuals are influenced by both push and pull factors, and are driven by the underlying concepts of productionism and environmentalism. At the scale of individual households, the social spatial organization process represents a tension between the need for individual privacy on the one

hand, and the desire to live in familiar environments and ‘belonging’ in identifiable neighbourhoods on the other.

From an economic perspective the demise of communism since the 1980s and the growing dominance of capitalism coincided with the emergence of globalisation. Globalisation fundamentally altered the understanding of cities from the traditional view as a central point linked to the market of a distinct hinterland, to one also recognising its role and function in wider global economic processes. The increasing international mobility of labour, money and goods created opportunities for industries and businesses to relocate production processes to countries (and cities within countries) with the most favourable set of production conditions. Changes in the organizational and management functions of firms also influence this global process of industrial restructuring. Production processes are increasingly located in newly industrialised countries, while the multi-national command and control functions and associated advanced producer services are retained in the international prominent cities of industrialized countries. Production cost escalations related to welfare economics and the introduction of stricter environmental controls also contributed to a decline in the profit levels generated from mass production, resulting in the evolution of many businesses to focus on more differentiated or targeted services niche markets as part of the transition to Post-Fordism. In addition, technological advances (especially in the field of ICT and transportation) has made certain segments of the labour market more geographically independent by allowing them- to live further away from work.

At the level of individual firms or households, the trade-off between land cost or rent (or housing costs) and transport costs as a manifestation of friction costs provides one of the fundamental drivers of urban structure. In principle, the land use that provides the highest revenue (also factoring in transportation cost) at a particular location will outbid all other uses. These mechanisms are however not only determined by market forces and social organization processes, but also influenced by historical path dependency (such as historical spatial planning ideologies in South Africa), and mediated through institutional processes such as land use planning, infrastructure investments decisions, and taxes. Spatial planning concepts and mechanisms such as building height controls and ‘urban growth boundaries’ can limit the lateral expansion of urban footprints, but with an accompanying increase in property prices.

These trigger factors, mediated through local conditions and historically specific settings, result in a number of key urban spatial organization processes such as agglomeration, decentralization, diversification, and flows within and between different human ecosystems. As outlined in Chapter 2 the distinction and relationship between the factors described as ‘triggers’ and those described as ‘processes’ are not always straightforward. The example used was the aspect of globalisation that can be considered as both a ‘trigger’ and a ‘process’, depending on the scale and focus under consideration. Migration can also be considered as a spatial structuring process resulting from a combination of triggers as described in Section 2.4. Migration can in turn however also be considered as a trigger factor contributing to spatial structuring processes such

as decentralization that can manifest itself in different urban elements such as the suburbanization of population, the decentralization of marketplaces, or the decentralization and suburbanisation of employment. The decentralisation of employment can in turn have different alternative outcomes ranging between dominant nodes in the form of Garreau's edge cities, dispersed nodal clustering in a limited number of major sub enters as postulated by the concept of polycentricity, or a more uniformly dispersed spatial pattern of employment distribution.

The interactions between the various triggers and the resulting spatial structuring processes summarised above and described in detail in Chapter 2 are diverse and complex, and differ across time and at different spatial scales. The trigger factors described in Section 2 can either individually (e.g. changes in demographic structure) or in combination (e.g. the interaction between demographic structure and advances in transportation technology) contribute to urban spatial structuring processes. These triggers and processes operate across various units of spatial analysis (such as housing markets, commuting zones, water catchment areas), at various spatial scales (e.g. suburb, city, city region/region, national, global), and their influence and impact are not static, but changes over time.

The use and application of energy sources in an urban system provide a good example of the complexity of these interactions. Trigger factors such as increases in international commodity prices of coal and crude oil, and changing global perceptions on sustainable development can initiate a range of processes at different scales and across various time periods that have a direct influence of urban spatial development patterns. At a local neighbourhood scale these triggers could result in shorter term impacts and responses such as the increasing use of alternative energy sources (e.g. solar energy) and increasing attention to detailed urban design principles such as orientation of stands and buildings to minimise energy use for heating and cooling purposes. It could also contribute to an increase in the use of public transport in response to rising transport costs. At a city scale the property market is likely to respond to the increasing attractiveness of properties in closer proximity or with better access to public transport nodes and facilities. At a city region scale the suitability of land for facilities such as wind farms and the resulting impact thereof (both positive such as reduced carbon footprint, and negative such as visual intrusion) could influence longer term spatial development patterns. Ultimately, both the local level and city-region factors cumulatively influence global processes such as climate change.

The opposite is also true with changing global perceptions on sustainability and resilience influencing local scale processes such as reducing ecological footprints at a household, neighbourhood and city scales. Global goals such as the need to reduce the carbon footprints of countries and cities are translated into local planning discourse influencing spatial development. Spatial planning goals such as increased public transport use and reduced private travel, supported by planning concepts such as higher population densities focussed along specific corridors to support viable public transport systems will increasingly dominate local spatial planning agendas. The role and influence of these factors are also likely to change over time. The

reduction in unit costs of renewable energy sources is likely to result in the increased use thereof at an urban level, and as a consequence, the location of urban development will become less dependent and influenced by the availability of, and access to, bulk energy infrastructure networks. This in turn will affect the relevance of spatial planning concepts such as urban development boundaries and infill development and may diminish the influence of these concepts and the emergence of others with greater prominence.

The example outlined above illustrates the effect of only a single trigger factor (from the vast array of possible permutations of triggers and processes discussed in Chapter 2) and its associated potential influence on spatial structuring processes. It also illustrates the varied influence on different scales and over different time periods. The implication for spatial planning (and spatial planning and spatial plan evaluation processes) is that alternative spatial goals and spatial proposals have to be comprehensively evaluated against the full and complex set of potential influencing factors and associated likely outcomes. Locally optimal solutions may thus not necessarily represent the best long-term urban planning solution, and imply a change in approach from identifying interventions based on current situations to a mode of planning that considers time, rate of development and direction of progress.

A more subtle, but equally important finding from the aspects discussed in Chapter 2, is the manner in which global planning discourse influences local urban spatial planning processes and outcomes. Of particular interest is the Los Angeles school of urban theory grounded in the postmodernist paradigm, and the Baltimore school of urban ecology. As discussed in Chapters 2 and 4, the postmodernist view of cities is particularly concerned with the manner in which popular societal attitudes towards specific social and cultural groups (such as ethnic or lifestyle, single parent households, unemployed, disabled) can influence underlying patterns of spatial development in cities. The Los Angeles school rejects the idea of completely separated urban functions in favour of neighbourhoods with a 'balanced mix' of functions and land uses, and with a strong emphasis on pedestrian orientation and transit-oriented transportation corridors. The Los Angeles school considers the modernist view of cities separated according to land use and class as characterised by social injustices. The overall vision of the Los Angeles school is thus to enhance social and economic equality and contribute to increased social integration. The ultimate goal of urban planning is thus greater social justice. When considering the five overall principles for spatial planning in South Africa as outlined in SPLUMA, this goal of the Los Angeles school specifically resonates with the principle of 'spatial justice' concerned with redressing issues such as development imbalances, the inclusion of previously excluded areas and persons in spatial planning processes, and land use management systems that specifically include disadvantaged areas and communities.

The Baltimore school of urban ecology also recognizes social systems as a key element, but views cities as integrated ecosystems consisting of biotic, physical, social, and built components jointly forming a complete mosaic of land uses in urban systems. As discussed in Chapter 2 the Baltimore school became prominent in urban planning theory as a result of long term ecological research projects over a period of

more than 20 years that commenced in 1995. One of these long terms ecological research projects included the Baltimore Ecosystem Study. The growing levels of knowledge resulting from urban ecological studies, together with increasing global levels of global urbanization contributed to the mounting interest in urban ecological systems. In parallel and roughly over the same period the concept of ‘sustainable development’ became increasingly dominant in international planning and development discourse. This concept gained significant momentum since the report of the World Commission on Environment and Development (the Brundtland report) in 1987 that proposed sustainability as a new integration of poverty alleviation and environmental improvement. This was followed by Agenda 21 as the UN action plan for sustainable development in 1992, and the more recent 2030 Agenda for Sustainable Development adopted in 2015. A specific focus also developed around sustainable urban development spearheaded by the work of the United Nations Human Settlements Programme and the various UN global summits from Habitat I in 1976 to Habitat III in 2016. These summits developed global commitments to sustainable urbanization and urban development. Extensive policy guidelines have been developed and the most recent New Urban Agenda that emanated from Habitat III includes ten detailed policy units, including focus areas such as urban spatial strategies, right to the city for all, and urban ecology resilience.

The urban ecological approach of the Baltimore school, together with the growing prominence of the concept of sustainable urban development thus extended the key concerns of urban theory beyond the social integration focus of the postmodernist Los Angeles school to also include critical ecological resources and global sustainability issues. In addition to impacts at an urban level, many of these impacts are global in nature and are of particular concern for international consideration. The impact of urban spatial structure on global issues such as climate change and international ecological footprints resulted in spatial planning goals and concepts such as compact development and densification, a focus on transit oriented development and public transport, and socio-economic integration becoming critical elements in local urban spatial planning. Urban spatial planning is thus increasingly becoming a vehicle for addressing a broader international agenda aimed at globally contentious issues such as reducing ecological footprints and addressing climate change. In the South African context this is clearly manifested in the three SPLUMA principles of spatial sustainability, efficiency, and spatial resilience.

8.2.2 South African spatial planning doctrine (Objective 2)

The impact of the triggers and forces on urban form is mediated through local and historically contingent factors. These factors are of particular relevance in the South African context where urban growth and development were substantially influenced by two historical processes. The first is the pre-1948 colonial legacy that first introduced structural segregation of towns and cities in the period after the 1850’s and coincided with the rise of the age of imperialism. The second is the post-1948 apartheid planning system that shaped policies and legislation such as the various versions and amendments of the Group Areas Act. The ultimate goal of this act was the establishment of separate areas for exclusive occupation by different

race groups and manifested itself at two levels. Firstly, at an urban systems level, policies were aimed at decentralizing and deconcentrating employment at the macro level and to limit access of the African population to cities. At individual city level the aim was to develop cities according to different racial areas. Apart from influencing the normal social and economic factors at play in urban development, the Group Areas Act also resulted in direct interventions such as large-scale forced removals and township development in so-called ‘group areas’ mostly located at peripheral urban locations. It also used physical characteristics in the urban landscape to create designated ‘border strips’ to act as barriers and ensure physical separation between different group areas. The outcome of both the colonial and the post-1948 apartheid city policies is a distinct set of characteristics attributed to South African cities commonly referred to as the ‘apartheid city’. These characteristics include a segregated and fragmented spatial form, peripheral location of low income settlements resulting in unequal access to economic and social opportunities, social segregation, urban sprawl, and low population densities.

The notion of ‘spatial reconfiguration of cities’ hence emerged as a key element of spatial planning policy in South Africa after 1994. The analysis of this evolving policy and legal framework identified a number of common spatial planning goals and concepts that are entrenched in national policy and legislation spanning over a period of more than 20 years and that have been widely applied in the SDFs analysed in this study (Cape Town, Johannesburg, Tshwane, and eThekweni, Bloemfontein, Pietermaritzburg, Witbank and Nelspruit). This doctrine (or principle of spatial outcomes) can be summarised as follows:

- Long term vision: Reconfiguring historically distorted spatial patterns
- Long term outcomes: Compact, sustainable and productive cities
- Medium term outputs: A greater mix of land uses, increased population densities and access to economic opportunities, and improved public transport systems
- Implementing spatial concepts: A network of nodes and corridors.

This spatial planning doctrine is well established in national policy and legislation, and is widely applied in the municipal SDFs of the cities that have been analysed. An assessment of this long term vision of ‘spatial configuration’ against the reality of the triggers and processes driving evolving urban form as described in Chapter 2 identified a number of important implications for urban spatial planning. Firstly, spatial plans to drive ‘reconfiguration’ are likely to yield the best results if approached from a neighbourhood or precinct level, instead of higher city level plans. Although consistent interventions are required at various scales, the real success of ‘reconfiguration’ will be determined at local neighbourhood level. Secondly, a considerable proportion of South African cities on face value reflects a ‘fragmented’ urban structure with widespread occurrence of undeveloped areas. In practice, a significant proportion of these undeveloped parts of the urban footprints are however influenced by physical constraints such as historic and current mining activities, ecologically sensitive areas, topographic and other physical constraints. These locally contingent factors have a significant impact on the relevance and applicability of widely supported normative planning concepts such as compact development, increased population

densities, and a greater mix of land uses to implement the ‘reconfiguration’ vision. Thirdly, spatial plans and policies based on a limited number of simple rules or principles, rather than complicated ‘integrated’ plans, are most likely to produce persistent and systematic patterns aligned with the vision of ‘reconfiguration’. There are two preconditions for the successful implementation of this concept. The first precondition is that the rules and principles have to operate through some ‘trial and error’. The second precondition is the need for a rigorous process of ongoing evaluation and feedback to assess the effect of the established basic principles. A fourth relevant aspect related to the vision of ‘reconfiguration’ is the impact of the quality and effectiveness of the spatial planning system. The availability (time and resource wise) and quality (skills levels) of human resources available in the planning system determines the complexity of spatial planning processes that can be successfully dealt with, and the quality of outputs and outcomes from spatial planning processes. This implies that complex urban systems cannot be successfully controlled or influenced by a planning system (and operating environment) without the necessary level of sophistication.

8.2.3 Theoretical and methodological foundations of spatial planning evaluation

(Objective 3)

The analysis of the main paradigm shifts in procedural planning theory described in Chapter 4 concluded that there are no strictly defined impermeable boundaries between the identified paradigms and its associated theories of spatial planning, and that most spatial planning processes contain some elements of the dominant orientations from more than one or all of the identified paradigms (see Figure 4.2). No successful spatial planning process can be based on only (or mostly) one of these approaches. This analysis further revealed that aspects often presented as elements of a planning process or application can in fact be more closely associated with fundamental planning theory. What also transpired from the transitions between the different planning paradigms is that, despite the approaches inherent to each paradigm having been improved through subsequent later developments, the critical elements of the original approaches have been maintained and remained an essential part of contemporary spatial planning practice. Most spatial planning processes, either implicitly or by design, recognise the complexity within local urban systems and sub-systems nested in interrelationships with other systems at various scales.

Based on the analysis of procedural planning theory, a set of principles for developing a methodological framework for comprehensive spatial planning evaluation was identified in Section 4.5. The evaluation of the current official guidance for spatial planning evaluation and monitoring in South Africa as described in Section 4.6 found that the current procedure for preparing municipal SDFs only makes provision for monitoring and evaluation activities and deliverables during the spatial plan preparation process. The current procedure is clearly insufficient to provide a suitable methodological approach for comprehensively evaluating the influence of spatial plans and policies on urban development processes and outcomes. A comprehensive spatial planning evaluation methodology was hence developed using the identified

principles as point of departure. The proposed methodological framework (see Figure 4.5) identified a flexible and modular approach to spatial planning and spatial plan evaluation consisting of eight components:

- Contextual evaluation
- Evaluation of operational environment quality
- Goal evaluation
- Plan alternative evaluation
- Plan quality evaluation
- Ex ante planning quality evaluation
- Ex post plan performance evaluation
- Ex post plan conformance evaluation

8.2.4 Key trends in the urban structure of South African cities since 1994 (Objective 4, component 1)

The analysis of changes in urban structure focussed on two of the most prominent goals of the post-1994 spatial planning doctrine: compaction and densification (analysed in Chapter 6), and spatial and land use integration (analysed in Chapter 7). The results confirmed modest increases in net population densities since 1994 in all eight cities analysed, ranging between 1.4 persons/ha and 15.1 persons/ha. The growth rates of the residential built-up footprint generally far exceeded the growth of the total built-up footprint and continued to increase as a proportion of the total footprint over the period of study. The growth patterns of the four larger metropolitan cities are distinctive with relatively low levels of physical growth (generally below 2% per annum) at distances up to 20 km from the city centre, and areas of most rapid physical growth at distances between 20km and 30 km from the city centre at levels between 3% and 4% per annum. In the smaller intermediate sized cities, physical growth is largely concentrated at peripheral locations of the urban structure. The results indicate that, although historical city centres still dominate the South African urban landscape, a more decentralized structure is emerging with the focus areas of most significant physical growth at increasing distances from the historical city centres.

The relevance of the double linear density model to the South African cities analysed are varied. Some cities like Bloemfontein and Nelspruit reflect the normal double linear model, whilst others (including Cape Town, Durban, and Pretoria) corresponds with the traditional model with a negative central gradient, but with a gradual increase in density from the breakpoint towards the periphery (positive gradient) instead of the normal gradual decrease. These patterns are indicative of the persistence of a spatial structure dominated by higher densities at peripheral locations. A further variant of the model (for example Bloemfontein) can best be described as an inverse double density gradient model, characterized by a relatively gradual decrease in density on the central gradient, followed by the more rapid decrease in the peripheral gradient. A comparison of the 1994 and 2009 models confirmed that the distance from the city centre to the breakpoint

has remained largely unchanged over the study period, and that the slopes of the central gradients displayed only marginal increases over the same period.

The density analysis at a more spatially disaggregated level as reflected in Annexure B indicates that the changing population density trends in the four largest metropolitan cities analysed cannot exclusively be viewed as decentralization. There are indications of population density increase occurring in and around the traditional central city areas. In the case of Johannesburg, Tshwane and eThekweni there is clear evidence of increases in population density in and around the traditional CBD areas, as well as widespread increases in decentralised suburban locations. These trends in the four metropolitan cities support Soja's (2000) argument of a growing convergence between urban and suburban densities and monocentric metropolises transformed into polycentric regional cities, as well as Bruegmann's (2005) contention that densities in many cities are actually rising at both the centre and at the edges. These trends are not evident in the four smaller intermediate sized cities analysed.

The levels of land-use mix in the four metropolitan cities are higher than in the intermediate-sized cities, both in terms of intensity-based and pattern-based land-use mix indicators. Only marginal changes in the overall levels of land-use mix have been identified between 1994 and 2009/10 in all eight cities. This implies that city structure as expressed by land use mix indicators change relatively slowly over time. A notable trend over the study period has been the increase in land-use mix in some historically low-income suburbs that formed part of the national URP. This may be indicative of the positive influence of this area-based programme on these areas in the post-1994 era, facilitating the provision of a wider range of social and commercial facilities in these areas resulting from both focused public-sector intervention and increased private-sector investors' confidence. The changes in land-use mix are however not equally prominent in other large low-income suburbs not benefitting from this programme.

8.2.5 Evaluation of spatial plan quality and spatial plan success (Objective 4, component 2)

The evaluation of urban spatial plan quality described in Chapter 5 indicated that the latest generation of spatial plans analysed as part of this research reveal improved horizontal and vertical alignment of spatial planning processes between adjacent municipalities, and between different spheres of government. The integration of sustainability principles into spatial planning processes and SDFs also showed positive progress. The SDFs of the metropolitan municipalities evaluated only revealed limited progress in the analysis and understanding of the urban space economy, and the introduction of innovative measures to improve the alignment of infrastructure development and capital investment with spatial planning. However, very little progress is evident with the other challenges. Despite the principle of physical and socio-economic integration remaining central to the spatial planning policy agenda since 1994, it has been one of the identified areas of concern showing very little substantial progress in the SDF contents. This also

applies to the informal sector which still remains largely marginalised from the mainstream spatial planning processes, and the use of indicators and quantified targets to monitor implementation and impact being absent from most urban spatial plans that were evaluated.

Chapters 6 and 7 evaluated the influence of SDFs on guiding the spatial transformation of the cases between 1994 and 2011 in terms of two of the prominent goals of the post-1994 spatial planning doctrine: compaction, densification and spatial and land use integration. The analysis results indicate generally low levels of conformance between the SDF focus areas, and the areas of highest population density increase. The total population growth rate (1996 to 2011) in the SDF focus areas only exceeded the total overall city level population growth rate in one of the eight cities analysed (Cape Town). Moreover, the population density increases within the SDF focus areas in only three of the eight cities studied (Cape Town, eThekweni and Nelspruit) were higher than the overall city level density increases. Although the population densities in the other five cities also increased somewhat within the SDF focus areas, these increases were lower than the comparative city level figures and represent only modest increases ranging from 1 person/ha in the case of Pietermaritzburg to 8.1 persons/ha in Tshwane. An analysis of the statistical significance of the observed spatial patterns revealed two important observations. Firstly, in the case of Tshwane, Johannesburg and eThekweni it confirmed the occurrence of statistically significant spatial clusters of high population density increases occurring in both the historical city centres as well as in a number of clearly defined suburban nodes. Secondly, in the case of Tshwane and Johannesburg it confirmed low levels of conformance between the SDF focus areas and the clusters of high population density increase, and only moderate levels of conformance in the case of Cape Town and eThekweni.

Both the intensity and pattern-based indicators of land-use mix revealed higher levels of historical land-use mix within the SDF focus areas compared to overall aggregate city-level figures. However, when only considering the levels of change in land-use mix between 1994 and 2009/10, the areas with the most significant increases show only limited correlation with the focus areas defined in the SDFs. The results of the cluster-outlier analysis of land use mix index (LUMI) changes over the study period for the four largest metropolitan cities also indicated limited spatial concurrence between the high-high clusters of LUMI change and the SDF focus areas in the case of Tshwane, Johannesburg, and eThekweni. The levels of spatial coincidence in Cape Town is somewhat higher than in the other three metros but can still at best only be described as moderate. The levels of concurrence in the four intermediate sized cities are generally also very limited. However, when considering only the growth of economic activity density (commercial and industrial activities) over the study period, a very different pattern emerges. In this instance, there is clearly high levels of coincidence between the identified SDF focus areas and the high-high clusters of growth in economic activity density. This would suggest that the SDF focus areas had a clearly recognizable positive influence on the location of new economic activities over the study period.

8.3 VALUE AND CONTRIBUTION OF RESEARCH

8.3.1 Contribution towards theory and planning concepts

The theoretical analysis provided in Chapter 2, together with the findings of the empirical analysis outlined in Chapters 6 and 7 provide some alternative viewpoints on the relevance and application of the concepts of compact city structures and increased population densities, and establishing a greater mix of land uses.

As far as the notion of **compact city structures and increased population densities** are concerned the results of this research indicate that there is clear evidence of widespread increases in population density in decentralised suburban locations, as well as in and around the traditional CBD areas in the metropolitan cities analysed. These findings confirm elements of Mumford's (1925) 'fourth migration', as well as Fishman's (2005) concept of a 'fifth migration' in some of the cities analysed in this study. These patterns are also influenced by factors such as advances in ICT and transportation resulting in certain segments of the labour market becoming more geographically independent. At an intra-urban level many households value aspects such as proximity to open space and scenic landscapes, and will be willing to pay for these attributes in lower density parts of cities. Others will be seeking locations optimising access to potential economic opportunities, often in closer proximity to inner-city areas. Spatial planning policies can thus not only make provision for the latter and ignore the spatial implications of processes associated with the concept of environmentalism. The functioning of the bid-rent concept also results in situations where, due to land prices, affordable housing is often developed at decentralised locations on cheaper land – an outcome in direct contrast to the notion of compaction and densification.

The interplay of these market forces are however not always that simple. Although lower income housing is often forced to peripheral locations due to land prices, factors such as increasing transportation costs increasingly compel poorer households with limited ability to spend on transportation to seek out locations with easy access to employment and services. This results in poor people living in city centres at very high densities (and often of poor quality), and not only at peripheral locations on cheaper land. This does not only take the form of planned high-density residential buildings, but also some derelict industrial and commercial buildings that might or might not have been converted for residential purposes (often informally and/or illegally). The requirements of different groups at inner-city locations further complicate this matter. For lower income groups affordability will be the dominant consideration. This implies service standards, levels of design, and maintenance very different from that of middle and higher income groups. Lower income groups will also require access to subsidised social facilities such as health and education facilities. In contrast, middle- to high income groups require more generous space standards, higher levels of security, and high quality social and retail facilities nearby (Turok 2011). The different goals of local governments of accommodating low-income groups whose choices are limited by affordability constraints, attracting middle- and high-income families with a choice of where to live, and providing flexible space for business and related activities also present a complex decision making environment. These intricacies imply

that the concept of spatial planning aimed at compact city structures and increased population densities in specific locations cannot assume a simplistic ideologically driven view, but has to recognise the different factors and processes operating at various scales in cities and resulting in different outcomes. The oversimplified application of popular spatial planning concepts such as urban development boundaries and zoning mechanisms to limit the lateral expansion of urban footprints can also lead to unintended results. For instance, the popular short-term impact of these types of instruments could be that population growth will mostly take the form of development within the existing urban footprint. However, resulting upward pressures on land prices could, over the longer term become strong enough to cause ‘leapfrog’ development outside the urban edge. The short-term benefits of such policies may thus in the longer term have the opposite effects than originally intended.

The overall goal of establishing a **greater mix of land uses** is mainly informed by the postmodern view of new-urbanists that the spatial segregation of functions is an outdated idea. These neighbourhoods should ideally be characterised by a ‘balanced’ mix of uses and functions such as dwellings, places of employment, retail facilities, parks, and social institutions in a single neighbourhood. Although there are undoubtedly elements of this view that are applicable in the South African urban context, there are a number of factors to consider when determining their relevance in individual local contexts. As eluded to earlier, people in cities across the world prefer to live in small and identifiable places such as specific neighbourhoods or urban precincts where they feel intuitively most comfortable. This implies a limit to the level of ‘land use mix’ that would be tolerable at a neighbourhood or precinct level, before processes such as invasion and succession as described in Chapter 2 will start to modify the planned character of a precinct. One of the arguments in support of an increased mix of land use, and the idea of relatively self-contained neighbourhoods is the co-location hypothesis. This hypothesis assumes that conditions of greater employment-housing balance at a local level will result in decreases in congestion. This assumption is however not that clear and as indicated in Chapter 2 the results of empirical studies revealed divergent views on this matter. The theoretical principle of a greater balance between employment and housing at a neighbourhood scale (and a key element of the concept of mixed land use) assumes an overly simplistic assumption that individuals will necessarily have the desire and ability to be employed at the most accessible local employment opportunities, and will prefer to use local commercial and social facilities. However, as discussed in Chapter 2 and in Section 3.3.5, the locational decision making of individuals and households are much more complex than this simplistic assumption, and is influenced by a wide range of interacting triggers and spatial structuring processes.

A third theoretical contribution of this study is the confirmation that there are no strictly defined, impermeable, boundaries between the different **paradigms of procedural planning theory**. There is a general tendency in planning literature and planning practice for planners that are fundamentally aligned with one of these dominant paradigms to create caricatures of planners, or planning processes, fundamentally anchored in one of the alternative paradigms. The analysis provided in Chapter 4 however

convincingly established that no successful spatial planning process can be based on only (or mostly) one of these approaches. What this analysis also revealed is that aspects often presented as elements of a planning process or application can in fact be more closely associated with fundamental planning theory rather than merely procedural planning theory. The different paradigms described in Chapter 4 do not represent a strict chronological sequential development of procedural planning theory, but do provide a clear indication of gradual transitions between the dominant paradigms. What clearly transpired from these transitions is that, despite the approaches inherent to each paradigm, having been improved through subsequent developments, the critical elements of the original approaches have been maintained and remained an essential part of contemporary spatial planning practice.

A fourth theoretical contribution of this research is the **refinement of the double-linear density model of urban built-up space**. The population and built-up densities of cities are generally measured by exponential or power functions based on the principle of a continuous gradient of decreasing built-up densities. Existing literature identified two areas of criticism against these traditional exponential or power functions. Firstly, the urban forms of many cities are characterized by a significant break in the value of built-up densities instead of a progressive decrease. Secondly, abrupt breaks in the built-up density profiles of cities can be more adequately described by a double linear adjustment than negative power or exponential fits. In response to these criticisms Guerios & Pumain (2008) introduced a double linear function as an alternative measure of urban built-up density. This double linear function differentiates between central and peripheral gradients of built-up surfaces (Guerois & Pumain 2008) and is based on the notion of a strong urban centre and its influence on the organisation of space at different gradients from centre to periphery. The key characteristics of this model include a central plateau represented by the first few kilometers around the urban centre with a highly saturated built up pattern, followed by a central gradient beyond this threshold with a rapid decrease of built-up form in urban space. The peripheral gradient from the breakpoint towards the periphery reflects a fairly gradual and uniform decrease in built-up form. The results presented in Chapter 6 identified five distinct variations of this double-linear density model of urban built-up space model (Figure 8.1).

The first variant is the normal single linear model describing a negative relationship between increasing distance from city centre and built-up density. This model is applicable to Johannesburg (1994 and 2009 data) and Pietermaritzburg (1994 and 2009) and reveals no distinct central and peripheral gradients or a clear breakpoint. The second variation is the normal (negative) double linear model with a rapidly decreasing central gradient, and peripheral gradient reflecting a fairly gradual and uniform decrease. This pattern was identified in Nelspruit (1992 and 2009) and in Witbank (1994 and 2010). The third variation is a negative inverse double linear model that exhibits a bi-modal density pattern characterized by a relatively gradual decrease in density on the central gradient, followed by the more rapid decrease in the peripheral gradient (applicable to Bloemfontein 1994 and 2008). This is indicative of high levels of saturation of the urban built-up pattern in close proximity to the traditional city centre.

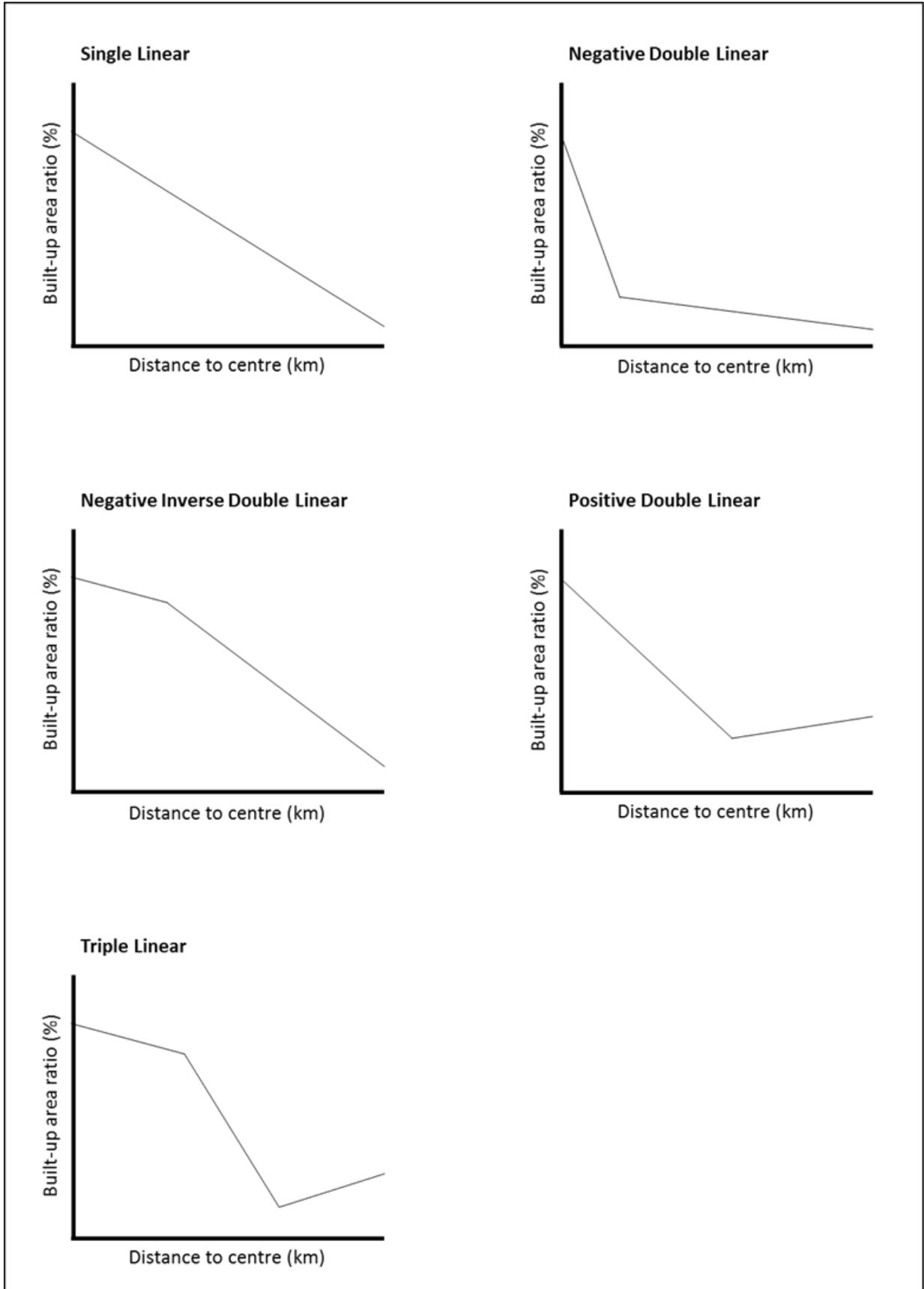


Figure 8.1: Variations of the double-linear density model of urban built-up space

The fourth variant is a positive double linear model and is characterised by a decrease of the central gradient and a gradual increase in density from the breakpoint towards the periphery, instead of the normal further gradual decrease in density (applicable to Durban in 1994 and Pretoria in 1994 and 2009). This spatial pattern can be explained by the dominance of large and growing developments on the periphery of the cities. The fifth variant is the triple linear model and is characterized by a relatively gradual decrease in density on the central gradient, followed by a more rapid decrease in the first peripheral gradient, and a gradual increase in built-up density in the second peripheral gradient. This more complex model was identified in Cape Town (1993 and 2009) and Durban (2009). This variant can be the consequence of a number of factors. The first factor is complex intermediate zones resulting in uneven central gradients that obscure the transition between the central and peripheral gradients. A second factor is large scale high density settlements originally planned at peripheral locations but increasingly being assimilated in the urban structure as a result of a rapidly growing urban footprint, and continued development occurring at peripheral locations. The analysis included two time periods in each of the eight cities. Increasing the number of time periods within the analysis could enable the identification of potential regularity in the sequence in which these profiles may change over time in a single city. This could open up the possibility to associate specific sequences with a generalized set of historically contingent factors and spatial planning interventions.

8.3.2 Contribution towards practice

The research results contribute towards spatial planning practice in the fields of a proposed spatial planning evaluation methodology, the implementation and integration of this methodology into the broader SDF preparation and review process, suggested improvements for spatial plan quality, the identification and application of innovative spatial analysis techniques in support of spatial planning, and some practical guidelines for operationalising the concept of land-use mix in spatial planning.

The comprehensive **methodology for evaluating the influence of spatial plans** provides a methodology that is sufficiently robust to accommodate different spatial planning approaches. The proposed methodological framework (Figure 4.5) outlines a flexible and modular approach to spatial planning evaluation and describes various evaluation components, the methods that could be applied in each component, and the type of indicators associated with each evaluation component. The overall evaluation framework consists of eight components:

- Contextual evaluation
- Operational environment quality evaluation
- Goal evaluation
- Plan alternative evaluation
- Plan quality evaluation
- Ex ante planning quality evaluation
- Ex post plan performance evaluation
- Ex post plan conformance evaluation

This proposed methodological framework provides a robust guiding framework for engaging in the process of spatial planning evaluation and can be applied either comprehensively or selectively in a modular approach, depending on the objectives of the evaluation process and the governing circumstances. For example, if the focus of the evaluation process is on the role and contribution of the quality of the plan in achieving the plan outcomes then the focus will be on the plan quality evaluation component and the plan conformance evaluation component. However, if the primary purpose of the evaluation is to evaluate the contextual and operational factors influencing the plan outcomes, then the selected focus will be on the contextual evaluation component, operational environment quality evaluation component, and ex post plan conformance component. The individual components within this framework can thus either be applied individually, or in selected combinations, or in totality based on the requirements of individual circumstances.

The second main contribution is a suggested **framework to incorporate the proposed spatial planning evaluation methodology into the existing prescribed SDF preparation process**. The official guidelines for the preparation of municipal SDFs describe a timeframe of five years for SDF preparation and implementation. The overall suggested timeframe from inception of the process to final adoption of the SDF is approximately 16 months. As indicated on Figure 4.4 in Chapter 4, the process within this 16 month period makes provision for various activities related to monitoring and evaluation (activities ME1 to ME5 in Figure 4.4). These monitoring and evaluation activities and deliverables are however limited to the spatial plan preparation process, and do not reflect any evaluation aspects relating to the organizational structure or operational environment within which spatial planning operates, the interrelationship between different sub-systems and actors, or the evaluation process subsequent to plan approval during the implementation phase.

In response to this deficiency the proposed methodology outlined in Section 4.5 provides a comprehensive spatial planning evaluation methodology of various individual and combined stages of the spatial planning process and its outcomes. The practical challenge is to incorporate this methodology outlined on Figure 4.5 into the broader overall SDF preparation and review process as prescribed by official guidelines and legislation. The schematic structure depicted in Figure 8.2 hence provides a guiding framework to integrate the evaluation methodology with the stages of the overall SDF process.

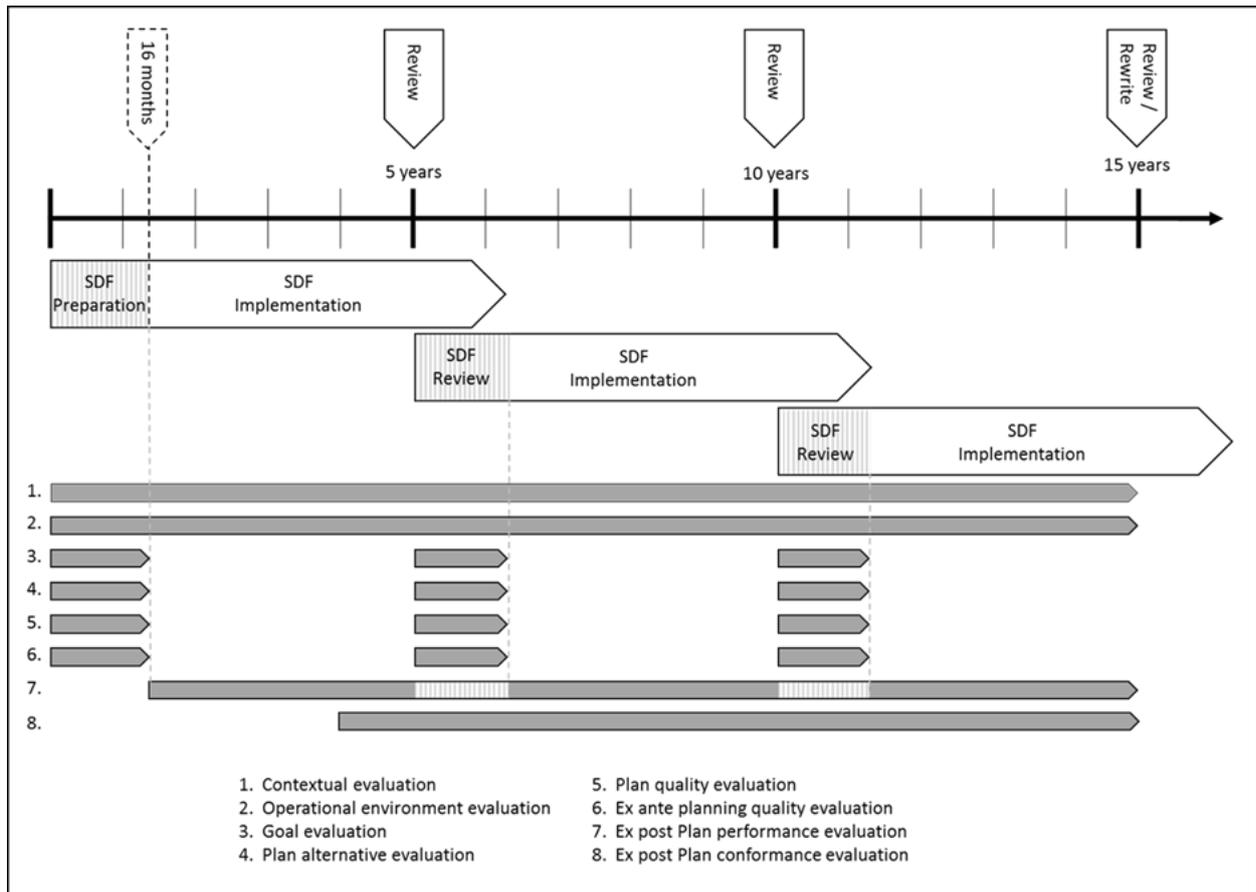


Figure 8.2: Incorporating the proposed spatial planning evaluation methodology into the overall SDF process

A third contribution of this research is the identification of the potential **deficiencies of existing SDFs** as identified in Chapter 5 and recommendations to address these deficiencies. The spatial plan quality evaluation indicated that the majority of urban spatial plans remain devoid of any comprehensive spatial analysis of the urban economic space and the spatial analysis of market and investment trends. The analysis of urban economic space and market and investment trends should be guided by the factors and triggers identified in Chapter 2 and through the application of analysis techniques eluded to in the following paragraph. The findings of Chapter 5 also indicate that the integration of infrastructure development and capital investment strategies with spatial development planning is largely unsatisfactory. The infrastructure and capital investment requirements associated with SDF proposals should be more fully unpacked and presented in SDFs and linked to the municipal IDP process. Although SDFs generally contain clearly defined sustainability principles to guide the SDF proposals, most SDFs do not translate these principles into quantifiable sustainability indicators and targets that can be used for measuring the impact and success of the SDFs. The informal sector largely remains unrecognised in spatial planning, and SDFs generally do not reflect any clear spatial proposals for the informal sector in its future spatial development proposals. The informal component of South African cities is likely to remain an inherent component of the urban landscape in the foreseeable future, and will require more specific and detailed attention in SDFs. The

review of the SDFs established very little evidence of the application of spatial analysis techniques, and the identification of indicators and targets to evaluate the aggregate influence of spatial strategies and proposals. The proposed evaluation methodology can potentially remedy this shortcoming. In addition to the standard approach of ensuring that SDFs comply with all legislative requirements (e.g. SPLUMA and the Municipal Planning and Performance Management Regulations), the overall quality of SDFs should also be assessed against the general principles of good spatial plans as identified in Chapter 4:

- a clear identification of issues important to communities and stakeholders;
- a strong empirical base leading to evidence based issue identification and evidence informed policies;
- internal consistency among issues, goals, objectives, and policies; and
- clearly identified processes and indicators for monitoring plan performance and plan conformance after formal adoption of the plan itself.

These characteristics of ‘good plans’ resonate directly with principles 1.3, 1.4, 2.2 and 2.3 identified in Section 4.5.

The fourth main contribution of the research to practice is the **identification and application of innovative spatial analysis techniques in support of spatial planning**. The various indicators and spatial analysis techniques described in Chapters 6 and 7 can significantly improve the understanding of the key elements of the spatial planning doctrine within individual cities, and be applied to evaluate the influence of SDFs on the implementation of these elements. This will provide a much stronger analytical and technical basis for spatial planning than has generally been the case up until now. In general, far less knowledge exists on urban form at an overall metropolitan level than at intermediate or lower levels of spatial aggregation. For analysis and monitoring purposes it is therefore imperative to include appropriate measures of overall urban form (‘global statistics’) in addition to the more widely used indicators at lower levels of spatial integration (‘local statistics’). The full impact of spatial policies and plans on urban form should thus be judged based on a comprehensive and multi-dimensional evaluation at various scales and across various timeframes. The application of spatial statistical analysis techniques such as the Anselin Local Moran’s I technique (‘cluster-outlier analysis’) in particular can add significant value to the SDF process and products. As illustrated in Chapters 6 and 7 the application of this technique adds the dimension of statistical significance to observed spatial patterns. High positive local Moran I values imply that the unit under analysis has similar high or low values as its neighbours, and can therefore be regarded as spatial clusters. A high negative local Moran I value means that the value of the unit under analysis is different from the values of their surrounding locations and that the location under study is a spatial outlier. The identification of such clusters and outliers can make a very meaningful contribution to the development and evaluation plan alternatives during the SDF preparation process, and in the evaluation of plan success during the implementation phase.

A fifth contribution of the results of this research to practice is in the form of some guidelines to operationalise the concepts of **integration and increased land-use mix in spatial planning**. The results

presented in Chapter 7 illustrated that the mere spatial demarcation of mixed land use areas in spatial plans are unlikely to result in a significant increase in land use mix within these targeted areas. The identification of areas for increased land use mix should thus not be based on intuitive proposals based on historical trends, but be informed by diagnostic results, considering the theoretical underpinnings in planning discourse, and its relevance at various spatial scales. The concept of land use mix implies a greater variety and equality in distribution of different land uses in spatially defined units. Locational decision making for different individual urban land uses is however determined by a unique combination of triggers and processes alluded to in Sections 2.2, 2.3 and 2.4. These triggers and processes operate in different combinations for different land uses, and the same factors have different influences on alternative land uses. There are thus theoretically only a limited number of locations within cities where these forces and triggers operate in sufficient harmony to result in the co-location of a specified mix of land uses. These areas can only be successfully identified with a sufficient understanding of how these forces and triggers operate and how they influence the individual land uses earmarked for inclusion in mixed land use areas. The relevance of the goal of increased land use mix is also influenced by the scale of spatial planning. From a planning perspective it is likely to yield the most significant impact at the level of detailed spatial planning and urban design of individual properties (or groups of properties) or street blocks where compatible land uses could be incorporated through detailed urban design. At increasing levels of spatial aggregation (such as neighbourhood, precinct, or city level) the concept becomes increasingly abstract and difficult to operationalise due to the factors explained above. At these levels it will be necessary to provide a clear differentiation between different types of 'mixed use' envisaged at specific locations such as identified nodes or corridors. The type of land uses suitable for the identified mixed use areas will differ between cities and at different scales and localities within the same city. Spatial plans should thus at least provide some indication of the intended dominant nature of the identified nodes and corridors (e.g. mixed residential focus, institutional focus, or commercial focus). In addition, at least some broad indications of the ideal balance between the various uses deemed appropriate within each type of node or corridor, is required (e.g. what is the ideal proportion of different residential density types, social facilities, and commercial activities within a specific node).

8.4 LIMITATIONS OF STUDY AND POSSIBLE FURTHER RESEARCH

Despite the value of the research as outlined above it is also necessary to be sufficiently reflective on the results and findings. Some potential limitations of the study, together with recommendations for possible further research to address these limitations, are outlined below.

- **Potential limitation:** The reflections on the quality of the SDFs presented in Chapter 5 are based on a sample of 15 SDFs. The sample may be too limited to generalise the findings to all urban areas in South Africa. However, the cities that were included as part of the evaluation represent approximately 50%

of the total urban population of South Africa, and is therefore representative of those plans affecting a substantial proportion of the country's urban population.

- **Possible further research:** Apply the spatial plan quality evaluation methodology to a wider range of SDFs representative of various city sizes and different institutional capabilities, and to compare outcomes at different scales within the four larger metropolitan areas. A further recommendation is to also analyse the latest post-SPLUMA SDFs to determine whether any progress has been made with the potential deficiencies of these plans.
- **Potential limitation:** The results presented in Chapter 5 only reflect the documented outcome of the SDF process and not the planning processes that led to these plans. It therefore does not provide insights or explanations of the institutional and procedural aspects contributing to the identified challenges (Ex ante spatial planning evaluation).
- **Possible further research:** It is recommended that the contextual evaluation, and the operational environment quality evaluation components as outlined on Figure 4.5 be applied to the relevant municipalities to investigate the underlying causes and factors contributing to the findings described in Chapters 5 to 7.
- **Potential limitation:** Without considering the third dimension of the height of individual structures, the measuring of the density gradients in terms of the built-up footprint in two dimensions as applied in Chapter 6 only partly describes development intensity. It will generally underestimate the occupation of the most densely populated zones. The land-use mix analysis is also based on a two-dimensional view of land-use mix and do not include the third dimension, which accounts for the vertical mix of land uses on the same footprint or within the same buildings. Consequently, the levels of land-use mix in areas such as the central business districts of the cities will generally result in an underestimation of land-use mix values in these areas.
- **Possible further research:** The analysis procedures could potentially be supplemented by including the third dimension of building height through the combined application of a digital surface model (including the height of objects on the ground) and a digital terrain model (elevation of the ground surface). This could solve the challenge of building intensity as represented by the height of individual structures, but will not be able to address land-use mix in the third dimension which accounts for the vertical mix of land uses on the same footprint or within the same buildings. This data will probably only be available through detailed surveys of multi-storey buildings in a specified study area. A further variant of the analysis conducted in Chapter 6 could also include population density analysis using the same parameters as the double-linear density model of the urban built-up ratio to undertake a joint interpretation of both the built-up footprint and population densities across the same urban field.

- **Potential limitation:** The alternative variants of the double density linear model identified in Chapter 6 and summarised in Figure 8.1 is based on the analysis of eight cities and across two time periods within each city.
- **Possible further research:** Further analysis including more cities and/or more time periods will be required to confirm the five variants of the double-linear density model of urban built-up space. Increasing the number of time periods within the analysis will also enable the identification of potential regularity in the sequence of change of these profiles over time in a single city. It would then be possible to associate these sequences with specific historically contingent factors and spatial planning interventions.
- **Potential limitation:** Due to the complex nature of urban growth management strategies and spatial plans as described in Chapter 4, it is difficult to isolate the impacts of any specific instruments (such as SDFs) of an urban growth management programme that is connected to specific changes in urban form. The results presented in Chapters 6 and 7 do not imply direct statistical causality between spatial policies and plans on the one hand, and changes in urban form and structure on the other.
- **Possible further research:** Further analysis such as multivariate regression and Geographically Weighted Regression can advance the understanding of the relationship between changes in urban structure and a range of influencing triggers and factors (as identified in Chapter 2). This type of analysis could establish the statistical significance and contribution of individual influencing factors (including spatial plans) to changes in urban form.
- **Potential limitation:** The LUM index as applied in Chapter 7 assumes that all land-use categories used in the analysis are deemed acceptable in mixed land-use areas. From a practical point of view it may however be necessary to exclude certain land-use categories such as some types of industrial, transport or utility uses from consideration in the measurement of land-use mix patterns. The definition of 'appropriate' land uses may also differ between cities, and from area to area within an individual city.
- **Possible further research:** Undertake further analysis of the indicators identified in Chapter 7 to determine the sensitivity of results to alternative definitions of land-use mix.
- **Potential limitation:** Any empirical analysis of urban structure, specifically higher population densities and land-use diversity, generally under represents the qualitative aspects within the range of indicators. There is a strong subjective element in the perceptions involved in the experience of density and land-use mix at any specific location. These subjective perceptions are not accounted for in the indicators used in this research.

- **Possible further research:** Undertake research into the qualitative perceptions of development densities and different levels of land-use mix reflecting the experiences and perceptions of individuals. This could include perceptions of both the objective and subjective dimensions of ‘quality of life’ in areas with different characteristics, and associated with specific SDF goals and concepts (e.g. mixed land use nodes; high population density corridors).

8.5 CONCLUSION

The overall aim of this research was to establish the influence of spatial planning (based on the prevailing spatial planning doctrine) on key elements of city structure in South Africa. Based on the findings and conclusions presented in Chapters 2 to 8 the research objectives specified in Chapter 1 have been successfully achieved:

- **Objective 1:** Identify the forces shaping the development of urban form and morphology and establish how these forces interact with urban spatial planning processes and outcomes. Objective achieved and results described in Chapter 2.
- **Objective 2:** Analyse the evolution of the overarching spatial planning doctrine in South Africa since 1994 and determine how this doctrine has influenced spatial planning and spatial plans in South Africa. Objective achieved and results described in Chapter 3.
- **Objective 3:** Develop a methodological framework for evaluating the influence of spatial planning and spatial plans. Objective achieved and results described in Chapter 4.
- **Objective 4:** Undertake an empirical analysis to assess the quality of SDFs, and evaluate the influence of these SDFs on the urban structure of South African cities since 1994. Objective achieved and results described in Chapters 5, 6 and 7.
- **Objective 5:** Determine the implications of the research results for future urban spatial planning processes and practices, and provide recommendations for improving and refining the evaluation of spatial plans. Objective achieved and results described in Chapter 8.

Increasing the influence of urban spatial planning will require a shift in focus from planning activities primarily aimed at the plan preparation phase to an increased focus on spatial plan evaluation during the implementation phase. This implies that urban and regional planners will have to be better equipped with the necessary technical skills to not only engage with the preparation of urban spatial plans, but also monitoring and evaluation the implementation thereof. Effective monitoring and evaluation of the influence of spatial plans require a multi-dimensional evaluation at various scales and across various timeframes. The application of spatial statistical analysis techniques in particular can add significant value to the evaluation of spatial plans. The relevance and application of the goals and concepts forming part of the South African spatial planning doctrine have to be considered across different scales and timeframes, and within the context of locally specific physical and historical factors.

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APPENDIX A

SPATIAL AND LAND USE CHANGE PATTERNS OF CASE STUDY CITIES

Figure A1: Cape Town spatial and land use change patterns (1993 – 2009)

Figure A2: Johannesburg spatial and land use change patterns (1994 – 2009)

Figure A3: Tshwane spatial and land use change patterns (1994 – 2009)

Figure A4: eThekweni spatial and land use change patterns (1994 – 2009)

Figure A5: Bloemfontein spatial and land use change patterns (1994 – 2008)

Figure A6: Pietermaritzburg spatial and land use change patterns (1994 – 2009)

Figure A7: Witbank spatial and land use change patterns (1994 – 2010)

Figure A8: Nelspruit spatial and land use change patterns (1992 – 2010)

Table A1: Land use classes applied in spatial analysis

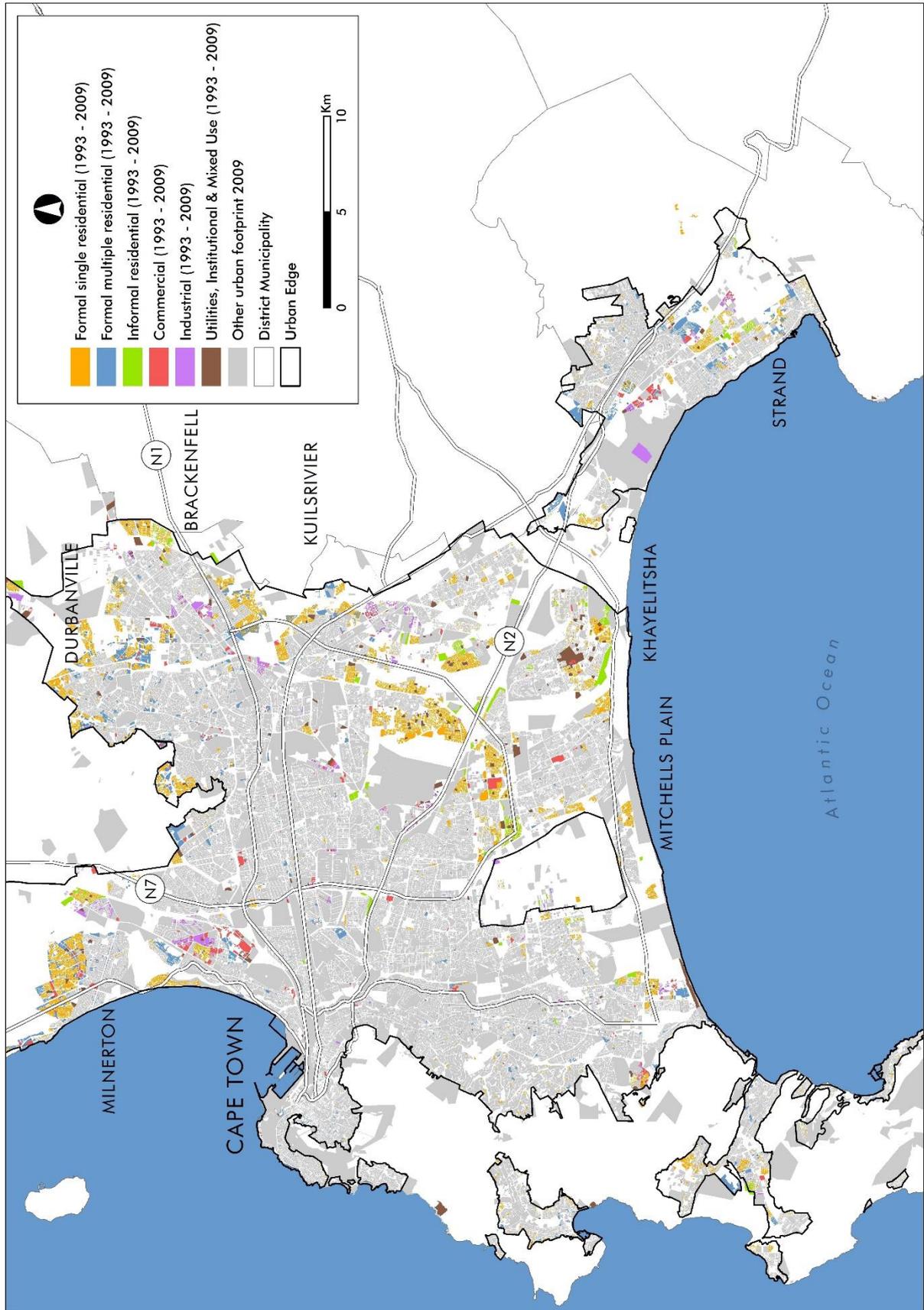


Figure A1: Cape Town spatial and land use change patterns (1993 – 2009)

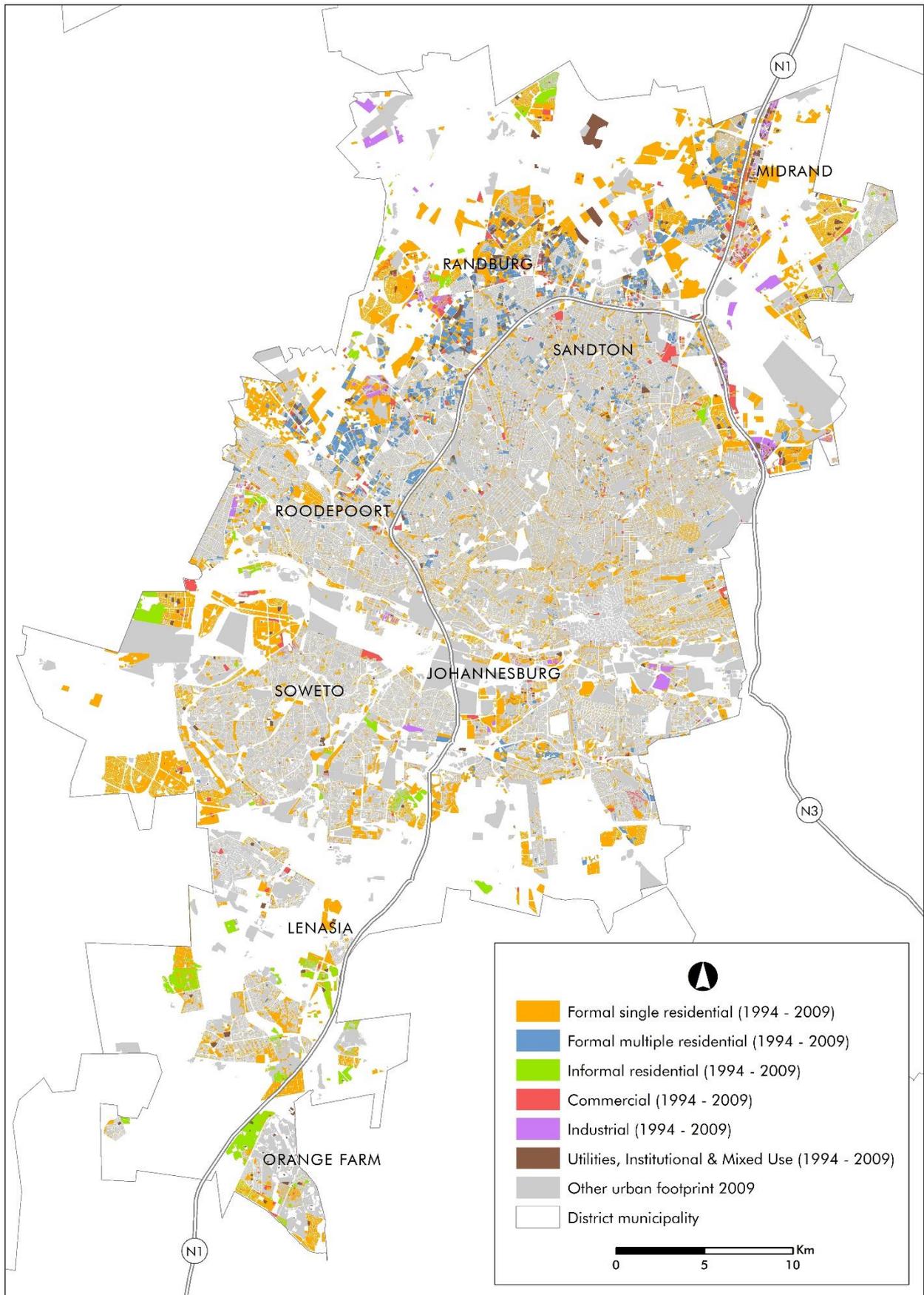


Figure A2: Johannesburg spatial and land use change patterns (1994 – 2009)

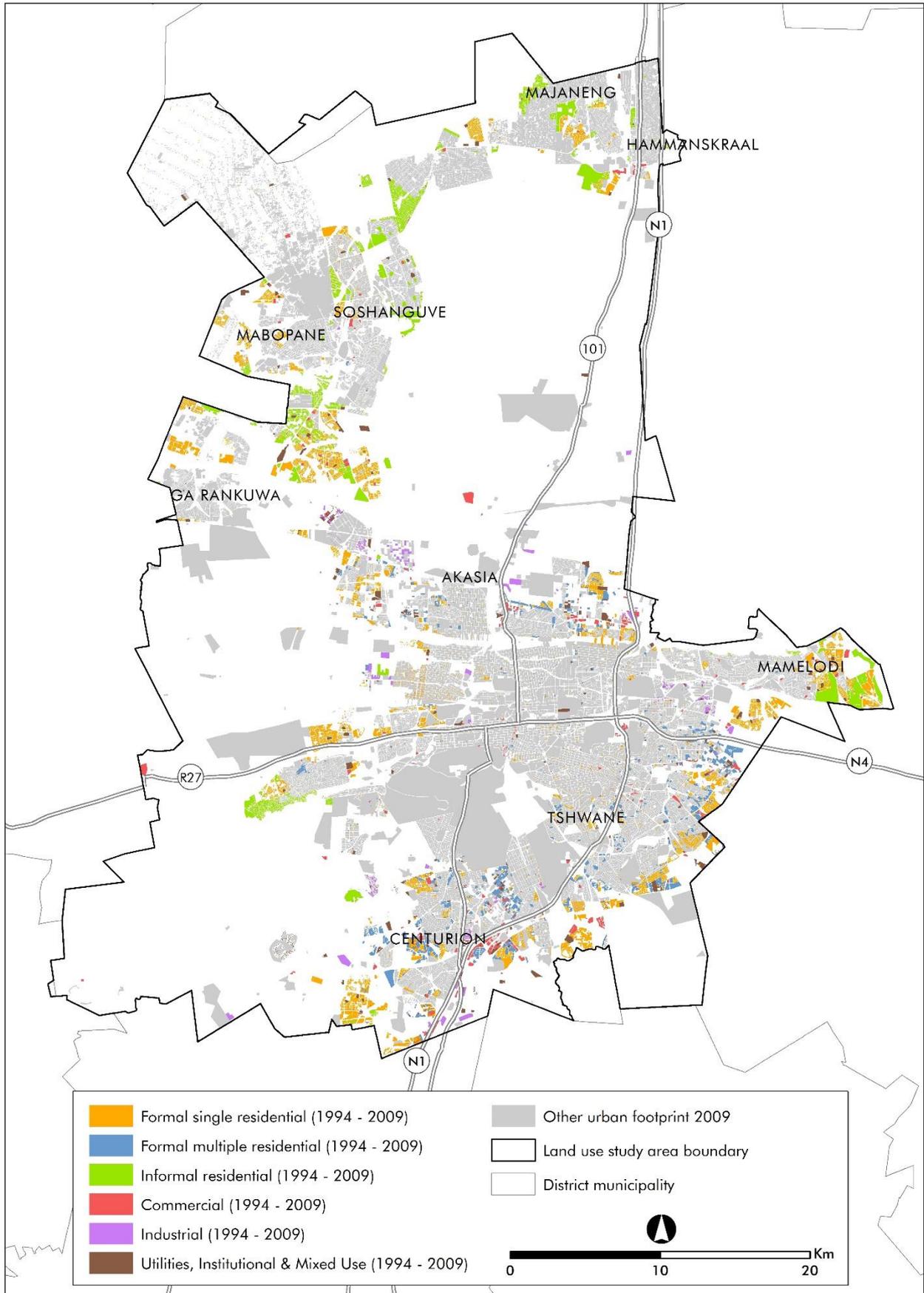


Figure A3: Tshwane spatial and land use change patterns (1994 – 2009)

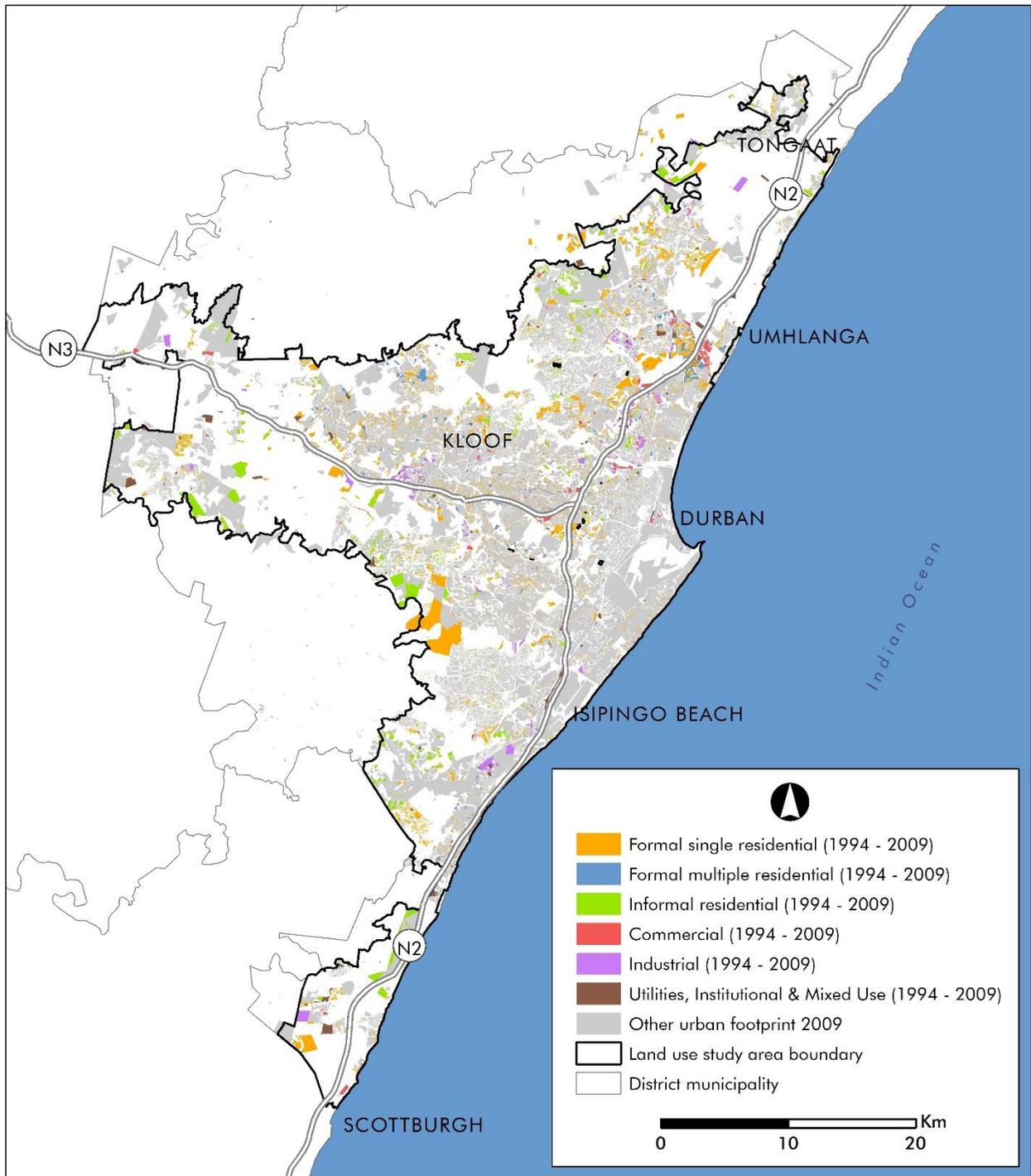


Figure A4: eThekweni spatial and land use change patterns (1994 – 2009)

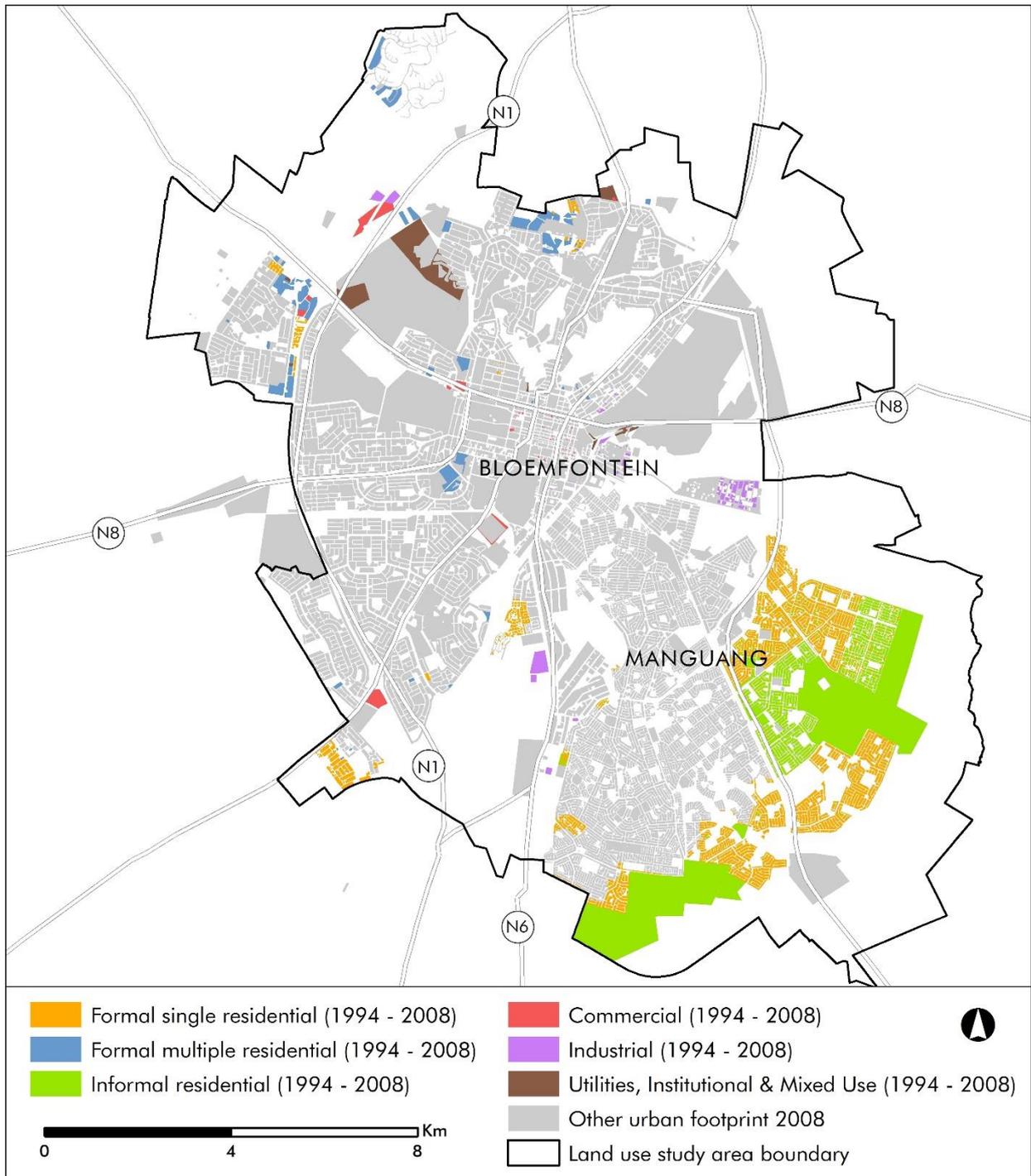


Figure A5: Bloemfontein spatial and land use change patterns (1994 – 2008)

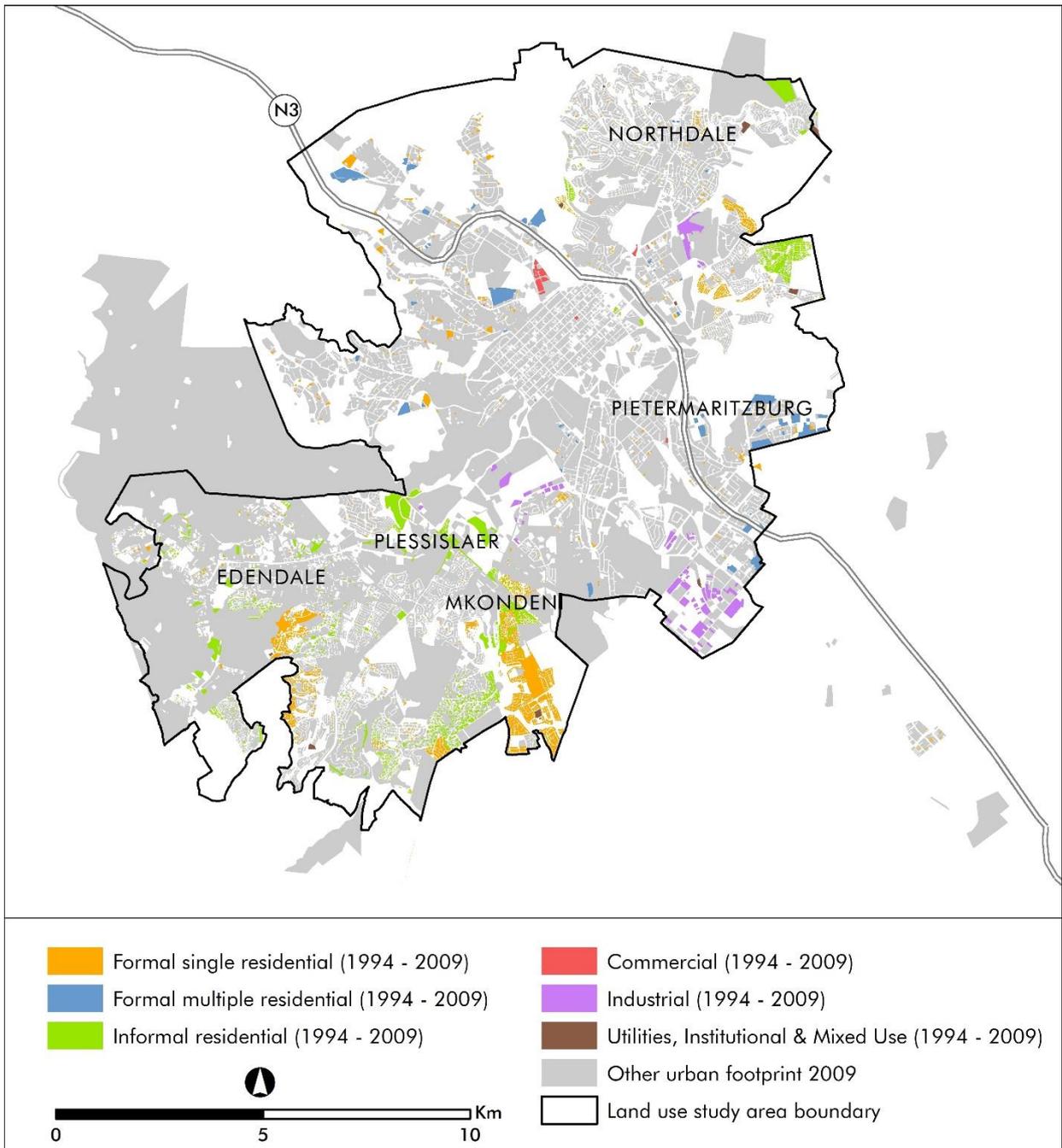


Figure A6: Pietermaritzburg spatial and land use change patterns (1994 – 2009)

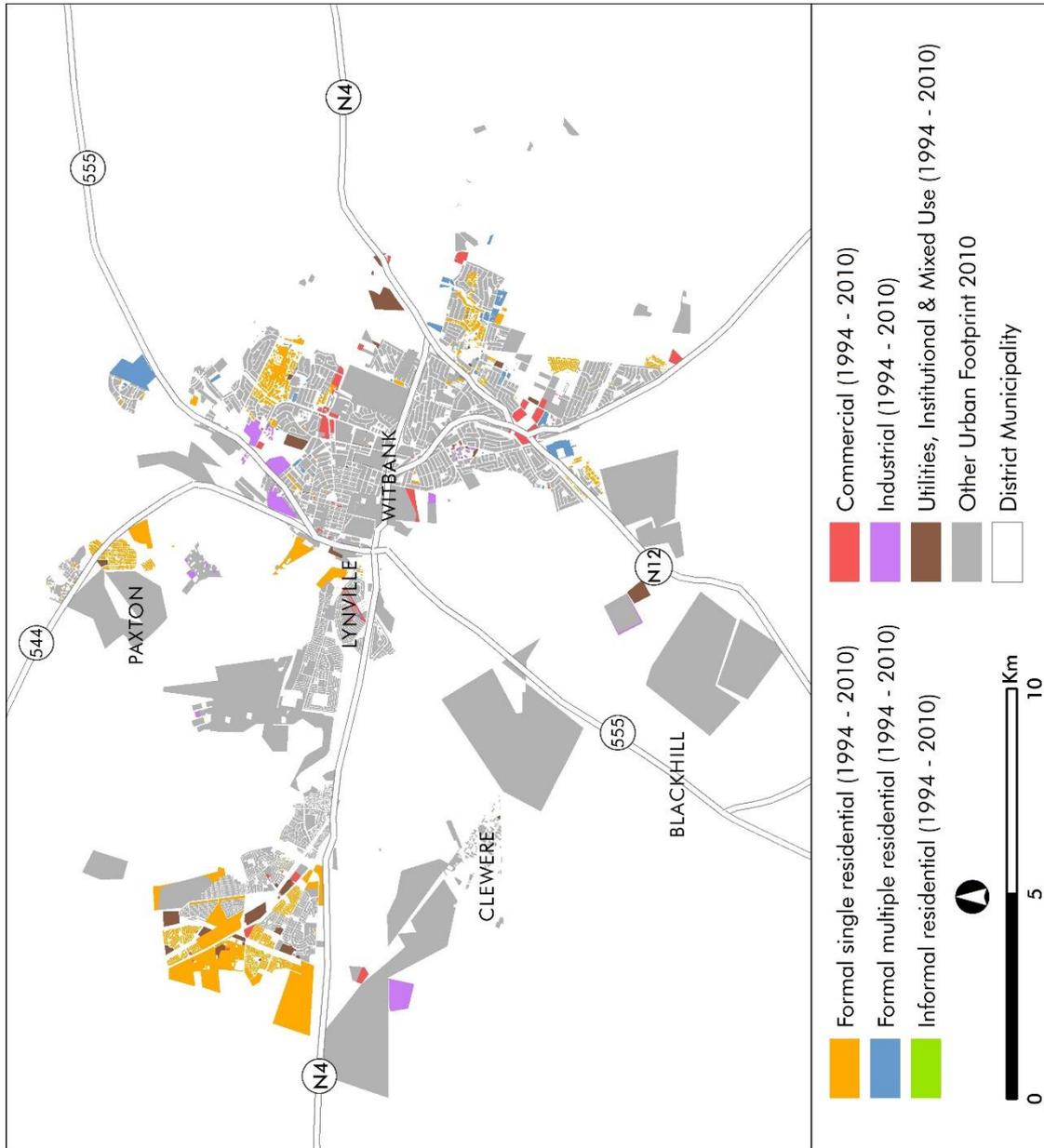


Figure A7: Witbank spatial and land use change patterns (1994 – 2010)

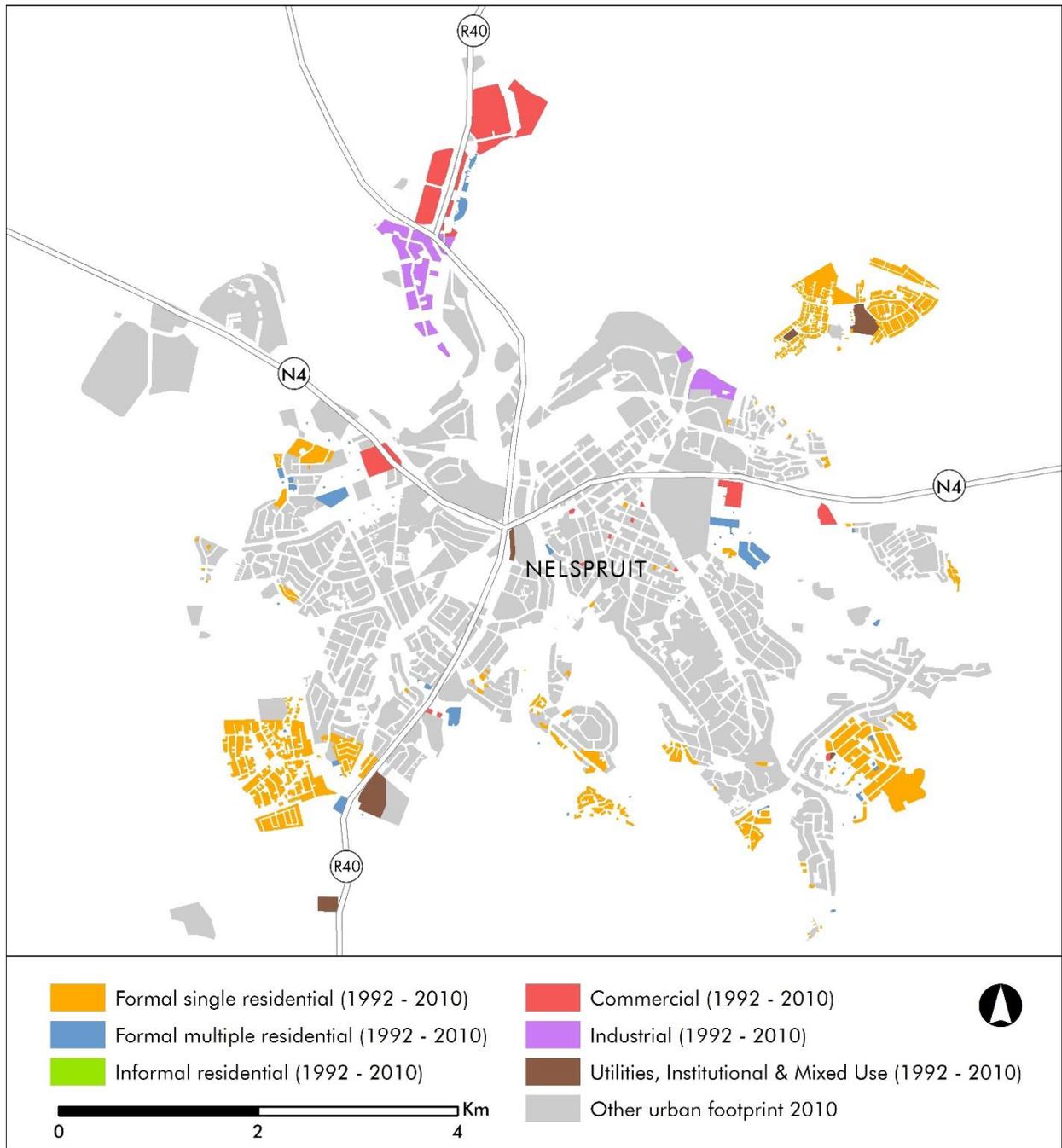


Figure A8: Nelspruit spatial and land use change patterns (1992 – 2010)

MAIN CLASS	SUB CLASSES
Formal housing (multiple)	Flats
	Hostels
	Security Estates
	Retirement Villages / Old Age homes
	Complexes
	Student Residencies
	Orphanages / Children Homes
Formal housing (single)	Freehold houses
Informal housing	Informal
	Transitional
Commercial	Shopping Centre
	Commerce (Offices, Shops, Retail, Services, Financial Institutions, Restaurants, Conference Centre)
	Petrol Station, Service Station
	Office Parks (Business Parks)
	Informal Trading
Industrial	Light Industries & Warehousing/Distribution
	Heavy Industries
	Fuel Depot
Transport & utilities	Toll Plaza
	Terminals (Bus, Taxi & Other)
	Railway Stations (Passengers, Goods & Freight Handling)
	Airports (Terminals, Goods, Freight Handling & Hangers)
	Harbours (Terminals, Goods, and Freight Handling & Hangers)
	Open parking
	Parking Garages
	Car Ports
	Other Vehicle Storage
	Water Storage & Sewerage Treatment plants
	Energy Production & Distribution
	Refuse Disposal (Landfills)
	Post & Telecommunications
	Access Control
	Social & Institutional
Community Facilities (Community Centre, Youth Centre, Homeless Shelter & city halls)	
Library, Art Galleries & Museums (includes Cultural and Provincial Heritage sites, Monuments, Statues, Plaques & Memorials)	
Cemeteries & Crematoria	
Hospitals	

	Other health care facilities (Practices, Surgeries & Clinics)
	Animal Clinic
	Pre-School
	Primary School
	Secondary School
	Tertiary Education Institutions
	Other Schools (includes combined schools & schools for children with disabilities)
	Other Education Institutions (includes Adult Education)
	Research Institutions (Campuses)
	Defence
	Police
	Emergency Services
	Correctional Services
	Government (all tiers of Government, National, Provincial & Local, Traffic departments are included)
	Foreign Government (includes embassies and consulates)
Sport & Recreation	Amusement & Show Places (includes Theatres, Planetarium, Exploratorium & Picnic sites)
	Sports Facilities
	Zoological Gardens
	Holiday Resorts (Chalets)
	Camping Sites & Caravan Park
	Tourist Accommodation (Hotel, Guesthouse, Bed & Breakfasts)
Mining	Mine related buildings
	Workings & Quarries
Parks & Conservation	Parks
	National Park
	Nature Reserve
	Conservation Area
	Botanical Garden / Herbaria
	Major Outbuildings
Agriculture & Forestry	Major agricultural outbuildings (e.g. Barns, Sheds)
	Major forestry Outbuilding
Mixed Residential	Any combination of formal housing (multiple), formal housing (single), or informal housing on a single cadastral entity
Mixed land use	Any one (or combination of more than one) residential category together with any other non-residential land use/s on a single cadastral entity

Table A1: Land use classes applied in spatial analysis

APPENDIX B

SPATIAL STATISTICAL ANALYSIS RESULTS OF POPULATION DENSITY CHANGES

Figure B1: Population density change (1996 – 2011): Tshwane, Johannesburg, eThekweni & Cape Town

Figure B2: Population density change (1996 – 2011): Bloemfontein, Nelspruit, Witbank & Pietermaritzburg

Figure B3: Cluster-outlier analysis of population density change (1996 – 2011): Tshwane, Johannesburg, eThekweni & Cape Town

Figure B4: Cluster-outlier analysis of population density change (1996 – 2011): Witbank, Pietermaritzburg, Bloemfontein & Nelspruit.

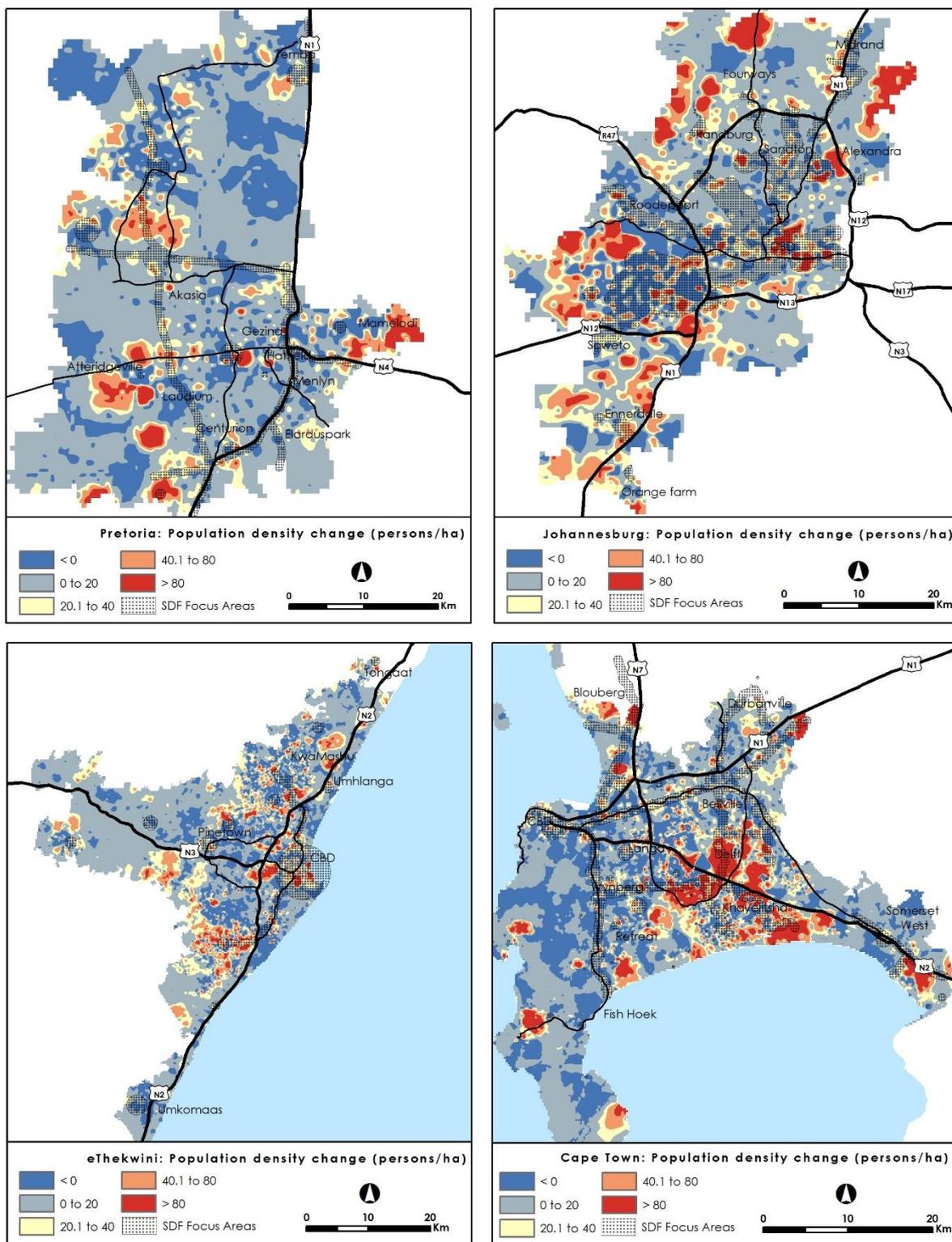


Figure B1: Population density change (1996 – 2011): Tshwane, Johannesburg, eThekweni & Cape Town

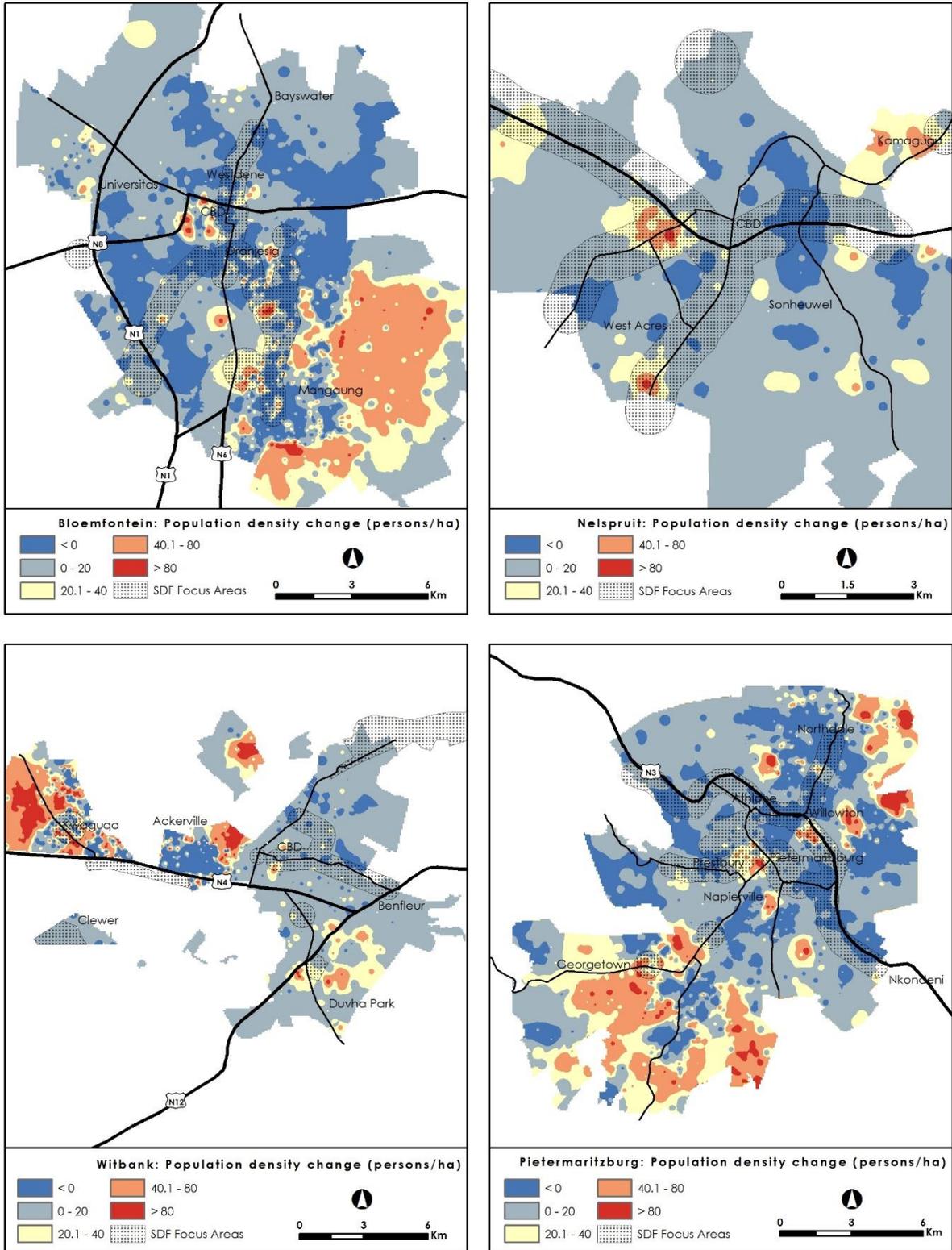


Figure B2: Population density change (1996 – 2011): Bloemfontein, Nelspruit, Witbank & Pietermaritzburg

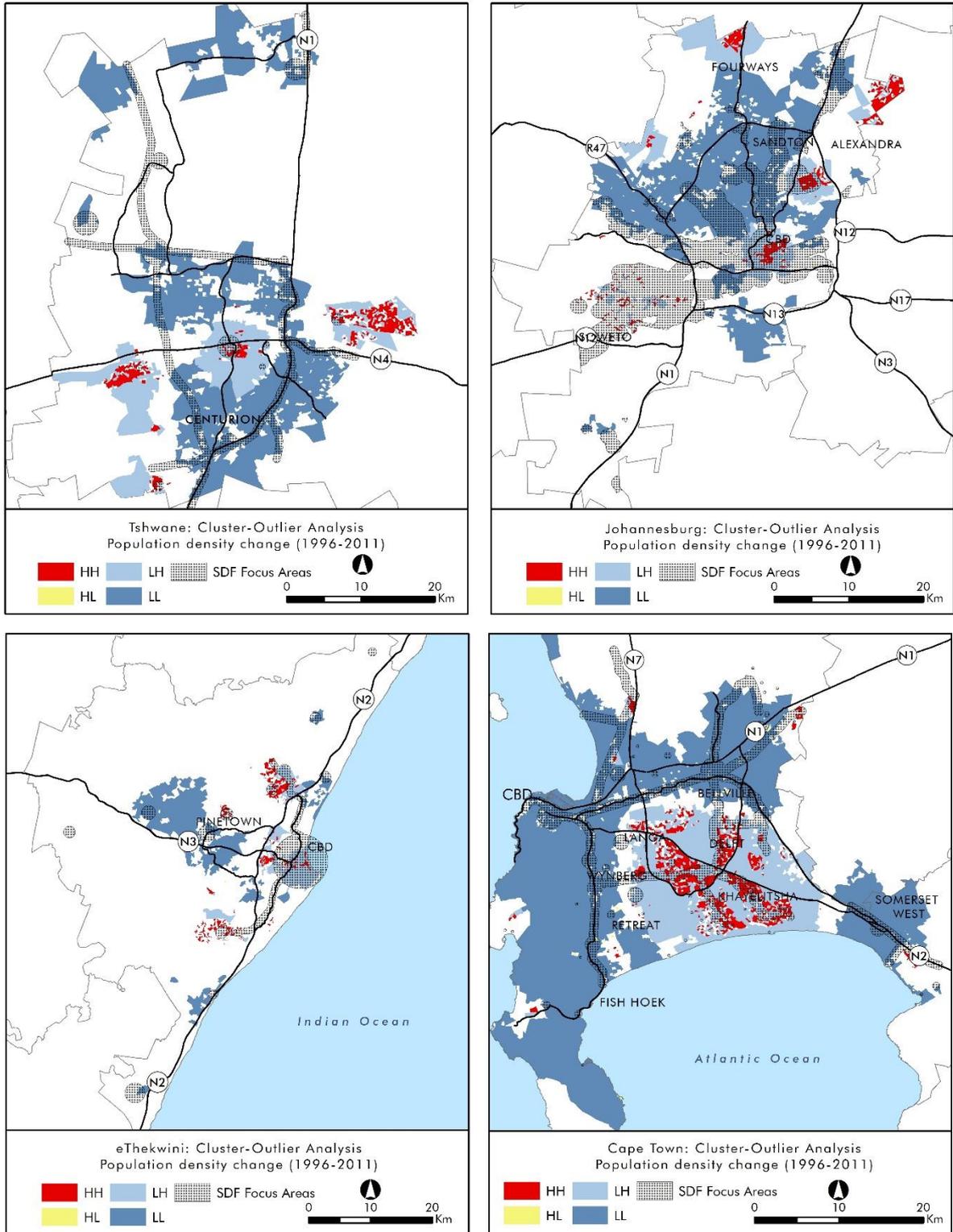


Figure B3: Cluster-outlier analysis of population density change (1996 – 2011): Tshwane, Johannesburg, eThekweni & Cape Town

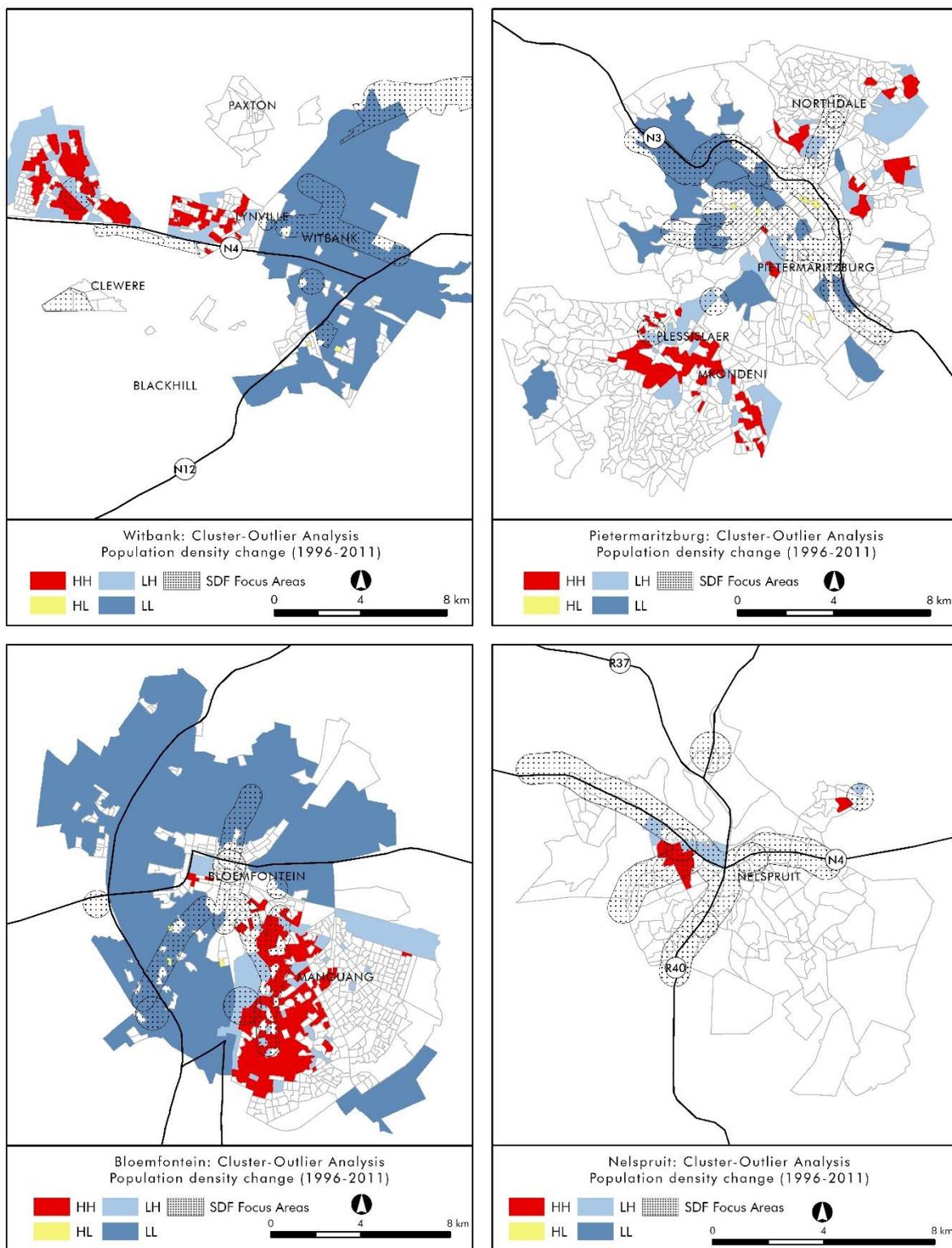


Figure B4: Cluster-outlier analysis of population density change (1996 – 2011): Witbank, Pietermaritzburg, Bloemfontein & Nelspruit.

APPENDIX C

SPATIAL STATISTICAL ANALYSIS RESULTS OF LAND USE MIX CHANGES

Figure C1: Cluster-outlier analysis of land use mix change: Tshwane, Johannesburg, eThekweni & Cape Town

Figure C2: Cluster-outlier analysis of land use mix change: Witbank, Pietermaritzburg Bloemfontein & Nelspruit

Figure C3: Cluster-outlier analysis of changes in economic activity density (1994 – 2009): Tshwane, Johannesburg, eThekweni & Cape Town

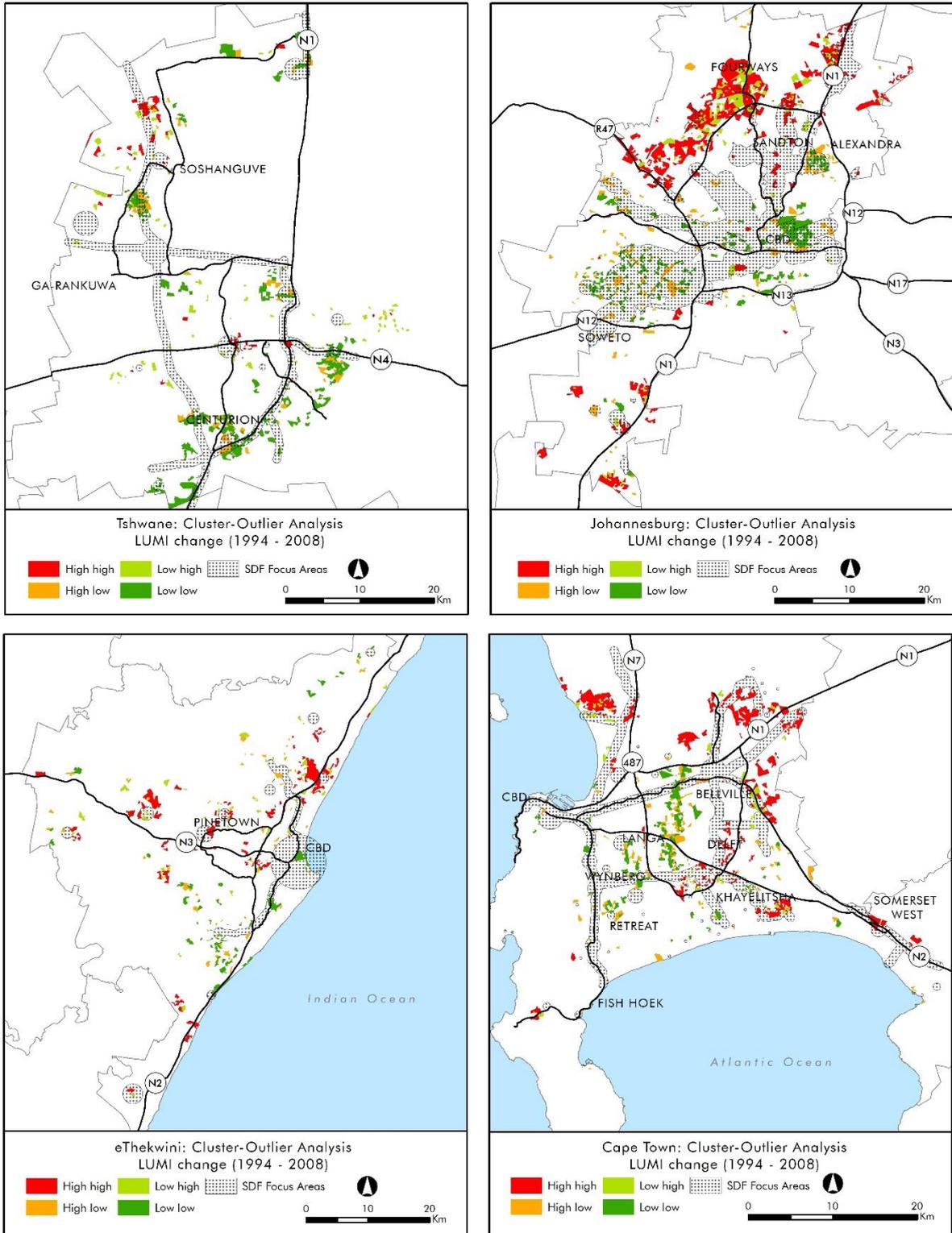


Figure C1: Cluster-outlier analysis of land use mix change: Tshwane, Johannesburg, eThekweni & Cape Town

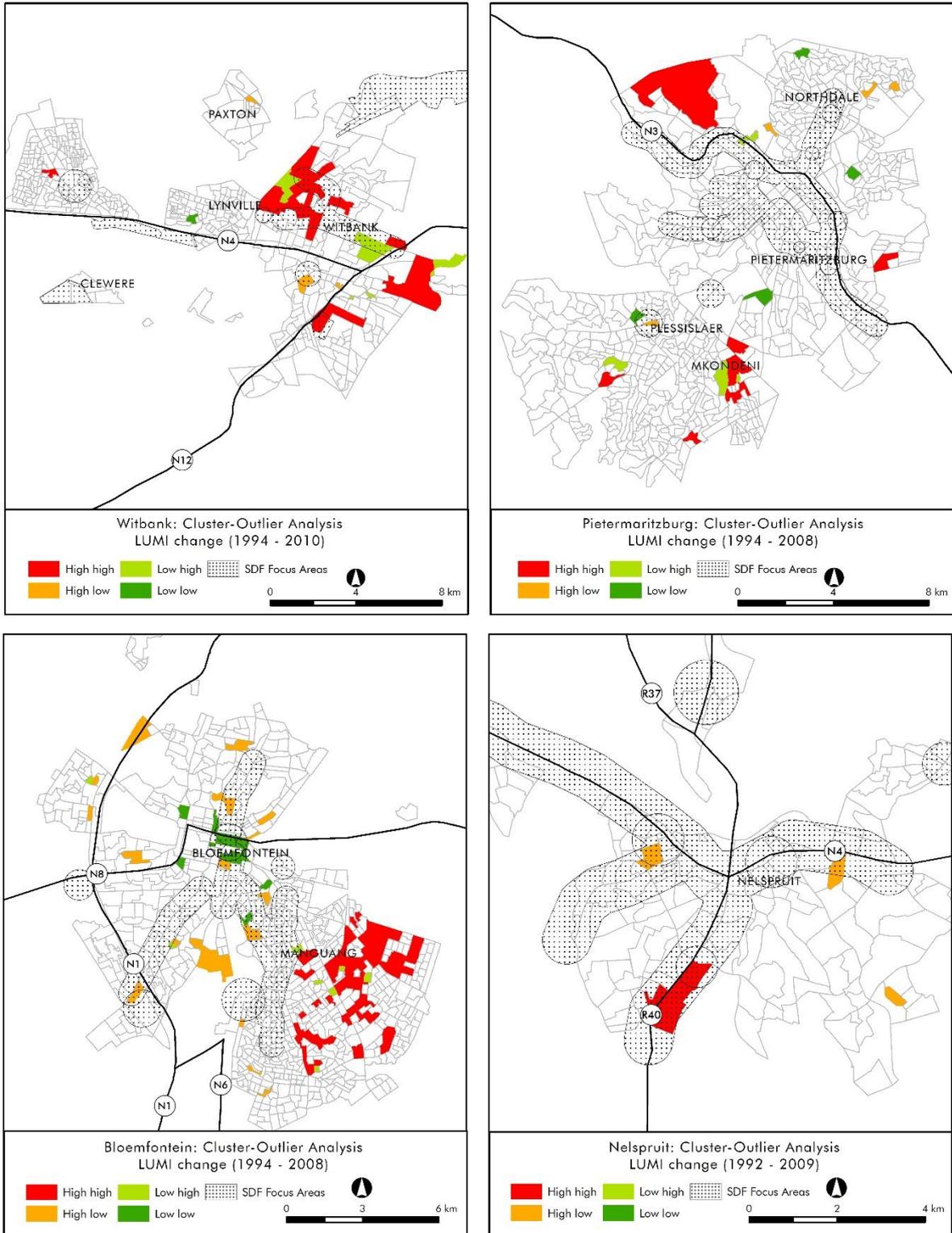


Figure C2: Cluster-outlier analysis of land use mix change: Witbank, Pietermaritzburg Bloemfontein & Nelspruit

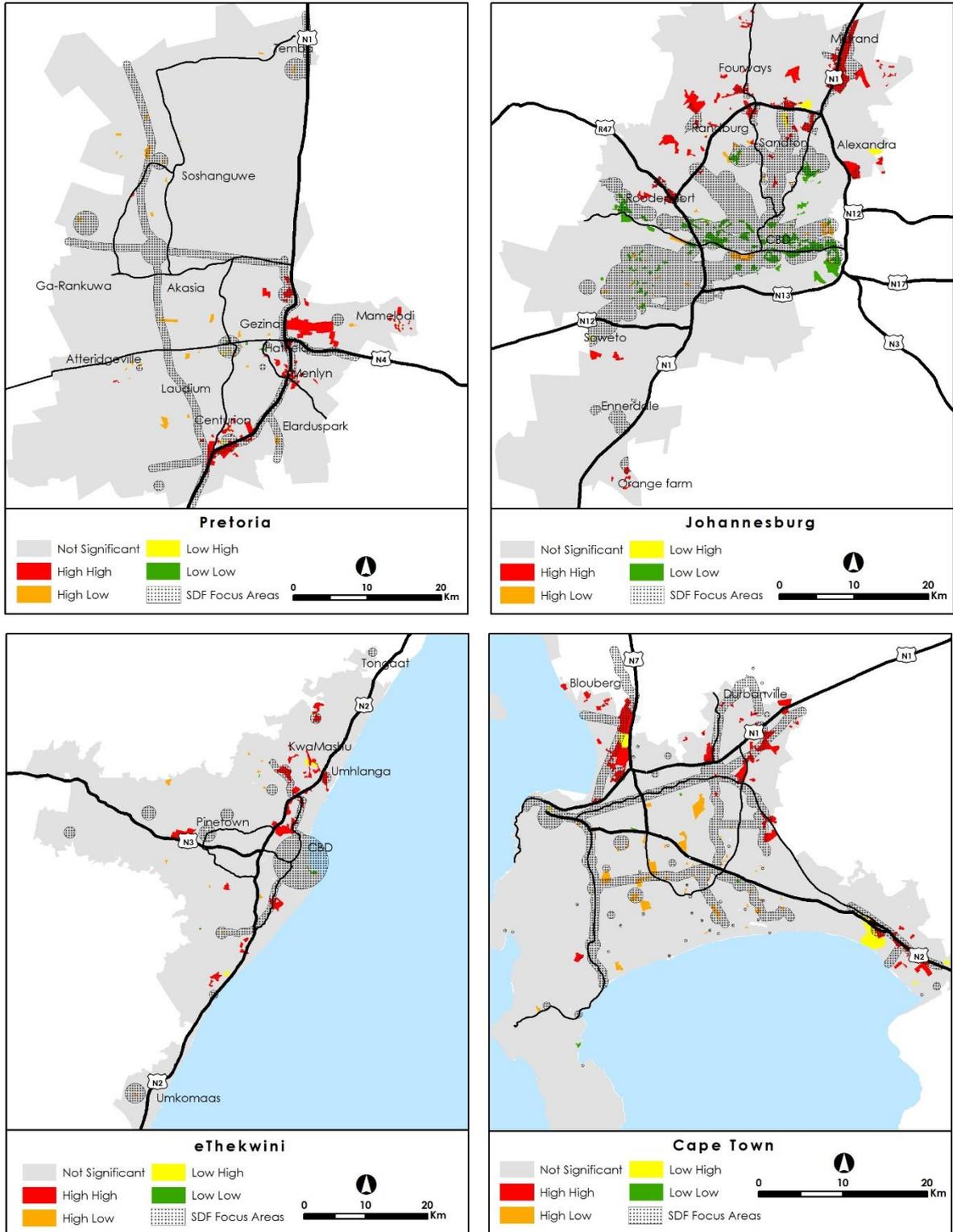


Figure C3: Cluster-outlier analysis of changes in economic activity density (1994 – 2009): Tshwane, Johannesburg, eThekweni & Cape Town

APPENDIX D

Published article (Chapter 5): Du Plessis DJ 2014. A critical reflection on spatial planning practices and outcomes in post-apartheid South Africa. *Urban Forum* 25: 69-88.

A Critical Reflection on Urban Spatial Planning Practices and Outcomes in Post-Apartheid South Africa

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Abstract The spatial planning and policy framework and associated implementing tools in South Africa have undergone fundamental changes since the onset of the democratic era in 1994. The effectiveness and influence of urban spatial planning on restructuring South African cities are however increasingly being questioned and there remains a surprising paucity of empirical evidence to evaluate the impact of these plans. Seven key challenges are identified as impacting on the effectiveness of urban spatial planning in the democratic era. The responses to these challenges as reflected by the urban spatial plans of a cross-section of cities indicate moderate levels of progress with improving the horizontal and vertical alignment of spatial planning processes and with the integration of sustainability principles into spatial planning. Some limited improvement was noted with the understanding of the urban space economy and the alignment of infrastructure development and capital investment with spatial planning. However, very little progress is evident with the principle of physical and social economic integration of cities, considering the informal sector in mainstream spatial planning processes, and with the use of appropriate indicators and quantified targets to monitor the implementation and impact of spatial plans. The application of innovative spatial and statistical techniques will not only greatly enhance the understanding of these issues, but will also provide the basis for formulating appropriate and robust indicators and targets to monitor the impact of spatial plans.

Keywords Spatial planning · Post-apartheid · Urban integration · Impact monitoring · National Development Plan

Introduction and Background

There is a growing body of evidence to suggest that cities make a disproportionate contribution to economic production and employment creation (Bridge and Watson

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2000; Baycan-Levent 2002; Bourne and Simmons 2002; Geyer 2007) and function as sources of economic dynamism (Turok and Parnell 2009). In the South African context, urban areas are recognised as the drivers of economic and population growth and points where many social and ecological challenges are concentrated. Nearly three quarters (71 %) of South Africa's population live in a limited number of cities and towns, and have well-established local economies that account for 92 % of all formal economic activity in the country (Republic of South Africa 2009). It is however also widely acknowledged that South African urban form is characterised by a number of inefficiencies such as unequal access to economic and social opportunities, poorly located lower income settlements, insufficient public transport and spatial structural elements resulting from apartheid-era policies and legislation (Drakakis-Smith 1992; Maylam 1995; Boraine et al. 2006; du Toit 2007). Not surprisingly, the spatial planning policy framework and associated implementing tools have undergone fundamental changes since the onset of the democratic era in 1994. The most prominent of these include the introduction of a system of Integrated Development Planning (IDP) supported by a number of sectoral plans, most notably the Spatial Development Frameworks (SDF) as an instrument for giving spatial expression to the developmental vision and priorities of municipalities. The SDF concept largely replaced the traditional guide plans and structure plans that for many decades formed the backbone of the forward planning process and functioned as the primary tool for guiding the spatial development patterns of South African cities and towns.

The effectiveness and impact of urban spatial planning in the post-apartheid era and its impact on restructuring South African cities are however increasingly being questioned and it has been argued that South African cities remain among the most inefficient urban environments in the world (Du Plessis and Landman 2002). Robins (2002, p. 666) expresses the view that despite concerted planning efforts aimed at desegregating the apartheid city, the "everyday socio-spatial legacies of apartheid continue to be reproduced". This view is echoed by Pieterse (2004) who is of the opinion that South African cities may be as segregated and fragmented as they were at the dawn of the democratic era. These arguments are also recognised in official policy documents. The National Urban Development Framework (NUDF) states that policies since 1994 have not succeeded in restructuring the apartheid spatial patterns of South Africa's cities and towns (Republic of South Africa 2009). The National Planning Commission identified "spatial challenges that continue to marginalise the poor" as one of the critical cross-cutting issues that will influence South Africa's long-term development and expresses the opinion that although the spatial legacy of apartheid was identified as a particular focus area for attention before 1994, the situation has probably been aggravated since then (Republic of South Africa 2011a). In the subsequent National Development Plan 2030 (NDP), it is recognised that densities have increased in some urban areas and that partial regeneration of inner cities has been achieved but that little progress has been made in reversing apartheid geography (National Planning Commission 2012).

In view of this apparently limited impact of spatial planning initiatives and the growing international trend of introducing evidence-based planning (Alexander 2009; Wong and Watkins 2009), now is the time to reflect critically upon the spatial planning system and its outcomes in South Africa since the dawn of the democratic

era in 1994. This article examines these issues by focusing on three key themes. It begins by briefly outlining the changing urban spatial planning context in South Africa over the last two decades. This provides the backdrop for a literature review to synthesise the key challenges in urban spatial planning in South Africa. The third element considers the responses of contemporary urban spatial plans to these identified challenges, through a review of the spatial plans of a cross-section of South African cities. In conclusion, a number of suggestions are offered to address these challenges and pave the way for some practical solutions.

The Changing Urban Spatial Planning Context in South Africa

Historically, from an international perspective, spatial planning has been concerned mainly with the relationship between various land uses and infrastructure components and channels (Chapin 1985), and was dominated by the master planning approach in many parts of the world after World War II. This approach was aimed at developing detailed plans focusing on the configuration of various land uses (Todes et al. 2010). From the late 1970s, master planning has been widely criticised, especially for its static nature, as being incompatible with rapid urban growth (Clarke 1992). The dominance of ‘control and command’ policies has given way to evolutionary and participatory planning principles (Baycan-Levent and Nijkamp 2008). Important new concepts and approaches, which gained prominence from the 1990s onwards include the concept of networks through the work of Castells, based on the tension between places and flows (Castells 1996), the rise of civil society and the question of power in the production of urban space (Friedman 1998; Amin 2002), dynamic conceptualisations of multiplex places (Graham and Healy 1999), and methods for establishing and invoking a common ‘spatial planning doctrine’ (Faludi 2000). Despite the introduction of these new concepts and approaches, a number of key elements have remained more or less consistent aspects of the spatial planning process. Healy (2007) summarises these elements as a proper understanding of the physical structure of an urban area and the forces shaping it, orientating goals expressed through policy statements, a framework of principles outlining concepts, projects and programmes, and an inspirational future vision.

The history and evolution of the planning system in the South African context has been widely documented (e.g. Swilling et al. 1991; Mabin 1992; Beavon 2004; Harrison et al. 2008; van Donk et al. 2008). The current form and structure of South African cities and towns have probably been most profoundly influenced by the period referred to by Harrison et al. (2008) as ‘high apartheid’, from the late 1940s to the early 1970s, when influential planning policies and instruments such as the Group Areas Act were conceived and implemented (Mabin 1992). On an urban scale, this period was characterised by forced removals based on ethnicity and the development of new large-scale townships, in many cases still dominating the form and structure of many South African cities. The main focus of spatial planning was on the physical design of areas through guide plans and later structure plans (Todes et al. 2010). Hindson (1987) argues that the biggest impact of the period from the mid-1970s to 1990 was the creation of ‘semi-formal’ settlements on the urban periphery in areas such as Ivory Park in Midrand and Khayelitsha in Cape Town.

Influential work emerged during the 1980s in certain academic circles, with the most renowned being Dewar and Uytendogaardt's *South African Cities: A Manifesto for Change* (1991). Many of these concepts subsequently found their way into post-apartheid spatial planning policies and approaches. The initial phase of the democratic era after 1994 was dominated by the Reconstruction and Development Programme (RDP), which focused on investment in infrastructure and basic services. It introduced some enduring spatial planning concepts such as 'compact cities' and 'densification and unification of the urban fabric' (Republic of South Africa 1994). The Development Facilitation Act (DFA) was also promulgated during this era and, through its provision for the preparation of so-called Land Development Objectives, represented the first step to a new spatial planning framework. The set of normative spatial principles contained in the DFA (Republic of South Africa 1995) introduced a legal source to guide the spatial content of planning. The first municipal spatial plans produced after 1994 were strongly influenced by RDP and DFA principles. Another important policy instrument emanating from this period that impacted directly upon urban structure was the introduction of a new housing policy, providing subsidies from the state to qualifying beneficiaries. In retrospect, it became clear that the structure and application of the subsidy mechanism simply did not make provision for the acquisition of well located (but significantly more expensive) land that would facilitate the goal of integration and restructuring of the South African city and this led to the subsequent revision of this policy in 2004 (Republic of South Africa 2004). The period from 1996 saw a change in focus to a competitive and fast-growing economy and the introduction of policies such as the Growth, Employment and Redistribution programme (Republic of South Africa 1996). Later, there was the announcement of the Accelerated and Shared Growth Initiative for South Africa in 2006 (Republic of South Africa 2006), which identified planning and land-use management as key areas requiring institutional reform (Harrison et al. 2008).

Great emphasis was placed on integrated planning and service delivery by all spheres of government in the period from 2000 onwards. Important initiatives from this period included the introduction of the National Urban Renewal Programme and the first versions of the National Spatial Development Perspective. The most prominent impact upon spatial planning at an urban level has been the entrenchment of the Integrated Development Planning process, through the promulgation of the Local Government: Municipal Planning and Performance Management Regulations in 2001 (Republic of South Africa 2001). Of particular importance in the regulations is the prescription that the IDPs of municipalities must include an SDF, and they provide broad guidelines of what such a framework must contain. According to Watson (2002), the earlier versions of the IDP viewed spatial plans as playing an important pro-active and synthesising role, a function later replaced by the municipal budget.

After the national elections of 2009, rural development was elevated to one of the key political priorities for the new term of office. This period also saw the release of the NUDF. The NUDF emphasises that the term 'urban' does not seek to reinforce a divide between urban and rural but that these two concepts are rather viewed as "parts of a continuous regional, national, and international system interrelated through a web of economic, social, political and environmental linkages" (Republic of South Africa 2009, p.2). The most prominent initiative in the period after 2009 has been the establishment of the National Planning Commission in April 2010. The commission

is an advisory body tasked with preparing recommendations to the cabinet on issues affecting South Africa's long-term development. The first step towards a new National Development Plan was a series of Diagnostic Overview Reports. The detailed *Material Conditions diagnostic report* identified the form of future towns and cities as one of the six 'big issues' requiring significant focus in the national plan. The three critical concerns with regard to urban form and density were identified as very low overall densities, in international terms, an inverted density gradient with the highest densities in pockets of low-income settlements along the periphery, and the spatial fragmentation of the labour market, which disperses available work (Republic of South Africa 2011c). Not surprisingly, the transformation of human settlements is identified as one of the key elements in the subsequent NDP, which recognises that many of the elements of its spatial vision were known and accepted in 1994 but that the challenge has been "to translate the vision into implementation and meaningful spatial outcomes" (National Planning Commission 2012, p.286). The NDP offers a range of recommendations, seen as appropriate measures to reconfigure towns and cities into more efficient and equitable urban forms; it includes aspects such as the need for explicit spatial restructuring strategies in each municipality and the creation of a robust set of indicators as part of a spatial governance evaluation framework.

Emerging Challenges in South African Urban Spatial Planning

Introduction

In response to this changing institutional environment for spatial planning in South Africa, the need for new approaches to planning in general, and spatial planning in particular, have been recognised by academics, government and planning practitioners. Serfontein and Oranje (2008, p.28), in their evaluation of spatial planning in the Tshwane metropolitan area, identified what they refer to as "the deep disconnection between planning thought and the 'real, emerging' spatialities of the 21st century". One of the possible explanations they offer is the persistence of how planners interpret and act upon space in a manner still based on the nineteenth century industrial city. Todes et al. (2010) argue that some of the internationally identified principles for new urban planning are also applicable to spatial planning in South Africa, such as a greater focus on sustainability, improved integration and alignment between spatial planning and budgeting processes, and a better understanding of markets and the implications for producing credible plans.

Through a literature review, it was possible to synthesise seven key challenges that have been affecting urban spatial planning processes and outcomes since 1994. Each of these challenges is summarised in the following subsections, focusing on two interrelated strands of arguments. Each subsection first summarises the key elements of the debates inherent to each of the identified challenges based on the literature that was reviewed. The critical elements of these debates then provide the framework for analysing a cross-section of urban spatial plans of the larger urban areas in South Africa, to establish how municipalities have responded to these identified challenges in their latest generation SDFs. A total of 15 SDFs were evaluated, representing the four largest metropolitan municipalities (Johannesburg, Cape Town, Tshwane and

eThekwini), two municipalities that recently obtained metropolitan status (Mangaung and Buffalo City) and four intermediate cities (Msunduzi, Rustenburg, Emalahleni and Mbombela). Many of the larger metropolitan municipalities have introduced a hierarchy of plans dealing with more detailed proposals at lower levels of spatial aggregation. In these instances, both the overall metropolitan level SDF as well as one of the sub-regional spatial plans was evaluated (Table 1).

In all instances, the latest available SDF was used at the time of research and the dates of the plans range between 2003 and 2012. The municipal SDFs are normally reviewed in 5-year cycles, but this is dependent on the available financial and human resources within individual municipalities and is often reviewed less frequently. The analysis of these plans focused on the identified key issues within each theme and considered both the narrative content and the spatial proposals of the plans. In some instances, the responses to the identified issues as reflected in the SDFs were implied rather than explicit (e.g. referring to other detailed studies without including any specific information) and are reflected under the category 'implied' in the analysis tables.

Institutional Coordination and Alignment

Improved management of urban growth and improved urban governance are two of the strategic outcomes for South Africa's urban areas identified in the NUDF (Republic of South Africa 2009). The realisation of these outcomes is however impeded by both horizontal and vertical coordination and alignment challenges. At a municipal level, the

Table 1 Spatial development frameworks analysed

Name of Spatial Development Framework	Date of plan
Johannesburg Spatial Development Framework	2010/11
Johannesburg Regional Spatial Development Framework for Region D	2010/11
Cape Town Spatial Development Framework	2012
Helderberg District Plan: Spatial Development Plan and Environmental Management Framework (Cape Town)	2011
eThekwini Spatial Development Framework (contained in 2010/11 IDP review)	2010/11
eThekwini Municipality Central Spatial Development Plan	2010/11 review
City of Tshwane Spatial Development Strategy 2010 and beyond	2007
Tshwane Regional Spatial Development Framework North Eastern Region	2007
Buffalo City Spatial Development Framework	2003
Bonza Bay Local Spatial Development Framework (Buffalo City)	2008
Mangaung Spatial Development Framework	2010/11
Rustenburg Spatial Development Framework	2011
Msunduzi Spatial Development Framework Review	2009
Emalahleni Local Municipality Spatial Development Framework	2010
Mbombela Spatial Development Framework	2006

most fundamental horizontal alignment challenge is the lack of coordination of spatial plans with other sector planning activities within municipalities and with the planning of neighbouring municipalities (Republic of South Africa 2011b). The Gauteng provincial SDF for example notes that the preparation of municipal SDFs “has been undertaken at an isolated local authority level without cognisance of how they collectively comprise a province-wide development framework” (Gauteng Department of Economic Development 2010, p. 20). One of the main criticisms against the spatial plans in the post-1994 era is that they do not provide sufficient detail and guidance to inform decision-makers. This has resulted in a hierarchical system of planning, allowing for increasingly detailed plans at lower levels of spatial aggregation, now adopted by most of the metropolitan areas (e.g. Johannesburg, Cape Town, Tshwane, Ekurhuleni and eThekweni) and advocated by the draft set of national guidelines for the formulation of Spatial Development Frameworks. This implies that yet another dimension of alignment between the various tiers of spatial plans within individual municipalities is necessary. Recent research on the application of this approach (Todes et al. 2010) indicates that this in effect involves a return to master planning and therefore calls for debate and exploration of alternative forms of spatial planning. The major challenge for vertical alignment from a city-level perspective is the overlapping responsibilities between provincial government and local municipalities in aspects such as housing and land use management. This is exacerbated by the range of policies of different national departments responsible for various elements with a spatial dimension. This also complicates the alignment of investment programmes to achieve greater consistency in national priorities such as poverty reduction and employment creation (Turok and Parnell 2009).

Based on these arguments, there are at least three critical aspects of institutional coordination and alignment that need to influence and inform urban SDFs: horizontal coordination with the plans of adjacent municipal entities, vertical alignment with provincial-level spatial frameworks and strategies, and consideration of the national view on spatial development. The responses to these challenges, as documented and reflected in the 15 plans that were evaluated, are summarised in Table 2.

The information in Table 2 reflects mixed results for the horizontal and vertical alignment of spatial planning processes. What is clear is the limited consideration of national spatial development plans and frameworks in urban-level spatial plans. Although it could be argued that the NSDP has been controversial in certain aspects since its inception, one would have expected at least some consideration of the basic principles outlined in this framework. Only four of the plans evaluated showed clear evidence of consideration of the NSDP principles. This may be partly attributed to urban municipalities assuming that alignment with national spatial policies is

Table 2 Responses to institutional coordination and alignment

Dimension	Yes	Implied	No
Clear horizontal coordination with spatial plans of adjacent municipalities	6	2	7
Explicit vertical alignment with provincial spatial plans and strategies	7	3	5
Clear consideration of national spatial development plans and perspectives	4	–	11

achieved through Provincial Spatial Development Frameworks. The extent of horizontal alignment with adjacent urban areas, and the vertical alignment with provincial spatial plans, is more encouraging. Six of the plans revealed clear horizontal coordination with the spatial plans of adjacent municipalities and seven showed explicit vertical alignment with provincial spatial plans or strategies. The further strengthening of this element in urban spatial plans will make a meaningful contribution to what the National Development Plan refers to as the "...development of plans that cross municipal and even provincial boundaries and would promote collaborative action..."(National Planning Commission 2012, p. 286).

Physical and Socio-economic Integration

It has been argued that spatial governance in places characterised by existing levels of social inequality and racial polarisation will continue to be ineffective (Robins 2002). The concept of integration has been part of the South African spatial planning nomenclature since the early 1990s. As early as 1994, the RDP called for the "densification and unification of the urban fabric," (Republic of South Africa 1994, p.86) and was soon followed by the Development Facilitation Act (Republic of South Africa 1995), outlining the basic principles and dimensions of integration. The concept was associated with three dimensions: the integration of the various aspects of land development (social, economic, institutional and physical), the integration of land development in rural and urban areas in mutual support and the integration of residential and employment opportunities in close proximity to each other. The concept of integration remained central to the spatial planning and policy agenda right up to the current National Development Plan 2030, which contains as many as 88 individual references to the concept of integration (National Planning Commission 2012). The NDP specifically recommends that every municipality should have an "explicit spatial restructuring strategy" including identified "priority precincts for spatial restructuring" and "critical interventions to redress past social segregation" (National Planning Commission 2012, p. 286). Despite this strong focus on the concept of integration, the measurement and quantification of this goal remained vague at best.

The national guidelines for the formulation of SDFs provide some basic clarification and quantification of the concept of integration and distinguish between functional integration and social economic integration (Republic of South Africa 2011b). Functional integration is advocated through the walking-distance principle and recommends that at least 50 % of urban activities should be within walking distance (approximately 1,000 m in 20 min) of where people live. With regard to socio-economic integration, it pronounced that little progress has been made since 1994 and attributes this to resistance from communities and financial institutions. Research into changes in the socio-spatial landscape in the Tshwane metropolitan area for example indicated that although a number of neighborhoods experienced significant changes in ethnic composition, overall segregation levels have in fact increased slightly (Badenhorst et al. 2005). The SDF guidelines thus propose the use of a socio-economic gradient with relatively small differences in income and property value between adjacent communities to mediate this problem (Republic of South Africa 2011b).

Fundamental questions in this context relate to the understanding of integration and segregation and their measurement. Horn (2005, p. 68) is of the opinion that indicators such as the standard segregation index are “blunt, outdated, and misleading” and recommends that socio-economic integration processes be evaluated by combining appropriate quantitative measures with other empirical and qualitative techniques. Elements critical to the spatial planning process and outcomes thus relate to the methodological approach, analysing both functional and socio-economic integration, the formulation of explicit strategies to achieve this integration, and translating these strategies into spatial proposals. The responses to these elements as documented in the urban spatial plans are summarised in Table 3.

The results of the analysis reflected in Table 3 largely confirm that, notwithstanding the importance of the integration concept in policy documents, its translation into practical terms remains unclear. Only one of the plans evaluated contained a quantitative analysis of the extent of physical/functional integration, whereas quantitative measures of socio-economic integration clearly remain uncharted waters in spatial plans. Despite the lack of meaningful quantitative analysis, some of the spatial plans do contain explicit strategies and spatial proposals for pursuing the objective of functional and socio-economic integration. In these cases, the strategies and proposals are almost exclusively limited to the location of affordable housing at strategic locations to achieve the objective of improved integration. These results imply that a significant reorientation of urban spatial plans will be required to achieve the NDP recommendation that each municipality has an “explicit spatial restructuring strategy that is linked to instruments for implementation” (National Planning Commission 2012, p. 286).

Understanding the Space–Economy of Cities

One of the key tension points in spatial planning in South Africa is the interplay and associated trade-offs between the need for economic growth and competitiveness on the one hand, and for socio-economic redress on the other. Cities have to compete globally if they wish to develop their local resource base and improve their position (Jenkins and Wilkinson 2002). Not responding to global trends and demands will ultimately lead to reduced international investment, thus limiting available domestic resources and preventing their extension, to the detriment of the poor. Not surprisingly, one of the stated strategic outcomes of the NUDF (Republic of South Africa 2009) is improved economic competitiveness and resilience. Lemanski (2007) juxtaposes these points and asks whether it is possible for a city to be simultaneously

Table 3 Responses to physical and social economic integration requirements

Dimension	Yes	Implied	No
Quantitative analysis of physical/functional integration	1	0	14
Quantitative analysis of social economic integration	0	1	14
Explicit strategies for functional and social economic integration	4	1	10
Explicit spatial proposals for functional and social economic integration	3	1	11

globally competitive and address domestic socio-economic redistribution and argues that in the case of cities with increasing global success this has not necessarily been spread equally throughout the city.

One of the key factors underlying the inability of cities to address these tensions effectively is the limited understanding of their space economy. Although some advances have been made with the spatial economic analysis at a national and regional level in South Africa through the development of a set of mesozone units (Van Huysteen et al. 2009), the application at an urban level still remains a challenge. Todes (2008) suggests that planners need a deeper understanding of urban economic space and mechanisms through which planning relates to markets. Serfontein and Oranje (2008, p.28) hold a similar view and note that “any references to where the [real] potential of the economic landscape lay, were conveniently ignored and hence no logical connection could be found between urban potential and the planner’s view of the future shape and form of the [future] economic landscape.” More recently, the NDP cited a lack of understanding of economic principles, market forces and commercial realities amongst planners and other built-environment professionals, as one of the difficulties facing the planning system in South Africa and its ability “... to negotiate better development outcomes...” (National Planning Commission 2012, p. 275). This challenge is not unique to the South African situation, and Harris (1990) pointed out that comprehensive metropolitan spatial plans in developing countries are normally devoid of analysis of the real economy. Critical elements of urban spatial plans should therefore include an appropriate and comprehensive analysis of urban economic space and market and investment trends. Planners also need to reflect upon the extent to which the spatial strategies and proposals make provision for both economic competitiveness, as well as socio-economic development and redress.

The results reflected in Table 4 indicate that the majority of urban spatial plans which were evaluated remain devoid of any comprehensive spatial analysis of the urban economic space and the spatial analysis of market and investment trends. It may be argued that some of this data is contained in the local economic development strategies of the cities, but they have certainly not been integrated with the spatial development plans. There are isolated examples of progress on this front, with a city such as Cape Town having made significant strides in innovative spatial economic analysis techniques, such as their Economic Areas Management Programme. As far as balancing the need for economic competitiveness and growth on the one hand and social development and redress on the other are concerned, the focus has largely been on the socio-economic development component. Seven of the plans reviewed contained clear spatial strategies and proposals for socio-economic development, whereas only three plans included

Table 4 Responses to understanding the urban space economy

Dimension	Yes	Implied	No
Comprehensive spatial analysis of urban economic space	1	3	11
Spatial analysis of market and investment trends	1	0	14
Spatial strategies and proposals for economic competitiveness	3	2	10
Spatial strategies and proposals for social economic development	7	1	7

strategies and proposals dealing with economic competitiveness and growth. Spatial economic analysis at the urban level therefore appears to remain an area that would require significant attention in future urban spatial planning processes. There are however indications that some city-visioning processes are starting to make inroads into the challenge of entertaining both economic growth and service delivery (Robinson 2008).

Infrastructure Development and Capital Investment

Infrastructure provision is one of the most powerful forces shaping urban areas. This notion is not entirely new and Doxiadis (1970) concluded that the complex problems of cities cannot be solved through the development and official recognition of a physical plan alone. Instead, he argued for a development programme which is expressed in space by physical development plans, but also supported by economic, social, political, administrative, technological and aesthetic programmes (Doxiadis 1970). More recently, Healy (2004, p.46) confirmed the critical role of infrastructure and investment in the realisation of spatial planning goals by describing spatial planning as “self-conscious collective efforts to re-imagine a city, urban region or wider territory and to translate the results into priorities for area investment, conservation measures, strategic infrastructure investment, and principles of land use regulation.” This view is further emphasised by Todes (2008, p. 11) who states that “infrastructure planning with its own spatial logic was more powerful in shaping the spatial structure of cities than spatial planning.” The NUDF also identified improved urban infrastructure and service delivery systems as one of the strategic outcomes for South Africa’s urban areas (Republic of South Africa 2009). Specific issues that have a negative influence on the integration of infrastructure development and capital investment with spatial planning is the dominant influence of public sector-driven low-income housing projects funded by the Department of Human Settlements, the shaping of cities through up market private sector commercial and residential development (Harrison et al. 2008) and the emphasis on ‘mega-projects’ disjointed from spatial planning (Todes 2008). Turok and Parnell (2009) therefore call for the replacement of the traditional piecemeal pursuit of capital projects with a more coherent long-term view focused on selected areas and policy themes.

The integration of spatial planning with capital and infrastructure investment programming at the municipal level is intended to be achieved through the IDP process. In considering the response of municipal spatial plans to this challenge, it is therefore imperative to determine whether the IDP capital programme has been interpreted from a spatial perspective and integrated with the spatial development framework proposals. It is also necessary to determine whether key infrastructure projects resulting from the SDF proposals are identified and whether the investment implications associated with these infrastructure requirements have been quantified.

The results portrayed in Table 5 confirm that the integration of infrastructure development and capital investment strategies with spatial development planning remains largely unsatisfactory. Only three of the plans provided a clear spatial interpretation of the capital projects contained in the IDP, and only a single plan contained a clear reflection of the IDP capital projects in their spatial development proposals. A more positive element is that six of the evaluated plans included clearly identified key

Table 5 Responses to the need for integrating infrastructure development and capital investment with spatial planning

Dimension	Yes	Implied	No
Clear spatial interpretation of IDP capital projects	3	1	11
Integration of IDP capital projects with SDF proposals	1	2	12
Key infrastructure projects required for implementation of SDF proposals identified	6	2	7
Investment implications resulting from the SDF proposals quantified	1	-	14

infrastructure projects resulting from the SDF proposals. An important observation is that four of these six plans were sub-regional metropolitan spatial plans. It can therefore be inferred that in the case of larger metropolitan municipalities, the scope and complexities of infrastructure planning associated with spatial proposals are excessive at an overall metropolitan level, and are generally addressed at the levels of sub-regional spatial plans, at a lower tier of spatial aggregation. Only in a single instance was the identified infrastructure projects translated into a quantified estimate of the investment requirements to put the spatial proposals into effect. Although some of the larger metropolitan municipalities such as Johannesburg, Cape Town and eThekweni have developed innovative and comprehensive systems for evaluating and prioritising capital projects, the results of these processes and their incorporation into the spatial plans remain unclear.

Spatial Planning and Sustainability

The concept of sustainability has received particular prominence in development and spatial planning since the 1992 Earth Summit, where the important role that indicators can play in assisting informed decisions concerning sustainable development was recognised (Winston and Eastaway 2008). The National Strategy and Action Plan for Sustainable Development in South Africa articulate the national vision for sustainable development and indicate strategic interventions to reorientate South Africa's development path in a more sustainable direction (Republic of South Africa 2010). Despite this recognition of the need for greater alignment of sustainability criteria in all levels of integrated and spatial planning, some challenges and shortcomings still remain. Some of the key concerns are the lack of integration of sustainability principles, and the limited use of environmental information in the IDP and related processes (Sowman and Brown 2006). This may in part be ascribed to the fact that the introduction of the concept of sustainability into the field of urban and regional planning has emerged largely from outside the national departments in control of planning (Harrison et al. 2008). Other contributing factors include the provision of basic services, the primary delivery focus and often the most prominent criterion of political accountability at municipal level. Under these circumstances, the environmental dimensions are often perceived as subservient to the improvement of basic services and housing conditions. Moreover, the Performance Management Systems of municipalities have a very strong operational and project-level focus, and seldom assist in measuring and monitoring overall development

sustainability within a municipal area, particularly from a spatial planning viewpoint. A review of the effectiveness of Strategic Environmental Assessment (a tool often used to improve the sustainability aspects of spatial planning) concluded that strategic environmental assessments (SEAs) generally failed to inform or influence decision-making and is ultimately failing to achieve their objectives within the South African context (Retief 2007).

Based on these arguments, the evaluation of the SDFs focused on the following elements:

- Is there a clearly defined set of sustainability principles included in the SDF?
- Is there explicit and clear integration of the spatial development framework with a SEA or environmental management framework?
- Are the SDF strategies and conceptual proposals informed by ecological or environmental sensitivity mapping?
- Do clearly defined sustainability indicators and targets form part of the SDF?

The results portrayed in Table 6 show varying levels of response and commitment to the need for addressing sustainability issues in spatial planning. As a fundamental point of departure, slightly more than half of the plans evaluated contained, at the very least, a clearly defined set of sustainability principles to guide the SDF proposals. However, moving to the implementation of these principles at a more practical level, the results indicate that techniques such as Strategic Environmental Assessments and ecological sensitivity mapping were much less widely applied. A number of the evaluated plans seemed to have used these techniques, judging by references to these plans in related municipal planning processes, but without any clear evidence of the application or integration of these processes in the spatial plan. More important, only one of the plans evaluated contained clearly defined sustainability indicators and targets for measuring the impact and success of the SDFs.

Spatial Planning and Informality

Informality in the urban landscape can extend to various dimensions such as infrastructure provision, land and housing, and decision-making processes (Roy 2005). In the South African context, the concept of urban informality is associated with informal economic sector activities and informal housing and services, both often including some measure of illegality. South Africa has a vibrant and growing informal economy

Table 6 Responses to sustainability issues in spatial planning

Dimension	Yes	Implied	No
Is there a clearly defined set of sustainability principles included in the SDF	8	–	7
Is there explicit and clear integration of the SDF with a strategic environmental assessment (SEA) or environmental management framework (EMF)	4	6	5
Are the SDF strategies and conceptual proposals informed by ecological or environmental sensitivity mapping	4	3	8
Are there clearly defined sustainability indicators and targets forming part of the SDF	1	1	12

(Ligthelm and Masuku 2003) and it is estimated that approximately 10 % of potential retail trade, amounting to approximately R38 billion, is channelled through informal outlets, and that approximately 1.25 million people owe their existence to informal retail business activities (Ligthelm 2004). In 1996, approximately 403,000 households resided in informal backyard structures and 1.05 million households in informal structures in freestanding settlements (Statistics South Africa 1996). Despite the noble intentions of the government to eradicate informal housing within a period of 20 years, the sobering reality is that the number of households living in informal backyard structures has nearly doubled, increasing to approximately 713,000, and the numbers in informal settlements risen to 1.25 million by 2011 (Statistics South Africa 2011). These trends are also prevalent elsewhere in Africa with many governments accepting the growing poverty and informality of their towns and cities as inevitable (Turok and Parnell 2009).

From a planning and policy perspective, the informal sector has received considerable prominence. In economic terms, it has often been referred to as the ‘second economy’, engendering a preoccupation among policy-makers to develop and formalise this sector. Within the housing context, the focus has remained consistently on the eradication of informal settlements. In LeVrebian terms, the contrast between the reality of informal activities and localities on the one hand, and the abstract spaces of the planned city with spatial and land use plans on the other (Leveuvre 1991) poses the challenge of how planning and policy-making in general, and spatial planning in particular, should respond to this dichotomy. The NDP recognises that informal settlements provide the poor with affordable access to urban land and housing and expresses the view that there is insufficient understanding in policy of the informal strategies and livelihoods of the poor (National Planning Commission 2012). Harrison et al. (2008, p.225) however note that “despite stated policy claims that the informal sector is an important source of jobs, income and shelter for the poor, it is still subject to spatial marginalisation and control at the level of cities...”. Consequently, the analysis of the urban spatial plans sought to establish the extent to which the role of the informal sector is recognised in spatial strategies and proposals (Table 7).

The review of the SDFs clearly indicates that informality largely remains unrecognized in spatial planning. Only two of the plans reviewed contained explicit strategies relating to the informal sector, with a further six reflecting some strategies that at least imply consideration of some informal sector aspects. Those plans that did include strategies relating to the informal sector dealt almost exclusively with the upgrading of informal housing settlements and broad strategies for the management and control of informal trading areas. The interchangeable use of the terms ‘informal trading’ and ‘Small, Medium and Micro Enterprises’ also suggests a limited

Table 7 Responses of spatial planning to informality

Dimension	Yes	Implied	No
Explicit strategies for the informal sector in spatial plan	2	6	7
Explicit spatial proposals for the informal sector	1	1	13

understanding of the precise nature and operation of the informal economic sector. While some of the plans contained a spatial analysis of the location and extent of informal settlements as part of the analysis component, only one of the plans reviewed reflected any clear spatial proposals for the informal sector in its future spatial development plan. It could possibly be argued that the urban municipalities believe their spatial development plans are of a visionary nature, and that the informal sector generally has negative connotations, hence their reluctance to recognise and accommodate it in their future spatial development plans. The official statistics on the extent of informal housing and recent research on informal traders in four South African cities (Horn 2011) suggest however that the informal component of South African cities is likely to remain an inherent component of the urban landscape in the foreseeable future, and will require more than a fleeting reference in the spatial plans of these areas. The recognition in the National Development Plan of the role played by informal settlements also suggests the need for a much stronger focus on this element in future spatial planning.

Monitoring the Influence and Impact of Spatial Plans

The guidelines for the formulation of SDFs (Republic of South Africa 2011b) identified the establishment of targets to measure the success of plans as one of the key challenges in creating practical SDFs. In view of the importance attached to redirecting the form and structure of South African cities and the processes guiding this redirection, there is a surprising paucity of empirical evidence to evaluate and compare changes in both South African city structure and the role of new spatial policy and planning instruments since 1994. The extent of support for SDFs, which would improve their status and role in guiding decisions made by municipalities, is also questionable. A critical component determining the level of success of spatial plans is their ability to position informed intellectual arguments, so that they have significance in political contexts (Healy 2007). A key element of the ability to formulate and communicate these arguments is clear and easily understandable indicators reflecting the objectives and progress of spatial strategies and proposals. This suggests the need for a stronger analytical and technical basis for planning than has generally been the case in the past (Todes 2008). Despite the increasing availability of GIS and other data, the required statistical, analytical and planning support capabilities are generally still poorly developed and used (Van Huysteen et al. 2009).

The guidelines for the formulation of SDFs (Republic of South Africa 2011b) have taken the first tentative steps in this regard and identified some aspects of spatial plans that should be monitored and for which key performance indicators need to be developed. These include indicators for evaluating the desired spatial form, progress in addressing issues and needs, and decision-making in development applications. However, apart from illustrative density factors and their potential application, no quantified guidelines or spatial statistical indicators are provided. Specific elements of urban spatial plans that must be evaluated to respond to this challenge include the use and application of spatial statistical techniques for analysis purposes and informing strategies, the identification of monitoring indicators and the inclusion of a set of quantified spatial development targets (Table 8).

Table 8 Responses to the need for spatial impact monitoring

Dimension	Yes	Implied	No
Use and application of spatial statistical analysis techniques	1	7	7
Indicators for monitoring the implementation and impact of the SDF	2	2	11
Inclusion of quantified targets for evaluating the impact of the SDF	1	6	8

The use of appropriate spatial statistical analysis techniques is implicit to any approach where quantifiable indicators and targets are required to measure and evaluate the impact of spatial development strategies and proposals. Only one of the urban spatial plans reviewed contained results and proposals based on the application of these techniques. The narrative discussion in seven other plans suggests that some of these techniques may have been applied, although the SDFs do not contain clear outputs or results of these analytical processes. The identification and use of indicators and the inclusion of quantified targets to monitor the implementation and impact of spatial plans remains largely unresolved; these elements were only addressed comprehensively in two of the plans reviewed. In those instances where the use of indicators or targets was implied through brief references in the narrative component of the plans, the focus was mainly on residential density targets for specific areas or proposed land use budgets for new development areas. Indicators and targets to evaluate the aggregate impact of spatial strategies and proposals at an urban level is therefore still an element absent from most urban spatial plans. The recommendation of the National Development Plan suggesting the development of “...a robust set of indicators as part of a spatial governance and evaluation framework” (National Planning Commission 2012, p. 289) will require significant augmentation in the future review of spatial plans.

Conclusion

The findings of this research identified seven key challenges impacting the effectiveness of urban spatial planning in the democratic era since 1994. The NDP recognises that planning instruments have to be sharpened to enable the necessary reconfiguration of cities and towns, and devised a range of specific recommendations to achieve this goal. A summary of the potential impact (either directly or indirectly) of the seven identified challenges on the recommendations of the NDP is outlined in Table 9 and indicates substantial relevance to the NDP recommendations for transforming human settlements. This suggests that appropriate responses to these challenges will be required to enable successful implementation of the NDP recommendations.

The latest generation of spatial plans indicate moderate progress in several aspects—the horizontal and vertical alignment of spatial planning processes between adjacent municipalities and between different spheres of government, as well as the integration of sustainability principles into spatial planning processes. Some limited progress was noted in the larger metropolitan municipalities in the analysis and understanding of the urban space economy, and some of these municipalities have

Table 9 Implications of identified challenges for NDP recommendations

NDP recommendation	Institutional coordination and alignment	Physical and social economic integration	Understanding the space-economy of cities	Infrastructure development and capital investment	Spatial planning and sustainability	Spatial planning and informality	Monitor influence and impact of plans
1. Reform current planning system	■						□
2. Review grant and subsidy regime for housing		□	□	□			□
3. Land markets that work more effectively for the poor			■			□	□
4. Establish a national spatial restructuring fund		■		■	□		□
5. Instruments to support transition to environmental sustainability					■		□
6. Develop clear enabling legal and institutional framework	■		□	□			□
7. Recognise the role played by informal settlements			□			■	□
8. Support to rural spatial development							□
9. Give necessary attention to implementation	□						■

■ = Direct impact □ = Indirect impact

introduced innovative measures to improve the alignment of infrastructure development and capital investment with spatial planning. However, very little progress is evident with the other challenges. Despite the principle of physical and socio-economic integration remaining central to the spatial planning policy agenda since 1994, it has been one of the identified areas of concern where very little substantial progress has been made. This also applies to the informal sector, which still remains largely marginalised from the mainstream spatial planning processes, and the use of indicators and quantified targets to monitor implementation and impact being absent from most urban spatial plans.

The application of innovative spatial statistical techniques is a cross-cutting theme. Not only will it greatly enhance the understanding of these issues, but also provide the basis for formulating appropriate and robust indicators and targets to monitor the impact of spatial plans. This confirms the earlier view of Todes (2008) who identified the need for a much stronger analytical and technical basis for spatial planning than has generally been the case up until now. These techniques and indicators have to be introduced within the wider contextual debates on the efficiency of urban form and arguments for restructuring South African cities. The emergence of modern computing technology over the last decade changed the science of analysing and modelling urban form beyond recognition, and opened up new avenues for innovative spatial and statistical urban analysis. This certainly does not imply a return to the ‘black box’ type modelling of the 1970s and 1980s, but the use of innovative spatial and statistical analysis to supplement the qualitative and participatory techniques developed since 1994.

These spatial and statistical techniques must address all three dimensions of urban form and function (density, diversity and spatial structure pattern). Density measures refer to the degree of activity intensity within a defined space (such as various types of density measures) whereas diversity refers to the composition and manner in which a variety of land uses interact. The third category of urban form measures the spatial structural patterns of cities and can refer both to the overall spatial structure of an urban area (e.g. monocentric versus polycentric, centralised versus decentralised), or more detailed patterns expressed by spatial geometry, and quantified through spatial metric concepts such as compactness and centrality. Generally, far less knowledge

exists on urban form at an overall metropolitan level than at intermediate or lower levels of spatial aggregation (Tsai 2005). For analysis and monitoring purposes, it is therefore imperative to include appropriate measures of overall urban form ('global statistics') in addition to the more widely used indicators at lower levels of spatial integration ('local statistics'). The full impact of spatial policies and plans on urban form can only be judged based on a comprehensive and multi-dimensional evaluation of all three of these dimensions.

The results of this research should also be interpreted within the context of the limitations of the study. The reflections on the responses to the key challenges identified from the literature review and contained in the SDFs of cities are based on a sample of 15 of these plans. The sample may be too limited to generalise the findings to all urban areas in South Africa. However, the cities that were included as part of the evaluation represent approximately 50 % of the total urban population of South Africa, and is therefore representative of those plans affecting a substantial proportion of the country's urban population. A further consideration is that the results only reflect the documented outcome and not the planning processes that led to these plans. It therefore does not offer insights or explanations of the institutional and procedural aspects contributing to the identified challenges. It is recommended that this aspect be more fully explored to understand the underlying causes and factors resulting in these challenges. An improved understanding of these factors, together with the insights and recommendations from this research, could make a significant contribution to improving the urban spatial planning process and realising the vision for the NDP to transform human settlements in South Africa.

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APPENDIX E

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The Evolving Spatial Structure of South African Cities: A Reflection on the Influence of Spatial Planning Policies

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ABSTRACT *The need to transform the structure and morphology of South African cities remained high on the policy agenda of all three spheres of government in South Africa since 1994. The influence of a range of spatial policies and planning instruments aimed at achieving more compact urban structures and higher densities are evaluated through the application of a range of density indicators and models. A number of defining characteristics and distinct variations of density models applicable to South African cities are identified and compared to the profile of some international cities. The results confirm modest increases in densities and changes to urban form, as envisaged by spatial policies and plans. The observed patterns and changes suggest an emerging trend of more decentralized urban structures in South Africa.*

Introduction

Many of the contemporary debates over the efficiency of urban form have focused on the two opposing concepts of monocentric forms normally associated with compact development (characteristic of many European cities) and urban sprawl associated with decentralized development patterns often ascribed to the character of cities of the USA (Brueckner 2000; Johnson 2001; Frenkel and Ashkenazi 2008). The debates over the merits of compact or decentralized cities are however far from settled (Reid 1994; Soja 2000; Dieleman and Wegener 2004; Bruegman 2005; Cox 2006; Geurs and Van Wee 2006) and the emergence of polycentric urban forms as an alternative model somewhere between these two extremes have contributed a further range of arguments to enrich this discourse (Tsai 2005). Despite the vigour of these arguments, comprehensive comparative studies are less abundant and quantitative measures have only relatively recently started to influence these

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debates (Galster et al. 2001). These studies traditionally focused on cities of the global North (e.g. Burton 2002; Kasanko et al. 2006; Griffith and Wong 2007; Guerois and Pumain 2008; Schwarz 2010) and although these types of studies have gained some momentum in developing countries (e.g. Lopez et al. 2001; Barredo et al. 2004), comparisons of urban form between the Global North and South have, however, not been intensively researched (Huang, Lu, and Sellers 2007).

These debates on urban form also remained central on the urban spatial planning policy agenda in South Africa since the dawn of the democratic dispensation in 1994. Nearly three-quarters (71%) of South Africa's population live in a limited number of cities and towns and have well-established local economies that account for 92% of all formal economic activity (Republic of South Africa 2009) and these policy directions thus influence a significant proportion of the population and space economy of the country. The unique elements of the structure and morphology of South African cities are one of the most visible and lasting legacies of the planning ideology during the apartheid era and its characteristics have been well researched and documented (e.g. Simon 1989; Van der Merwe 1993; Maylam 1995; Christopher 2001; du Toit 2007).

South African urban form is generally characterized by distorted spatial patterns, underdeveloped public transport infrastructure, unequal access to economic and social opportunities, and poorly located lower income settlements. In an attempt to redress these shortcomings, the spatial planning policy framework has undergone fundamental changes since 1994. Central to these policy objectives is a more compact urban form, higher densities, the promotion of mixed land uses, and integrated transport and spatial planning decisions (Turok and Parnell 2009). The National Urban Development Framework (NUDF) identified greater urban integration and densification as one of its outcomes to improve urban form and sustainability (Republic of South Africa 2009). These concepts are also echoed in the official guidelines for the formulation of spatial development frameworks, (Republic of South Africa 2011a) which include a set of good principles for spatial planning. These include among others efficient urban structure, compaction, and densification. The concepts of 'compaction' and 'densification' of urban form thus became entrenched in the South African spatial planning policy and approach since the early 1990s and can be viewed as a key element of the overarching South African 'spatial planning doctrine'.

The effectiveness and impact of urban spatial planning policies and plans in the post-apartheid era and its impact on restructuring South African cities are however increasingly being questioned. Both Robins (2002) and Pieterse (2004) contends that despite the substantial planning resources aimed at restructuring the apartheid city structure, South African cities 'may be as segregated and fragmented as they were at the dawn of the democratic era'. These viewpoints also found resonance in official policy documents. The NUDF states that policies since 1994 have not succeeded in restructuring the apartheid spatial patterns of South Africa's cities and towns (Republic of South Africa 2009). The National Planning Commission subsequently also expressed the opinion that the spatial legacy of apartheid has probably been aggravated since then (Republic of South Africa 2011b). The National Development Plan 2030 recognizes that densities have increased in some urban areas and that the partial regeneration of inner cities has been achieved, but states that little progress has been made in reversing apartheid geography (National Planning Commission 2012).

The apparent limited impact of spatial planning processes and plans can be attributed to a number of factors. This range from problems relating to institutional coordination and alignment of spatial planning (Turok and Parnell 2009; Republic of South Africa 2011b), to the

integration of spatial planning with infrastructure and capital investment (Harrison, Todes, and Watson 2008; Todes 2008), and a lack of understanding of the space economy of South African cities (Serfontein and Oranje 2008; Van Huysteen et al. 2009). Despite the fact that the concepts of 'compaction', 'densification', and 'integration' have been part of the South African spatial planning nomenclature since 1994, the actual implementation of these concepts in a quantifiable sense remained vague. Although the guidelines for the formulation of Spatial Development Frameworks (Republic of South Africa 2011a) identified the monitoring of spatial form through the application of key performance indicators, no clear guidelines or spatial statistical indicators are provided (apart from illustrative density factors and their potential application). There is also a surprising paucity of comprehensive cross city comparative empirical evidence to evaluate the changes of South African city structure since 1994 and critically reflect on the impact of the new generation spatial policy and planning instruments. This suggests the need for a much stronger analytical and technical basis for spatial planning than has generally been the case till now (Todes 2008). These challenges are not unique to South Africa and the lack of consensus on the exact interpretation of concepts such as compact cities and quantitative indicators for measuring these aspects has also been identified elsewhere (Burton 2002; Pratt and Larkham 2010).

This article contributes to an improved understanding of changes to the urban form and density of South African cities since 1994 against the background of spatial plans and policies influencing these aspects. The fundamental aspects in the measurement of urban form and density are first described as a basis for identifying and selecting appropriate techniques and spatial indicators. These indicators are then applied to a cross section of eight South African cities with the aim of answering four questions:

- Does the range of basic population density indicators reflect an increase in density since 1994?
- Is the double density gradient model applicable to South African city structure and are there specific variations between larger metropolitan areas and smaller intermediate cities?
- Are the changes in the double density gradient model parameters since 1994 indicative of compact growth and densification?
- Does the evolution of urban spread over time since 1994 provide any indication of densification or compaction of the urban structure in relation to the city centre?

These results provide the basis for reflecting on the potential influence of relevant spatial plans and policies on urban form and density since 1994.

Indicators for Measuring Urban Form and Density

Approaches to the Statistical Measuring of Urban Form

Many urban form indicators and models have been introduced within the wider contextual debates on the efficiency of urban form and arguments based for and against the opposing concepts of urban sprawl and compact city form. The emergence of modern computing technology added a further dimension to the science of modelling urban form and changed this field of study beyond recognition over the last two decades. This opened up avenues for alternative measures of urban form at both a global and local level using

geospatial statistics and the simulation of urban development patterns making use of cellular automata and agent-based models (Batty 2007).

In a general sense, the analysis of urban form can be classified into three main categories: density, diversity, and spatial-structure pattern (Tsai 2005). The first category (density measures) refers to the degree of activity intensity within a defined space and includes various indicator types such as built-up areas, residential land use, land consumed by urban expansion, population density, and urban density (Kasanko et al. 2006). The second category (diversity) refers to the spatial scale, composition, and manner in which a variety of land uses interact (Cervero and Kockelman 1997; Douglas 1998). It has been argued that various land-use mix indicators can reflect on the economic, social and economic aspects of urban sustainability (Song and Rodriguez 2005). The third category of urban form deals with the spatial structural patterns of cities. This concept can refer both to the overall spatial structure of an urban area (e.g. monocentric versus polycentric, centralized versus decentralized) and more detailed patterns expressed by spatial geometry and quantified through spatial metric concepts, such as compactness, centrality, and porosity (Herold, Schepan, and Clarke 2002; Huang, Lu, and Sellers 2007; Schwarz 2010). This category also includes measures of the level of spatial clustering by applying techniques such as the global Moran and Geary coefficients (Anselin and Getis 1992; Zhang and Lin 2006; Anselin 2012). It is claimed that far less knowledge exists on urban form at an overall metropolitan level than at intermediate or lower levels of spatial aggregation (Tsai 2005). For comparative studies of urban form it is thus imperative to include appropriate measures of both overall urban form ('global statistics') and the more widely used indicators at lower levels of spatial integration.

Measuring Urban Density as One of the Three Main Components of Urban Form

The availability of appropriate data and the delimitation of urban areas are two of the most fundamental aspects influencing comparative urban density studies and models (Coombes and Wong 1994; Antrop 2004; Guerois and Pumain 2008). Where data are available, there is often the further complicating matter of a lack of agreement on the appropriate definition and approach to the delimitation of urban units (Brezzi et al. 2012). The definition of what constitutes urban areas differs significantly between countries (Ballas, Kalogeris, and Labrianidis 2003; Champion 2009) and complicates cross country comparisons. Schwarz (2010) found that the analysis based on the data of the administrative urban area and the sealed urban area resulted in different behaviour from population-related indicators.

The quantitative analysis of urban density patterns is also closely associated with the notion of 'compact cities'. The most common interpretation associated with the idea of compact cities is associated with the concept of high densities (McLaren 1992) and with travel behaviour and the provision of sustainable public transport infrastructure (e.g. Stead and Marshall 2001; Kenworthy 2006). The related concept of mixed used cities in spatial planning terms is often associated with the creation of a lattice structure consisting of high-intensity nodes linked by activity corridors focused around public transport routes (Newman 1992; Nijkamp and Rienstra 2010). In the South African context, the NUDF identified measures that will promote greater urban integration and densification (particularly along the major transport corridors) as an important element to improve urban form and sustainability (Republic of South Africa 2009). The processes leading to the compaction of urban form at different scales (intensified cities) are often supported

by spatial policies that generally take the form of either measures for limiting lateral growth or incentives for infill development and consolidation (Burton 2002).

Quantitative indicators for measuring the size and density of urban form should address a number of related elements. The first element includes various measures of population density and is regarded as the most common measure of urban form (Burton 2002; Guerois and Pumain 2008). The strength of these basic indicators is that it is normally relatively easy to obtain data and that it provides a useful baseline for comparative cross-city analysis. A shortcoming of traditional density measures is its sensitivity to methodological issues around the delimitation of urban areas and population figures based on administrative boundaries. It is also inadequate for describing spatial variation of intensity within a given urban area. Indicators falling within this dimension include gross population density, net population density, housing stock composition, and measures of the spatial variation of population density.

The second element focuses on built-up densities and is generally measured by exponential or power functions based on the principle of a continuous gradient of decreasing built-up densities (Bertaud and Malpezzi 2003). Guerois and Pumain (2008) identified two areas of criticism against these traditional exponential or power functions. First, the urban form of many cities is characterized by a significant break in the value of built-up densities instead of a progressive decrease. Secondly, abrupt breaks in the built-up density profiles of cities can be more adequately described by a double linear adjustment than negative power or exponential fits. They introduced a double linear function as an alternative measure of urban built-up density to account for this problem. This double linear function differentiates between central and peripheral gradients of built-up surfaces (Guerois and Pumain 2008) and is based on the notion of a strong urban centre and its influence on the organization of space at different gradients from centre to periphery. Its basic unit of measurement is the ratio of the built-up surface area to the total surface area of consecutive 1 km concentric rings from historic city centres to provide an estimation of the mean built-up density within each zone (Figure 1).

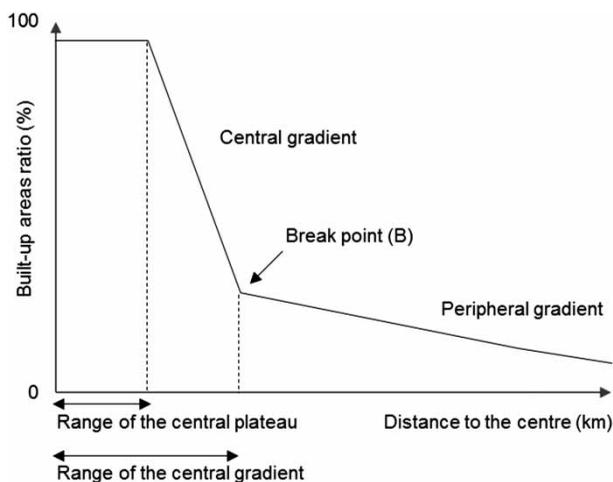


Figure 1. Basic concepts of double linear density model.

Source: Guerois and Pumain (2008).

The key characteristics of this model as described by Guerois and Pumain (2008) include a central plateau represented by the first few kilometres around the urban centre with a highly saturated built-up pattern (which can extend up to 10 km from the urban centre), followed by a central gradient beyond this threshold with a rapid decrease in built-up form in urban space. The peripheral gradient from the breakpoint towards the periphery reflects a fairly gradual and uniform decrease in built-up form. This breakpoint between the central and peripheral gradient is of specific interest, as it reflects a change in the urban built-up pattern. The advantages of this double density gradient model are that it enables comparisons between cities in the absence of standardized definitions of urban boundaries and it is not dependent on the size of basic statistical units. This model is however less accurate for measuring the intensity of the urban field than population figures. In the absence of the third dimension (building heights), it will generally underestimate the occupation of the densest zones containing the tallest buildings (Guerois and Pumain 2008). The double density gradient model is most appropriate for evaluating the urban structure which generally conforms to the European tradition of historically strong monocentred cities, and may be less applicable to polycentred urban areas. Griffith and Wong (2007) in their study of density across major US cities emphasized the importance of introducing polycentric specifications in the modelling of urban population densities in polycentric cities.

The third element of measuring urban density patterns also utilizes the basic concentric-type of analysis of built-up form to measure the evolution of urban spread over time. This analysis measures the increase in built-up surface areas within constantly defined parameters and provides a clear indication of densification of built-up areas in relation to distance from the city centre.

A Comparative Analysis of South African Cities

The concepts of ‘compaction’ and ‘densification’ of urban form became entrenched in the South African spatial planning policy and approach since the early 1990s. These overarching urban spatial planning principles and objectives can be directly related to the three main elements of the analysis of urban form including size and density, land-use diversity and complexity, and spatial structure and geometry. The analysis presented in this article is specifically focused on the size and density measures of the selected cities and the potential influence of the relevant spatial policies and plans.

Spatial Policy and Planning Imperatives

The initial phase of the democratic era in South Africa between 1994 and 1996 was dominated by the Reconstruction and Development Programme focused on investment in infrastructure and basic services to address inequalities resulting from the apartheid era. It introduced a number of prominent spatial planning concepts such as ‘more compact cities’ (Republic of South Africa 1994, 83) and ‘densification and unification of the urban fabric’ (Republic of South Africa 1994, 86). The subsequent Development Facilitation Act (Republic of South Africa 1995) provides a set of normative spatial principles to guide the spatial content of planning, including principles to discourage urban sprawl and promote densification. The most prominent impact on spatial planning at an urban level has, however, been the entrenchment of the Integrated Development Planning

process through the promulgation of the *Local Government: Municipal Planning and Performance Management Regulations* in 2001 (Republic of South Africa 2001) requiring municipalities to prepare Integrated Development Plans including a spatial development framework.

Despite these national-level policy guidelines, the response at an urban level has been varied. The Department of Rural Development and Land Reform undertook a countrywide evaluation of all spatial development frameworks in South Africa during 2008. The results indicated that the quality of the spatial development frameworks was generally not of an appropriate standard and subsequently embarked on an initiative to prepare a set of standard guidelines for the formulation of spatial development frameworks aimed at improving the quality of these plans. These guidelines include a set of good principles for spatial planning, among others, socioeconomic and functional integration, efficient urban structure, and compaction and densification. The principle of efficient urban structure is primarily seen to be achieved through appropriate densification (guided by density targets) and the limitation of the lateral growth of settlements through the use of an urban edge (Republic of South Africa 2011a).

This national-level policy framework provides the parameters within which the broad principles can be translated into more detailed implementation proposals at an urban level. A summary of how these principles have been translated into spatial planning principles and priorities at an urban level as part of the municipal spatial planning process of the selected cities is given in Table 1. The three spatial planning elements common among almost all these plans are spatial and land-use integration, densification and intensification, and environmentally sustainable development.

Methodology

There is a surprising paucity of comprehensive multi-year and cross-city analysis of urban form and structure in South Africa. Studies that have been conducted are focused on specific individual cities or time periods and do not allow for cross-city comparisons based on a common point of departure and consistent data sources. One of the main reasons is the absence of a common set of land-use or land-cover data at an appropriate scale for multiple time periods (du Plessis, 2014). As with any set of indicators, the identification and selection of indicators should be a pragmatic process based on criteria of robustness, relevance, independence, transparency, comparability, longevity, and spatial flexibility (Booyesen 2002; McMahon 2002; Spangenberg, Pfahl, and Deller 2002; Russel and Thomson 2009). The criteria of robustness and comparability were key considerations in the selection of appropriate indicators from the potential candidates available and the selection of cities to form part of the study. Eight cities were selected for the purposes of the comparative analysis, including the four largest metropolitan areas of Johannesburg, Cape Town, Durban (eThekweni), and Pretoria (Tshwane), as well as four smaller intermediate-sized cities of Bloemfontein (Mangaung), Pietermaritzburg (Msunduzi), Nelspruit (Mbombela), and Witbank (eMalahleni) (Figure 2).

The selected cities are representative of different geographical regions in South Africa and from a practical point of view the selection was influenced by the availability of comparative detailed land-use data for the purposes of spatial and statistical analysis. The selected indicators had to be available for multiple time periods for all cities forming

Table 1. Summary of spatial planning principles and priorities

Spatial principles/priorities	Johannesburg	Cape Town	Ethekwini	Tshwane	Bloemfontein	Pietermaritzb	Witbank	Nelspruit
Spatial and land-use integration	✓	✓		✓	✓	✓	✓	✓
Densification, intensification, and infill development	✓	✓	✓	✓	✓	✓	✓	
Strategically located economic growth			✓	✓	✓	✓	✓	
Improved access to economic opportunities		✓	✓					
Sustainable development	✓	✓	✓	✓	✓	✓	✓	✓
Inclusiveness		✓						
Create opportunities for the poor			✓	✓				
Optimum use of current capacity			✓					✓
Efficient movement system	✓	✓		✓				

Source: City of Cape Town (2011), City of Johannesburg (2010), City of Tshwane (2007), Emalahleni Local Municipality (2011), eThekweni Municipality (2010), Mangaung Local Municipality (2010), Mbombela Local Municipality (2006), and Msunduzi Local Municipality (2009).

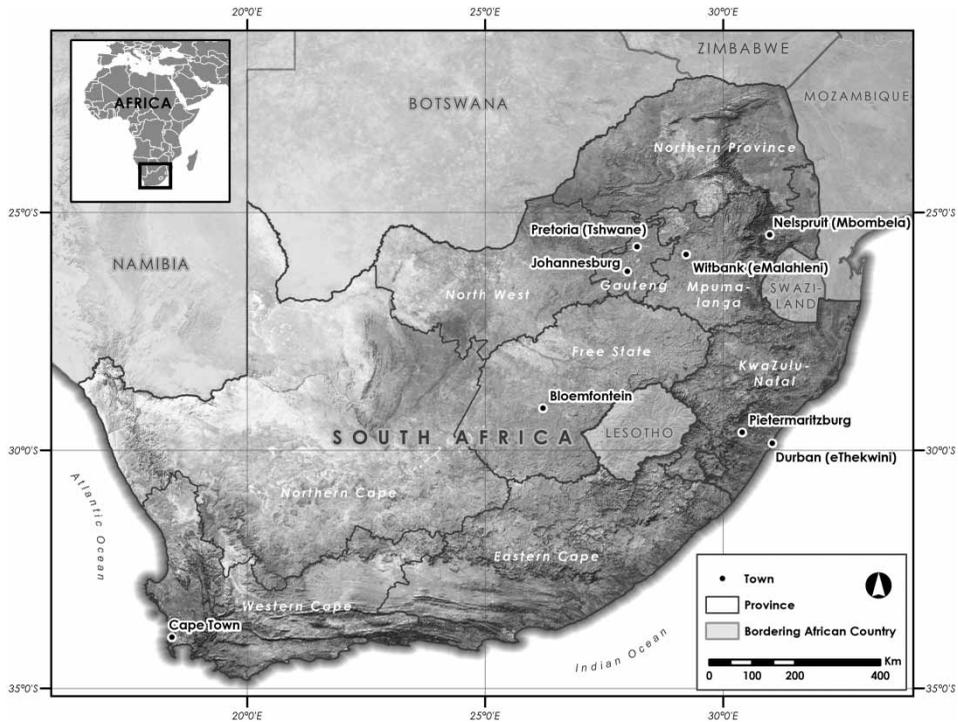


Figure 2. Location of study area cities.

part of the analysis and include measures from all three elements inherent to the measuring of urban density (Table 2).

All information relating to the built-up form of urban areas is based on a commercially available set of land-use data (GeoTerraImage (Pty) Ltd 2012). The Building Based Land Use[©]™ data-set contains buildings, structures, and other area-specific land uses as identified and mapped from high-resolution orthophotos as point data. The land uses are mapped using manual image interpretation techniques and classified into a standardized 70 class land-use classification using supplementary data-sets and fieldwork. These data sets undergo extensive quality control and validation to provide accurate and detailed land use for selected urban areas within South Africa. Two data-sets were used in each city: one as close as possible to 1994 and the other for the most recent time period for which data are available. The point data format is however not suitable for application to the selected indicators and was thus integrated with the latest available cadastral data for each city to produce a set of land-use data at the level of individual stands or land parcels as spatial unit of analysis. A Python script was developed in ArcMap 10 to integrate the land-use points and the erf boundaries and to consolidate the 70 land-use classes to 13 main classes. These classes include multiple residential, single residential, informal residential, mixed residential, commercial, industrial, transport and utilities, institutions, sport and recreation, mining, mixed land use, parks and conservation, and agriculture and forestry (du Plessis, 2014). The two classes of parks and conservation, and agriculture and forestry were not considered as part of the urban built-up footprint

Table 2. Selected indicators for measuring density patterns

Indicator	Unit	Sources
1.1 Gross population density	No people per ha within urban boundary	Burton (2002), Kasanko et al. (2006), Schwarz (2010)
1.2 Population per built-up urban surface area (net density)	No people per ha built-up footprint	Bertaud (2004), Burton (2002), Huang, Lu and, Sellers (2007), Schwarz (2010)
1.3 Net density per residential built-up area	No people per ha residential footprint	Burton (2002), Kasanko et al. (2006)
1.4 Density of densest ward	Persons per ha	Burton (2002)
1.5 Average density of four densest wards	Persons per ha	Burton (2002)
1.6 Variation in density across city	Variance calculated using statistical software	Burton (2002)
2.1 Extent and growth of built-up surface area	Annual percentage growth of built-up area	Kasanko et al. (2006), Guerois and Pumain (2008)
2.2 Annual growth of residential built-up areas	Percentage annual growth of residential built-up areas	Kasanko et al. (2006)
2.3 Ratio residential areas to total built-up area	Percentage residential of total built-up footprint	Kasanko et al. (2006)
2.4 Ratio population growth: built-up area growth area	Population growth rate/ built-up footprint growth rate	Kasanko et al. (2006)
3.1 Density gradient models	Functions relating density to distance from the city centre	Alonso (1964), Edmonston, Goldberg, and Mercer (1985), Guerois and Pumain (2008)
3.2 Densification of built-up surface areas according to city radius	Percentage growth of built-up area with distance from city centre	Guerois and Pumain (2008)

and excluded from the analysis. For the purposes of the double density gradient model, a multiple ring buffer of 1 km increments was created around historical city centres for each individual city. This buffer was overlaid with the reclassified erf boundaries to calculate built-up areas of various land-use categories per 1 km buffer ring (Table 3).

The population data are based on the results of the 1996 (municipal and enumerator-area levels) and 2011 (municipal and ward levels) national census. In the metropolitan areas of Johannesburg, Cape Town, Durban, and Pretoria, the urban footprint covers the entire municipal area and the total municipal population was applied. In the case of Bloemfontein, Pietermaritzburg, Nelspruit, and Witbank, the municipal area consists of a main urban centre, as well as a number of smaller towns and/or dense traditional settlement areas scattered across the area of jurisdiction of the municipality. In this instance, the urban built-up footprint and population figures were only applied to the main central urban area and not the isolated and scattered settlements. In these cases the population figures are based on the enumerator areas and wards falling within these urban centres only.

Table 3. Summary of cities analysed

City	Population (1996)	Population (2011)	Built-up footprint data used
Johannesburg	2,638,233	4,434,827	1994, 2009
Cape Town	2,563,095	3,740,026	1993, 2009
Durban (eThekweni)	2,745,926	3,442,361	1994, 2009
Pretoria (Tshwane)	1,665,391	2,675,701	1994, 2009
Bloemfontein (Mangaung)	249,646	362,351	1994, 2008
Nelspruit (Mbombela)	45,707	100,701	1992, 2009
Pietermaritzburg (Msunduzi)	258,266	507,736	1994, 2009
Witbank (Emalahleni)	143,861	266,664	1994, 2010

Analysis Results

Does the Range of Basic Population Density Indicators Reflect an Increase in Density since 1994?

The total population of the eight cities forming part of the study increased significantly from 10.3 million in 1996 to 15.5 million in 2011, representing a total growth of more than 50% (3.4% per annum). The average annual increase in the total built-up area in the four larger metropolitan areas varied between 1% and 1.5% in the case of Pretoria, Durban and Cape Town, to a much higher figure of 3.2% per annum in Johannesburg. To put these figures into perspective, the average annual growth of total built-up areas in 15 European cities from the 1980s to the 1990s ranged from 0.4% per annum (Bilbao and Palermo) to higher figures of 2.4% (Munich) and 2.5% in the case of Dublin (Kasanko et al. 2006). The growth rates of the residential built-up footprint generally far exceed the growth of the total built-up footprint. The average annual growth rate of the residential footprint ranged from 1.7% in Cape Town and Durban, to 2.6% in Pretoria and a significantly higher figure of 5.4% in Johannesburg. This trend in Johannesburg is also clearly depicted in the spatial analysis of the built-up footprint change (Figure 3(a)) showing large-scale urban expansion in the northern and northwestern parts of the city. The composition of the urban footprint can be expressed as the ratio of the residential footprint to the total urban footprint. This ratio ranges from as low as 37.2% in the case of Witbank to much higher figures in excess of 70% in Johannesburg, Durban, and Pietermaritzburg (Table 4). These ratios fall within the same general range as the figures reported by Kasanko et al. (2006), ranging from 45% in Bilbao and 48% in Bratislava to much higher ratios of 75% in Brussels and 79% in Palermo.

This rapid growth of the residential footprint is also reflected by the increase in this ratio in all eight cities. This trend is particularly noticeable in Johannesburg and Pretoria where the residential footprint as a proportion of the total footprint increased by 12.7% and 10.2%, respectively, between 1994 and 2009.

International comparisons of population densities based on the relationship between population figures and built-up surface areas revealed three distinct density categories: American cities with low densities generally below 25 persons per hectare, European cities generally ranging from 30 to 100 persons per hectare, and Asian cities generally in excess of 100 persons per hectare and often above 200 persons/ha (Bertaud 2004). In the study of 15 medium-sized and large European urban areas, Kasanko et al. (2006)

reported population densities between 5 and 55 persons/ha, while Burton (2002) found densities between 30 and 63 persons/ha in a study of 25 English towns and cities. The 2011 population density of the eight South African cities (persons per built-up area) ranges from 35 to 40 persons/ha in the intermediate-sized cities to between 40 and 70 persons/ha for the Metropolitan areas (Table 4).

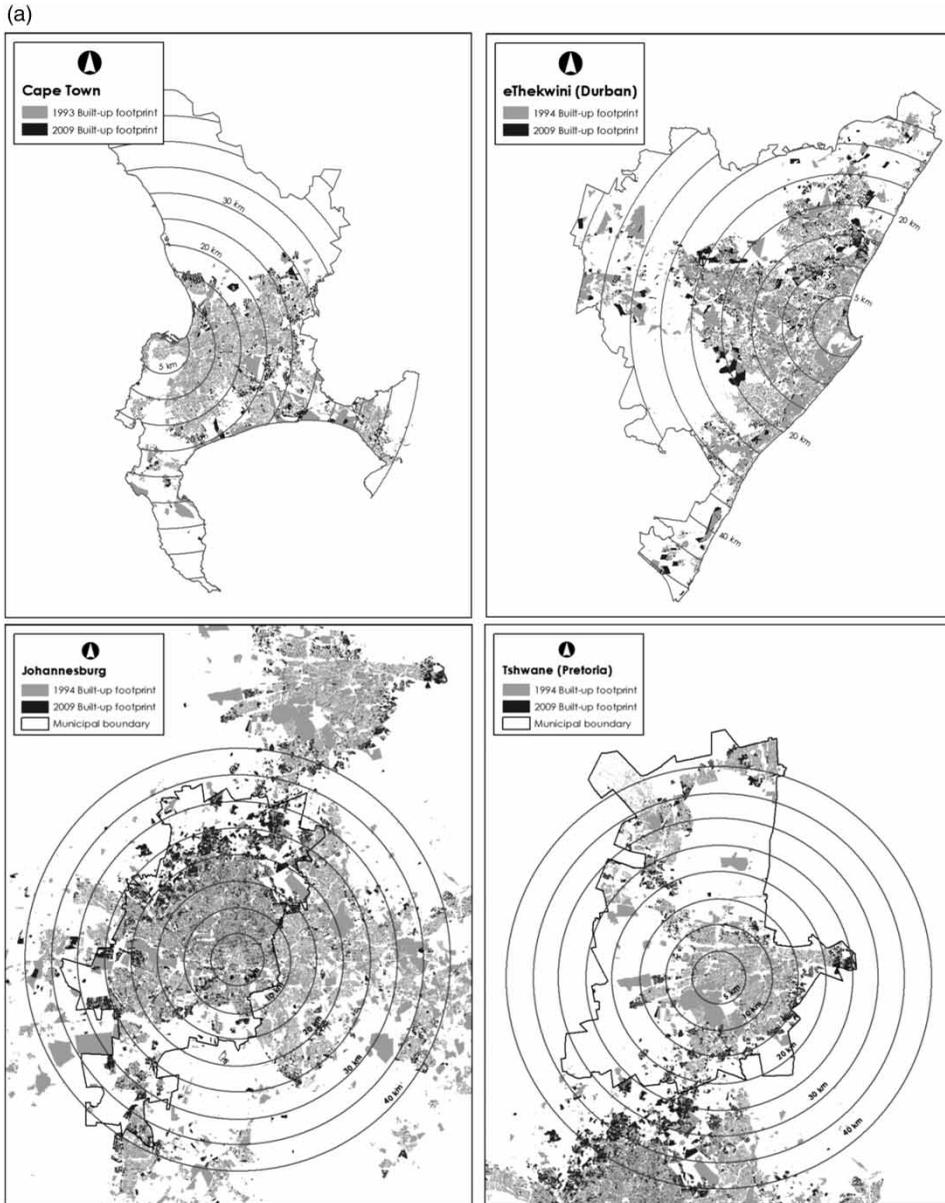


Figure 3. Changes in urban built-up footprint. (a) Cape Town, Durban, Johannesburg, and Pretoria. (b) Nelspruit, Bloemfontein, Witbank, and Pietermaritzburg.

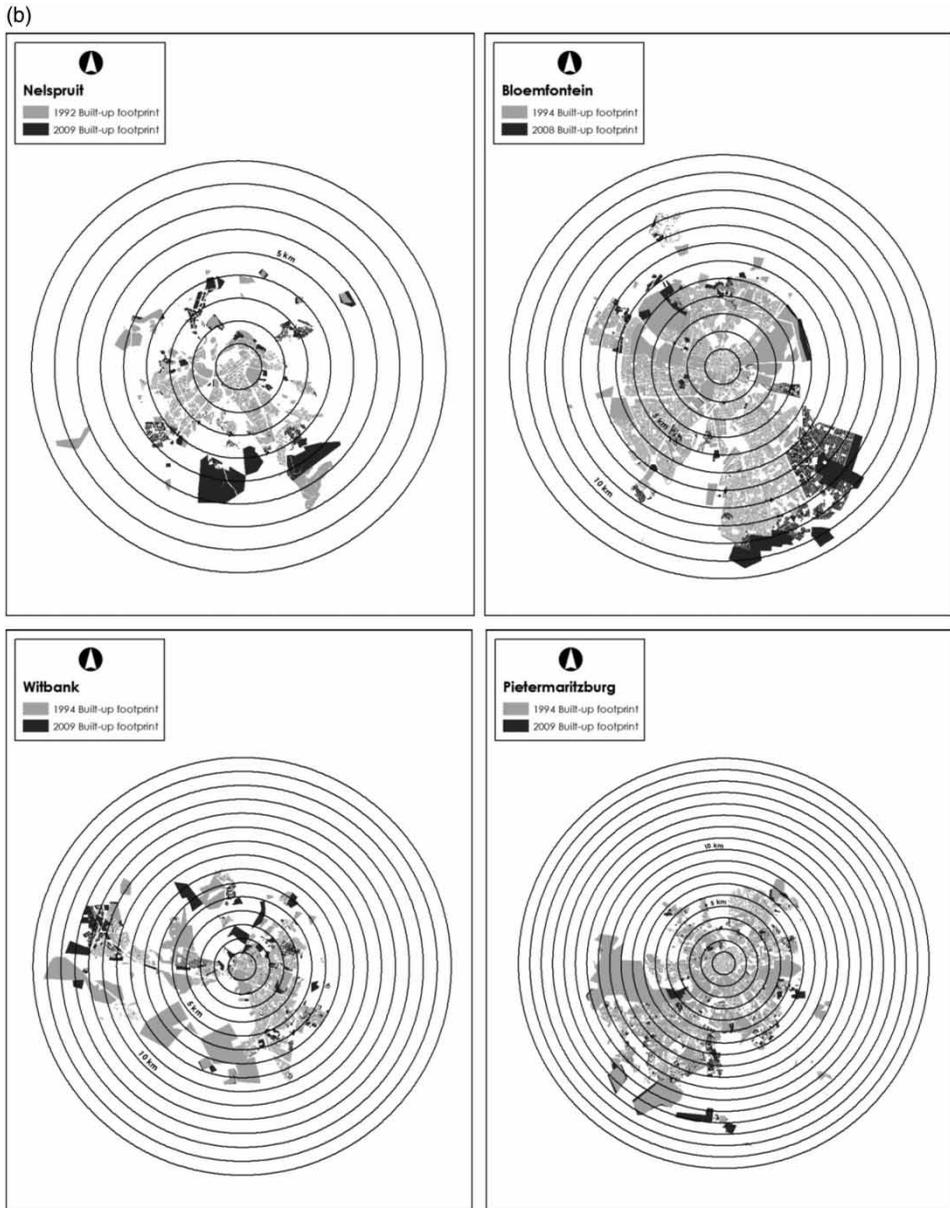


Figure 3. Continued

The overall population density has increased in all eight cities, ranging from a marginal increase of 1.4 persons/ha in the Durban Metropolitan area to more substantial increases of up to 13 persons/ha in Cape Town and 15 persons/ha in Pietermaritzburg. This increase in density in Cape Town is the result of a substantial population increase averaging 3.1%

Table 4. Urban density indicators

	Annual total built-up growth (1994–2009)	Annual residential built-up growth (1994–2009)	Population density 2011 (persons/ha)	Population density change 1996–2011 (persons/ha)	Population density per residential footprint 2011 (persons/ha)	Population density per residential footprint change 1996–2011 (persons/ha)	Residential footprint as % of total footprint (2009)	Residential footprint as % of total footprint change (1994–2009)	Ratio population growth/total footprint growth (1994–2009)
Johannesburg	3.2	5.4	55.6	6.8	79.3	–5.8	70.1	12.7	1.4
Cape Town	1.2	1.7	70.6	13.0	135.5	16.8	52.1	3.5	2.6
Durban	1.5	1.7	50.3	1.4	71.6	0.1	70.2	1.9	1.2
Pretoria	1.0	2.6	41.3	11.9	72.9	9.6	56.6	10.2	4.2
Pietermaritzburg	0.7	0.8	34.5	15.1	47.0	20.1	73.5	1.3	9.2
Bloemfontein	2.2	3.5	35.2	3.6	56.6	–1.4	62.1	7.7	1.4
Nelspruit	3.5	5.1	42.0	11.5	67.1	10.0	62.5	9.2	2.3
Witbank	1.6	2.8	34.2	11.0	92.0	20.0	37.2	4.9	3.5

over the period 1996–2011, while the overall city built-up footprint only increased by 1.2% per annum over the period 1993–2009. The opposite trend was experienced in Johannesburg characterized by a high population growth rate of 4.5% per annum between 1996 and 2011, accompanied by a city built-up footprint also increasing at a rapid rate of 3.2% annually over this period. The net effect is only a modest increase in net density from 48.8 persons/ha in 1996 to 55.6 persons/ha in 2011.

When relating urban population to only the residential footprint of the city, Cape Town reflects a substantially higher population density of 135 persons/ha compared to figures of between 70 and 80 persons/ha in the other three large metropolitan areas. Cape Town also shows the largest increase in net density relative to the residential footprint (an increase of 16.8 persons per hectare between 1996 and 2011). The rapid increase in the residential footprint of the city of Johannesburg resulted in a net population density decrease (measured relative to the residential footprint), despite substantial population increases. This trend is also evident in Bloemfontein where the growth rate of the residential built-up area outpaced the population growth rate.

A further reflection on population densities at a lower level of spatial aggregation is presented in Table 5. These densities are based on the population figures resulting from the 2011 South African census of which the first results at a spatially disaggregated level were released towards the end of 2012 at the ward level. The highest population densities measured at the ward level is prevalent in Johannesburg with a figure in excess of 1000 persons/ha for the densest ward. The comparative figures in the other three large metropolitan areas range from 184 persons/ha in Pretoria to 307 persons/ha in Cape Town, while those for the intermediate-sized cities are substantially lower. The average density of the four densest wards in each city shows similar characteristics with the highest figure in Johannesburg (704 persons/ha on average in the four densest wards) and much lower figures in the other cities ranging from as low as 9 in Nelspruit to 286 in Cape Town. The ward-level density patterns in Johannesburg are, however, highly variable with standard deviation values well in excess of the average ward-level density. In most other cities, the levels of variation in density are less pronounced with the standard deviation in all instances lower than the average density value for all wards. A study of 25 English cities and towns reported the average density of the four densest wards to range between 36 and 83 persons/ha (Burton 2002).

Table 5. Ward-level indicators

	Density of densest ward 2011 (persons/ha)	Avg density of four densest wards 2011	Avg ward-level density (all wards)	Ward density standard deviation
Johannesburg	1019.2	704.2	94.0	139.9
Cape Town	306.7	286.6	73.5	69.1
Durban	272.1	161.8	45.0	40.6
Pretoria	184.1	147.6	37.7	35.8
Pietermaritzburg	68.8	62.3	27.4	18.9
Bloemfontein	81.3	79.1	46.9	26.7
Nelspruit	22.5	9.1	6.3	8.9
Witbank	122.6	96.7	43.5	34.0

Is the Double Density Gradient Models Applicable to South African City Structure and Are the Changes in the Model Parameters Indicative of Compact Growth and Densification?

The results of the double density gradient model applied to the eight South African cities reveal a number of important characteristics. The first category is cities with no distinctive double linear pattern and where the density structure is best described by a negative linear relationship (Figure 4 (a) and 4(b)). This category includes Johannesburg and Pietermaritzburg. The second category roughly corresponds with the traditional double density gradient-type model characterized by a steep central gradient and a peripheral gradient with a gradual decrease in built-up density. Pretoria, Durban, Witbank, and Nelspruit fall in this category. However in the case of Pretoria and Durban the peripheral gradients have positive values of 0.1 and 0.3, respectively. This signifies a gradual increase in density from the breakpoint towards the periphery instead of the normal further gradual decrease in density. This pattern can be explained by the spatial structure (Figure 3 (a)) dominated by large and growing low-income settlements on the periphery of these two cities. The third category (Cape Town and Bloemfontein) can best be described as an 'inverse double density gradient model'. Both cities exhibit a bi-modal density pattern characterized by a relatively gradual decrease in density on the central gradient, followed by the more rapid decrease in the peripheral gradient. This is indicative of high levels of saturation of the urban built-up pattern in close proximity to the traditional city centre.

The average gradient of the central slope of the eight cities (including the values of the linear slopes of Johannesburg in Pietermaritzburg) implies a 4.3% decrease in built-up density for each kilometre outwards from the centre and a 1.4% decrease (excluding Johannesburg in Pietermaritzburg) on the peripheral gradient. Research in 40 urban areas in Europe found that the average slope of the central gradient represents a decrease of 9% in built-up density for each kilometre outwards from the centre, while the average slope of the peripheral gradient is only 0.3% per kilometre (Guerois and Pumain 2008). The average value of the central slopes of the eight South African cities is thus less than half the value of the European cities. The break-point distances of the four larger metropolitan areas (with their urban field extending to approximately 40 km) varies from 14 km in Cape Town to 20 km in Pretoria and 31 km in the case of Durban. The average distance to the break points in the European study was found to be 12.5 km ranging from minimum values of 6.7 km to a maximum value of 33.2 km (Table 6).

From a policy implication perspective the changes to the key values of the parameters of the double density model over time are probably more important than the absolute values. Theoretically, the movement of the break point either further away from the city centre or nearer to the centre may be indicative of the spread of the built-up urban footprint of the cities. Movements closer to the city centre and associated with an increase in the central gradient may be indicative of the impact of efforts to densify the urban footprint in proximity to the city centre. On the other hand, the movement of the break point away from the city centre and a decrease in the central gradient would signify dominant deconcentration forces further away from the city centre. Changes in the slope of the peripheral gradient are also indicative of either the reversal or persistence of entrenched historical spatial patterns (characterized by significant concentrations of high-density low-income population in peripheral areas). The most prominent trend between 1994 and 2009 is that the distance from the city centre to the break point has remained largely unchanged over this 15-year period,

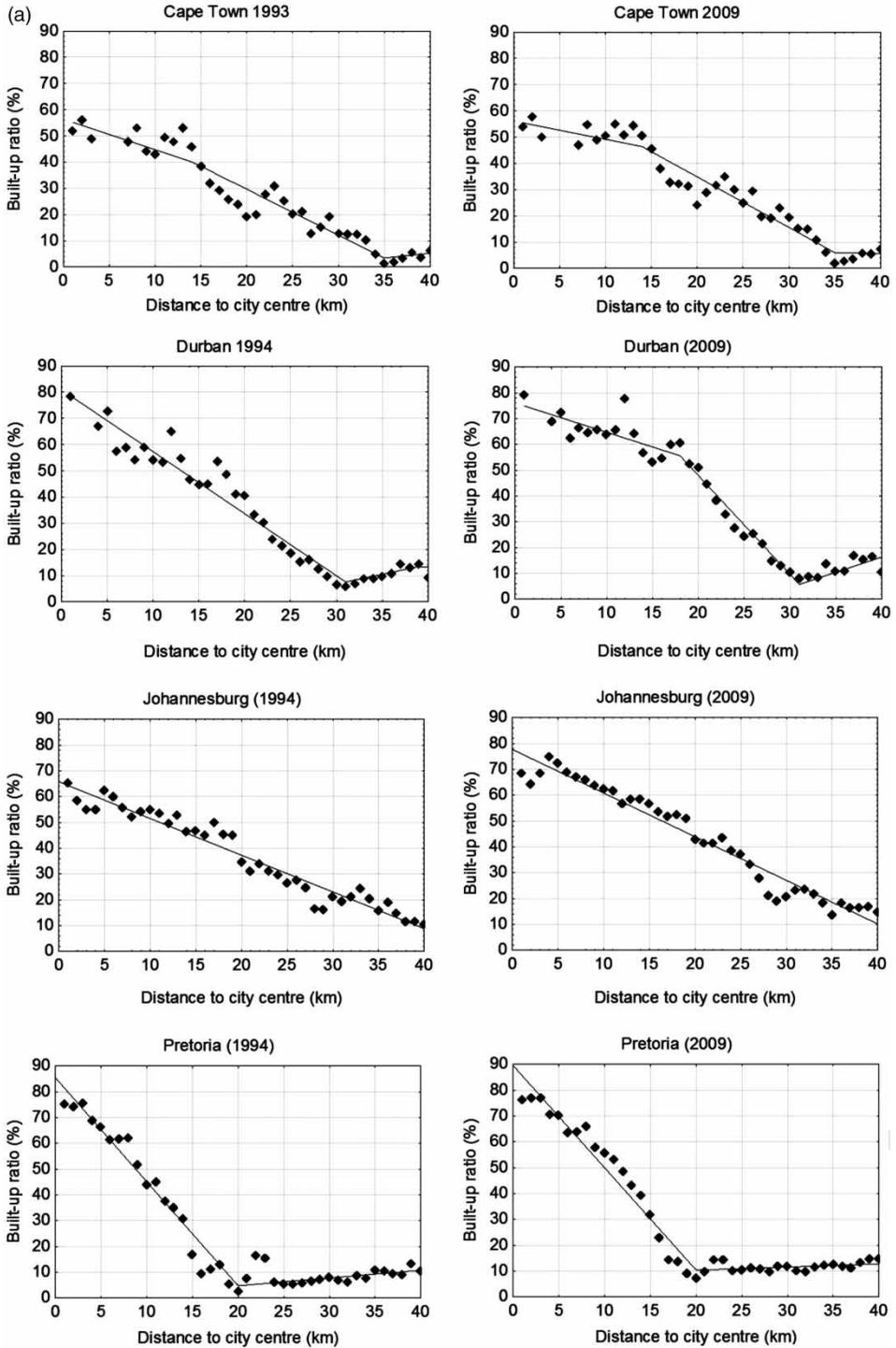


Figure 4. Double density gradient models. (a) Cape Town, Durban, Johannesburg, and Pretoria. (b) Nelspruit, Bloemfontein, Witbank, and Pietermaritzburg.

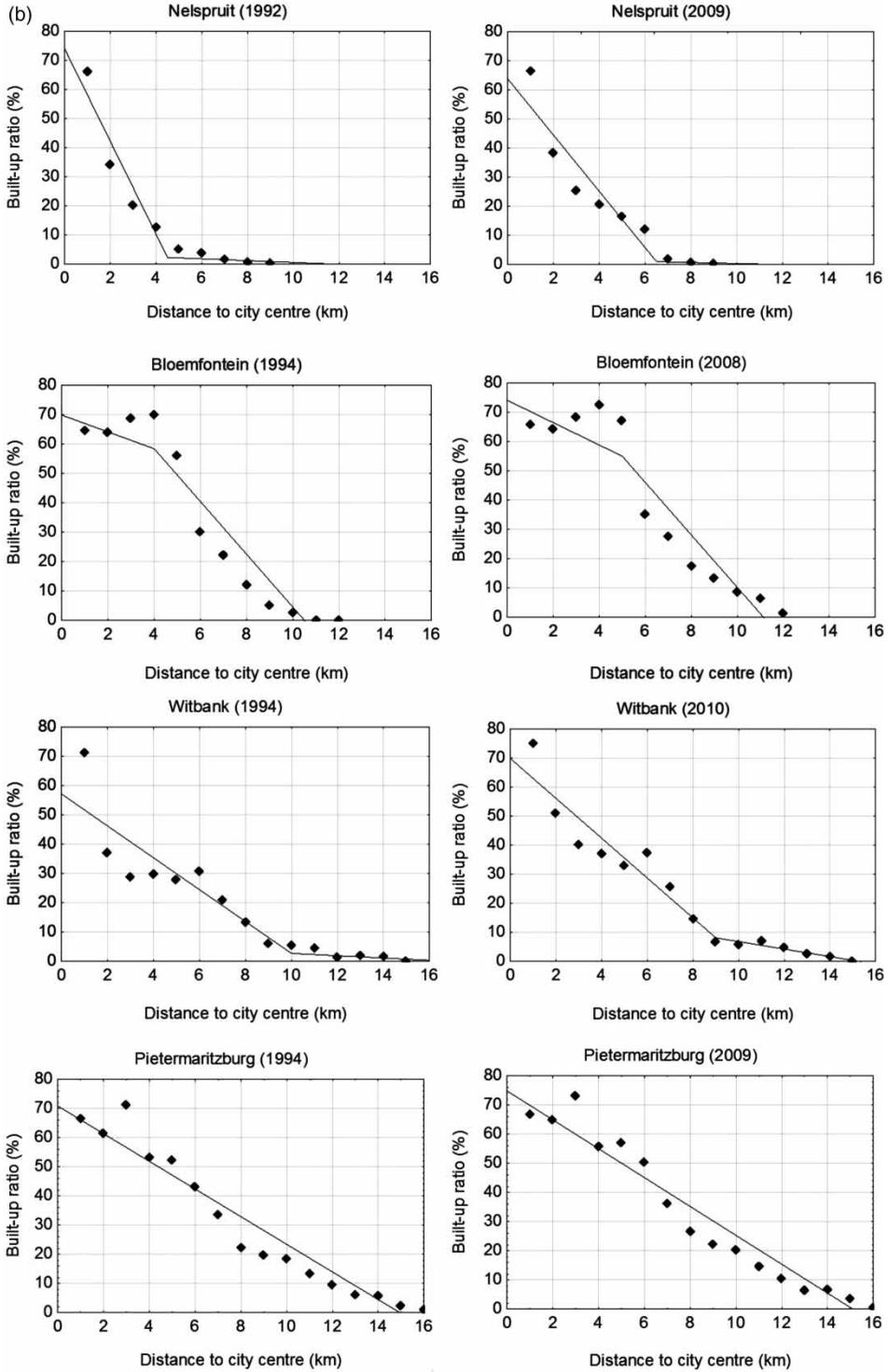


Figure 4. Continued.

Table 6. Comparative values of double density model parameters

City	Central slope 1994	Central slope 2009	Peripheral slope 1994	Peripheral slope 2009	Distance of break point from centre 1994	Distance of break point from centre 2009	R^2 global (1994)	R^2 global (2009)
Johannesburg	-1.4	-1.7	NA	NA	NA	NA	.95	.96
Cape Town	-1.2	-0.7	-1.8	-1.9	14	14	.93	.94
Durban	-2.3	-2.4	0.3	0.3	31	31	.95	.95
Pretoria	-4	-4	0.3	0.1	20	20	.97	.98
Pietermaritzburg	-4.7	-4.9	NA	NA	NA	NA	.93	.94
Bloemfontein	-2.9	-3.8	-9	-8.9	4	5	.92	.90
Nelspruit	-15.9	-9.6	-0.31	-0.2	4.5	6.5	.95	.91
Witbank	-5.4	-6.9	-0.4	-1.3	10	9	.87	.94

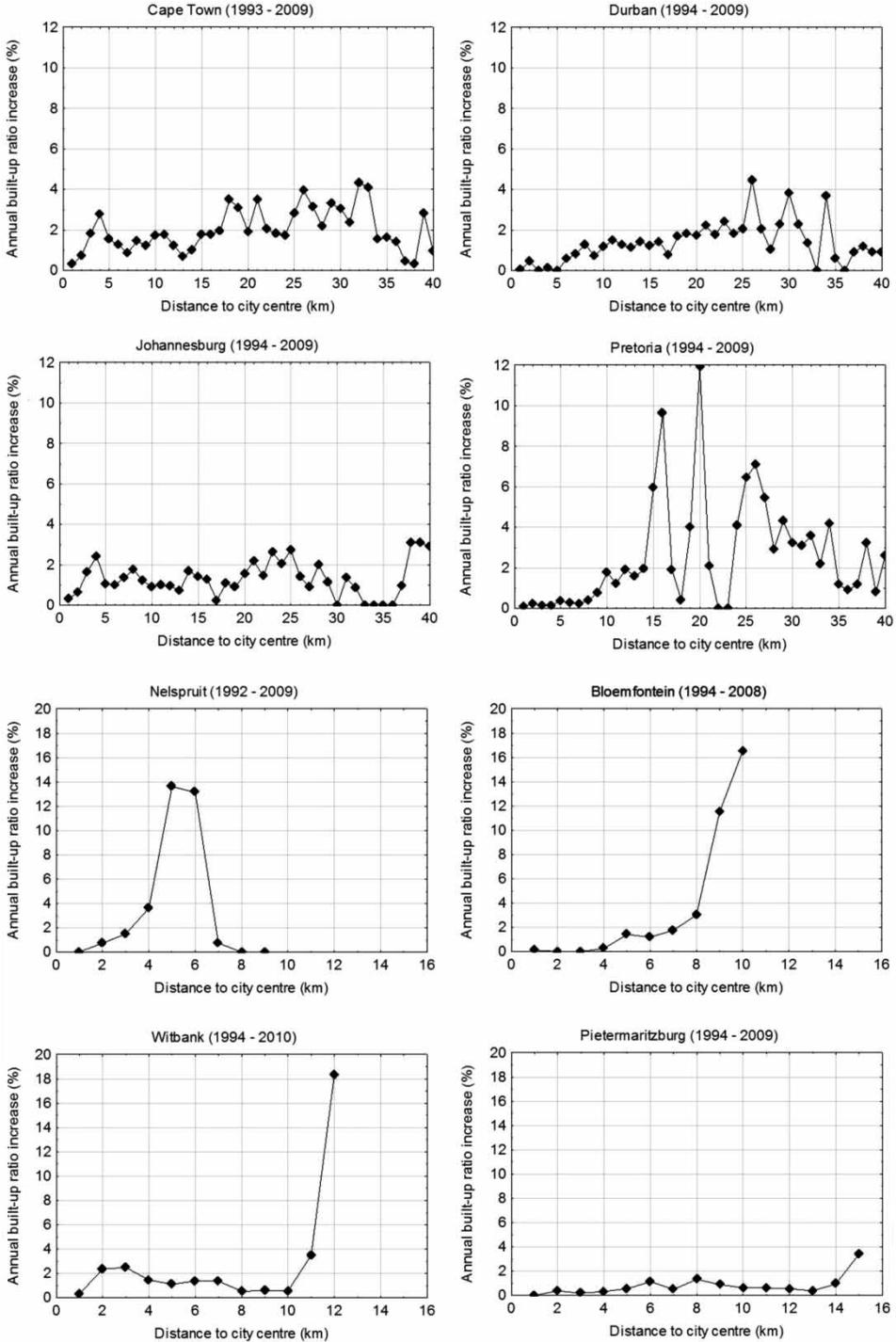


Figure 5. Annual built-up ratio increase.

with only marginal changes recorded in the intermediate-sized cities. The slopes of the central gradients have intensified somewhat in Johannesburg, Durban, Pietermaritzburg, Bloemfontein, and Witbank. This can be indicative of some intensification of the physical footprint in the area between the central saturated zone and the break point. The change in these values are however marginal and does not reflect a discernible trend. The gradient of the peripheral slopes have remained relatively unchanged over the 15-year period.

*Does the Evolution of Urban Spread since 1994 Provide Any Indication of
Densification or Compaction of the Urban Structure in Relation to the City Centre?*

The built-up footprint increase relative to distance from the city centre can provide some indication of the extent of influence of policy measures to achieve improved levels of urban compaction. Comparatively higher annual growth rates closer to the city centre could be indicative of the influence of densification and compaction policies, whereas high growth rates at increasing distances from the city centre could signify more dominant deconcentration forces. The four larger metropolitan cities generally reveal similar growth patterns characterized by relatively low levels of physical growth (generally below 2% per annum) at distances up to 20 km from the city centre. The areas of most rapid physical growth are located between 20 km and 30 km from the city centre at growth levels between 3% and 4% per annum. In the case of Pretoria and Durban, the maximum increase occurred at distances of 20 km and 26 km from the city centre, and in Cape Town and Johannesburg at 32 km and 38 km, respectively. In the smaller intermediate-sized cities, physical growth is dominated and largely concentrated in the peripheral locations of the urban structure. The limited extent of the urban field of these cities (generally less than 15 km) implies that the friction of distance plays a much smaller role in location decision-making with less benefits to be gained from development closer to city centres and hence the dominance of physical growth at peripheral decentralized locations.

The study of European cities found that the average annual increase in built-up density ranges from 1.3% per annum in the case of cities with a radius of up to 40 km and increases of up to 2% per annum in cities with city radius up to 60 km. It also found that in cities with a maximum range of 40 km (comparable to the four metropolitan areas in South Africa) the largest increase in the built-up ratio occur at a distance of 5 km from the city centre, while the most significant increases in the larger cities (cities with a range of 50 km) were prevalent at 8 km from the city centre (Guerois and Pumain 2008). This is in stark contrast to the distances well in excess of 20 km dominating the physical growth of the four largest South African cities in the study (Figure 5).

Conclusions and Implications

The research results confirm modest increases in densities and changes to urban form since 1994 with overall net population density increases in all eight cities, ranging between 1.4 persons/ha and 15 persons/ha. The growth rates of the residential built-up footprint generally far exceeded the growth of the total built-up footprint and continued to increase as a proportion of the total footprint. The growth patterns of the four larger metropolitan cities are distinctive with relatively low levels of physical growth (generally below 2% per annum) at distances up to 20 km from the city centre, and areas of most rapid physical growth at distances between 20 km and 30 km from the city centre at levels between

3% and 4% per annum. In the smaller intermediate-sized cities, physical growth is largely concentrated at the peripheral locations of the urban structure and will have to be critically reviewed within the context of the relevant spatial development frameworks. Cities that achieved the most success were able to limit the extent of the residential footprint growth, although not necessarily always at the idealized locations closest to the historical city centres. These results seem to suggest that, although historical city centres still dominate the South African urban landscape, a more decentralized structure is emerging with the focus areas of most significant physical growth at increasing distances from the historical city centres.

The results imply varying levels of relevance of the double linear density model to the South African cities with two distinct variations identified. The first variant roughly corresponds with the traditional model characterized by a steep central gradient, but with a gradual increase in density from the break point towards the periphery instead of the normal decrease. This can be indicative of the persistence of spatial patterns dominated by higher densities at peripheral locations. The second variant of the model can best be described as an 'inverse double density gradient model' characterized by a relatively gradual decrease in density on the central gradient, followed by the more rapid decrease in the peripheral gradient. A comparison of the 1994 and 2009 models confirmed that the distance from the city centre to the break point has remained largely unchanged over this 15-year period and that the slopes of the central gradients displayed some marginal increases over the same period. Complex intermediate zones can result in an uneven central gradient that obscures the transition between the central and peripheral gradients. Some aspects of this type of complex intermediate zones are also present in South African cities and can partly explain the occurrence of the 'inverse double density gradient model'. An example is large-scale high-density low-income settlements originally planned at peripheral locations now increasingly being assimilated in the urban structure as a result of a rapidly growing urban footprint. The range of the central saturated zone can also influence the slope of the central gradient and cross-city comparisons of these gradients should take caution in the interpretation of this variable.

A number of observations are also relevant from a methodological perspective. First, the measuring of the density gradients in terms of the built-up footprint in two dimensions only partly describes development intensity without also considering the third dimension of the height of individual structures. It will generally underestimate the occupation of the most densely populated zones. Population figures may provide a more accurate reflection of the intensity in various parts of the urban field, and experimental applications in Cape Town confirmed that population increases are possible without any major changes in the physical footprint of the city.

Second, the results would suggest that urban form is resilient and does not change dramatically over a period of 15 years. This corresponds with the opinion expressed by Burton (2002) that an extended time period of 20–30 years may be the most appropriate for the investigation of intensification trends. It may thus be somewhat premature to express a definitive opinion on the levels of influence of the spatial planning policies in South Africa since 1994.

Third, undevelopable areas within the greater urban structure (drainage, topography, geological conditions) are in many instances not accounted for in urban density models. These areas may be excluded in calculating metropolitan urban form and density indicators to better reflect the effect of land-use policy only and discounting the fragmenting effect of

natural constraints (Tsai 2005). The delimitation of the urban area can also influence the outcome of the results. The impact of this aspect was tested in Pretoria and Johannesburg. One set of analytical data have limited the extent of the urban field to the municipal administrative boundary, while the second extend the analysis to a distance of 40 km across adjacent municipal boundaries. Although the patterns of the results were broadly similar, it did reveal significant differences between the two sets of parameter values.

Due to the complex nature of urban growth management strategies and spatial plans, it is difficult to isolate the impacts of any one instrument or to answer the question of which specific instruments of an urban growth management programme are connected to specific urban form changes (Song and Knaap 2004). The full impact of the spatial policies and plans can only be judged based on a comprehensive and multidimensional evaluation of all three dimensions of urban form measurement. The findings of this research do not suggest causality between spatial policies and plans on the one hand and changes in urban form and structure on the other. From the perspective of density indicators and models, the spatial policies and principles seem to have at least contributed to some increases in population density. The results of this study may be sobering for the overall spatial planning and policy direction in South Africa and may indicate the need to further refine the local spatial plans and policies taking into consideration the full range of perspectives impacting on generic concepts such as ‘densification’ and ‘compaction’.

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APPENDIX F

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Land-use mix in South African cities and the influence of spatial planning: Innovation or following the trend?

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Spatial development policies and planning instruments in South Africa have undergone fundamental changes since the dawn of the democratic era in 1994. The aim of these policies is the restructuring of cities with a specific focus on achieving compact mixed-use development and higher densities. This article provides an overview of the various approaches and indicators to analyse land-use mix and provides a comparative spatial and statistical analysis of land-use diversity patterns and trends in eight South African cities since 1994. The results indicate marginal changes in the overall city-level intensity of land-use mix over this period. It also confirms high levels of land-use mix within the focus areas identified by the Spatial Development Frameworks compared to the aggregate city-level figures, but only limited increases in land-use mix in these focus areas over the study period. A more inclusive understanding of the concept of mixed-use zones or nodes, supported by quantified indicators, is recommended to achieve meaningful implementation of the concept of compact mixed-use development.

Keywords: spatial planning; land-use mix index; South African cities; spatial indicators; National Development Plan

Introduction and background

Many of the contemporary debates over the efficiency of urban form tend to juxtapose the concepts of compact development alongside urban sprawl, the latter often associated with decentralized development patterns (Brueckner, 2000; Frenkel & Ashkenazi, 2008; Johnson, 2001). Despite the wide range of arguments in this ongoing debate (e.g. Bruegmann, 2005; Cox, 2006; Dieleman & Wegener, 2004; Geurs & Van Wee, 2006; Reid, 1994; Soja, 2000), comprehensive comparative studies are scarce, and quantitative measures have only started to influence this discourse relatively recently (Galster et al., 2001, p. 682). These debates on urban form also remained central to the urban spatial planning policy agenda in South Africa in the post-1994 era and concepts such as ‘compaction and densification’, ‘socio-economic and spatial integration’ and ‘spatial restructuring’ have become entrenched in the South African spatial planning policy and approach since the early 1990s.

In the South African context, the notion of mixed land uses in particular has remained prominent on the spatial planning agenda since the early 1990s, and was most profoundly influenced by the seminal work of Dewar and Uytendogaardt (1991) (‘South African cities: A manifesto for change’) in which they argued that ‘The multifunctional use of space and facilities is not only desirable: it is economically essential’ (p. 59). They also identified the integration of urban activities and land uses as one of five central conceptual

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changes required for the transition of South African cities onto a more positive urban developmental path. These principles have subsequently been institutionalized by the inclusion of mixed-use development as part of a set of normative spatial principles contained in the Development Facilitation Act (Republic of South Africa, 1995), which was introduced as a legal source to guide the spatial content of planning in South Africa. More recently the concept of 'functional integration' was included in the Guidelines for the Development of Spatial Development Frameworks (SDFs; Republic of South Africa, 2011, p. 21) as one of the basic principles of good spatial planning practice. Despite this strong focus on functional integration, the quantification of this goal, however, remains rather vague, and the National Development Plan 2030 (NDP) as part of its recommendations for the reform of the current planning system calls for the introduction of incentives and regulations to support compact mixed-use development within South African cities. These ideals of compaction, functional integration and mixed-use development areas were, however, influenced by the reality of historic South African city structure. This structure includes elements of both the global North and South, as well as unique characteristics resulting from the peculiar spatial development history during the apartheid era. It is characterized by unequal access to economic opportunities, social segregation, poorly located lower income settlements and insufficient public transport systems (Drakakis-Smith, 1992; Harrison, Todes, & Watson, 2008). The arguments for the transformation of this structure are also influenced by broader spatial trends at national and local levels. While the national-scale spatial settlement trend in South Africa has been towards spatial concentration (driven by agglomeration benefits), local urban-level spatial patterns are showing increasing signs of a polycentric form or a polycentric network of cities in the case of the metropolitan regions (Van Huysteen, Meiklejohn, Coetzee, Goss, & Oranje, 2010, p. 37). These realities compelled local authorities to adopt spatial planning concepts such as transport corridors and development nodes to give effect to the spatial planning principles.

Despite these clear policy guidelines, there remain a surprising paucity of comprehensive cross-city comparative empirical evidence to evaluate the extent of changes to South African city structure since 1994 and to objectively review the impact of the new generation of spatial policy and planning instruments. The overall aim of this article is to investigate the patterns and trends of land-use mix in a number of South African cities, as well as the possible influence of spatial development plans on these patterns. The novelty of the approach and the findings of this study lie in three important contributions. First, it provides a multi-year and cross-city analysis of urban form and structure with a specific focus on urban land-use mix patterns to address the paucity of information in this field in South Africa. Quantitative urban form studies have generally focused on individual cities (or pairs of cities) or single time periods and do not allow for comprehensive cross-city comparisons (e.g. Donaldson & Kotze, 2006; Horn, 2005; Kotze & Donaldson, 1998; Lemanski, 2006; Sinclair-Smith & Turok, 2012; Turok, 2001). The results presented in this article compare a range of land-use mix indicators for eight different cities in South Africa since 1994. Second, it attempts to provide a comprehensive view of land-use diversity in South African cities through the application of a range of indicators reflecting both intensity and pattern-based land-use mix measures. Third, it compares the land-use mix patterns and trends with the main spatial principles and structuring elements contained in the SDFs of the eight cities, to review the appropriateness and effectiveness of these measures.

An overview of the various approaches and indicators of land-use mix and diversity is outlined as point of departure and provides the framework for a comparative spatial and

statistical analysis of land-use diversity in the eight cities. The analysis results highlight the land-use mix patterns and trends in the study areas and are also interpreted within the context of the spatial planning concepts and principles applied in the urban spatial plans of the various cities. The conclusion highlights a number of key findings on the patterns and trends of land-use mix in South African cities, and the potential implications for future urban spatial planning practices.

Approaches to the measuring of land-use mix and diversity

Defining the concept of land-use mix

The relationship between land-use mixtures and developmental outcomes has attracted interest from various fields including landscape ecology, environmental management (e.g. air quality), transportation (e.g. automobile ownership, travel behaviour) and even health sciences (physical activity behaviour and obesity). Arguably, the area of most attention has been the relationship between land-use mix and travel patterns. There has been a mushrooming body of empirical studies focused on arguments in support of higher levels of density and mixed land use, mostly associated with benefits such as reducing car travel, travel distances and transport costs (Barrett, 2010; Gakenheimer, 2011; Newman & Kenworthy, 1991; Nijkamp & Rienstra, 2010; Owens, 1986; Stead & Marshall, 2001; Zhang & Guindon, 2006).

The analysis of land-use mix requires a clear distinction between the related concepts of land-use mix and land-use diversity. The notion of mixed land use implies the location of compatible land uses in close proximity to one another. Fulford (2010, p. 130) describes mixed-use development as ‘... residential, employment and leisure uses brought together where feasible...’. Burton (2002, p. 224) further clarifies this definition and identifies three dimensions of the concept of mixed land use. The first refers to the supply of facilities and services and the balance between residential and non-residential land uses; the second dimension extends this understanding to the geographical spread of these facilities across the city; and the third refers to the mix of land uses within individual buildings on separate floors. These interpretations of the concept of mixed land use can be further expanded to incorporate elements rooted in landscape ecology, including dimensions such as the degree of diversity of land-use type (land-use diversity), the extent to which the land use is dominated by one or two types (land-use dominance), homogeneity of land-use types in a land-use pattern (land-use homogeneity) and the degree of fragmentation of land-use pattern (land-use fragmentation) (Liu, Jiao, & Liu, 2011, p. 349).

The broader concept of the diversity of cities was popularized by the work of Jacobs (1961). Despite her arguably romanticized notions of diversity and city life, many of these concepts have subsequently been adopted by a variety of planning approaches such as new urbanism. Although there are similarities between diversity and mixed land uses, diversity can be described as a ‘multi-dimensional phenomenon’ (Turner, Robyn, & Murray, 2001, p. 320) that also promotes other desirable urban features such as a variety of housing types, building densities, household sizes, ages, cultures and income. Diversity can therefore be seen to represent the social and cultural context of the urban form (Jabareen, 2006).

Measures of land-use mix

In its simplest form, measures of land-use mix normally concentrate on a broad type of mixes, such as proximity of residential uses and commercial facilities. There is, however, a

much broader range of measures of land-use mix that can be classified into three categories: accessibility (or proximity), intensity (or magnitude) and distribution pattern. Song and Rodriguez (2005, p. 9) describe these concepts as follows:

Accessibility is the degree to which mixed land activities are easy to reach by residents; intensity is the volume or magnitude of mixed land uses present in an area, and pattern is the way in which different types of land uses are organised in an area.

From a longitudinal perspective, the indicators in each of these three categories can further be distinguished as either ‘product indicators’ reflecting on the situation at a specific point in time, or ‘process indicators’ looking at changes over time (Burton, 2002, p. 227). A comparative summary of various measures of land-use mix and their interpretation is outlined in Table 1.

As with any set of indicators, the identification and selection of indicators for application should be a pragmatic process based on the criteria of availability, robustness, relevance, independence, transparency, comparability and spatial flexibility (Booyesen, 2002; McMahon, 2002; Spangenberg, Pfahl, & Deller, 2002). Coombes and Wong (1994, p. 1304) rightly asserts that ‘data availability is perhaps the most fundamental problem restricting the eventual set of indicators’.

The advantages and disadvantages of the various measures could be broadly indicative of the most appropriate type of indicators, given the objective of this research and its associated unique set of circumstances. The strength of the measures of intensity as described in Table 1 is their conceptual and computational simplicity, which in turn also implies ease of communicability. Conversely, its major disadvantage is its reliance on aggregate analysis units, where different levels of aggregation can affect results (the modifiable areal unit problem). For example, a larger neighbourhood is simply subject to more land-use types than a smaller area (Song & Rodriguez, 2005). Pattern-based land-use mix measures are better suited to indicators that reflect the diversity and clustering of land uses. Measures in this category such as the land-use diversity index are universally applicable, and can be used for comparative studies incorporating multiple land uses. Research indicated a high degree of correlation and interrelation between measures in this category and established that the residential land-use percentage is closely correlated with other measures of land-use composition, implying that the residential land-use measure by itself represents overall urban land-use composition (Frenkel & Ashkenazi, 2008, p. 68).

The use of a wide range of indicators is often perceived to represent a more ‘comprehensive’ analysis of urban land-use mix. The application of such a wide range of indicators, however, often reveals varying performance against different indicators (‘compensability’) and can lead to results of little use to policy-makers (Booyesen, 2002). However, a core set of indicators of direct relevance and concern to both citizens and policy-makers is most likely to influence decision-making processes (Song & Knaap, 2004, p. 213). Song and Rodriguez (2005) identified three important considerations in the selection of appropriate indicators of land-use mix. First, the choice of measure is dependent on the extent to which a measure captures the presence and configuration of land uses in space (in other words, is the pattern of several land uses more or less of interest, rather than merely the presence of those uses in the study area). Second, the choice of measure should be influenced by practical considerations such as data collection and management, computational burden and ease of communicability. Third, the purpose of the investigation should drive the measures selected (e.g. is the investigation primarily concerned with travel behaviour, accessibility to social facilities, environmental considerations such as pollution, or the impact of planning instruments and policies).

Table 1. Measures of land-use mix.

Indicator	Unit of measurement	Interpretation	Sources
1. Intensity-based land-use mix measures			
Land-use count (frequency)	Number of land uses present in specified units of analysis	Higher number implies a higher intensity of land uses	Song and Knaap (2004) and Song and Rodriguez (2005)
Area properties	Percentage of each land-use category	High percentage would imply a larger dominance by a single land use	Frenkel and Ashkenazi (2008) and Forsyth, Zimmerman, D'sousa, and Van Riper (2012)
Number of key facilities for every 1000 residents	Number/1000 residents	Higher number implies a higher intensity of facilities	Burton (2002) and Schwarz (2010)
Percentage of spatial units containing specified number of facilities (e.g. fewer than two, four or more, etc.)	Percentage of units	Higher number implies a higher intensity of facilities	Burton (2002)
2. Pattern-based land-use mix measures			
Ratio of residential to non-residential land use	Ratio residential to non-residential (km ²)	Values > 1 imply higher levels of homogeneity dominated by residential land uses	Burton (2002) and Kasanko et al. (2006)
Mix of non-residential land uses in the neighbourhood	Area of commercial, industrial, and public land uses in the neighbourhood divided by the number of housing units	The higher the ratio, the greater the land-use mix	Song and Knaap (2004)
Land-use balance index	The degree to which two different types of land uses exist in balance to each other within a neighbourhood	If the two land-use types are distributed evenly, the index is 1. The smaller the value, the greater the unevenness	Song and Rodriguez (2005)
Herfindahl-Hirschman index (HHI)	Sum of squares of the percentages of each type of land uses in the user-defined neighbourhoods	Scale of 0-10,000. If there is only one land-use type in the neighbourhood, HHI index will equal 10,000. The higher the value of HHI, the higher the level of dominance by a single land-use type	Song and Rodriguez (2005) and Forsyth et al. (2012)

(Continued)

Table 1 – *continued*

Indicator	Unit of measurement	Interpretation	Sources
Dissimilarity index	Degree to which different land uses exist within the smaller unit of analysis (e.g. grids or neighbourhood) and this distribution pattern is typical throughout the larger unit of analysis (e.g. neighbourhood or the city)	Scale of 0–1. Values closer to 1 imply higher levels of dissimilarity	Massey and Denton (1988) and Forsyth et al. (2012)
Land-use diversity index	Degree of diversity of land-use types and proportional distribution on a normalized index (0–100)	The higher the value, the higher the land-use mix. Index value increases as number of land-use types increases or proportional distribution of land-use types increases	Song (2005) and Liu et al. (2011) ^a
3. Accessibility-based land-use mix measures			
Distance measures	Linear or street network distance between residential land use and another given non-residential land uses	Shorter distance implies higher levels of proximity to specified facility	Song and Rodriguez (2005) and Forsyth et al. (2012)
Gravity-based measures of land-use mix	Sum of accessibility of residential land use to all other given type of non-residential land uses, discounted by the distance decay function between these two points	Lower values imply higher accessibility	Song and Rodriguez (2005) and Forsyth et al. (2012)

^a Liu et al. also provide further variations of this index termed the ‘index of land-use dominance’ and the ‘index of land-use homogeneity’.

There is, therefore, no single best measure of land-use mixture because each measure captures different dimensions of how land uses are distributed in space.

An analysis of land-use mix in South African cities

Data and methodology

In South Africa there is a surprising paucity of comprehensive multi-year and cross-city analysis of urban form and structure generally, and urban land-use mix patterns specifically. One of the main reasons is the lack of a common set of land-use data for different cities at an appropriate scale for multiple time periods. The criteria of availability and comparability were, therefore, key considerations in the selection of indicators from the potential candidates available and the selection of cities in this study. Data for the selected indicators had to be available for at least two similar points in time for all cities forming part of the analysis, the former as close as possible to 1994, and the latter to the date of the latest population census in 2011. The latest available set of land-use data from GeoTerraImage (2012) was the only available source that satisfied these criteria with data for periods ranging from 1993 to 2010 available for a number of cities. In addition, detailed SDFs also had to be available for these cities to enable an analysis of the impact of spatial policies and proposals on land-use mix patterns. Eight cities could thus be selected for the purposes of this comparative analysis, including the four largest metropolitan areas of Johannesburg, Cape Town, Durban (eThekweni) and Pretoria (Tshwane), as well as four smaller, intermediate-sized cities of Bloemfontein (Mangaung), Pietermaritzburg (Msunduzi), Nelspruit (Mbombela) and Witbank (eMalahleni).

The Building-Based Land Use^{©™} dataset is widely used in industry (e.g. South African power utility, Telkom, City of Johannesburg, Gauteng City Region Observatory, Council for Scientific and Industrial Research) and has been applied in research and academic work (e.g. Geyer, Geyer, & du Plessis, 2012; Organisation for Economic Cooperation and Development [OECD], 2012). This Building-Based Land Use^{©™} dataset contains buildings, structures and other area-specific land uses, as identified and mapped from high-resolution orthophotos as point data. The land uses are mapped using manual image interpretation techniques and classified into a standardized 70-class land-use classification using supplementary datasets and fieldwork. These data undergo extensive quality control and validation to provide accurate and detailed land use for selected urban areas within South Africa. Two datasets were used in each city: one as close as possible to 1994 and one for the most recent period closest to the date of the latest population census in 2011.¹ These data were integrated with the latest available cadastral data for each city to produce a set of land-use data at the level of individual stands or land parcels. An automated geographic information system based procedure was applied to integrate the land-use points and erf boundaries, and to consolidate the 70 land-use classes to 13 main classes. These land-use classes include multiple residential, single residential, informal residential, mixed residential, commercial, industrial, transport and utilities, institutions, sport and recreation, mining, mixed land use, parks and conservation, and agriculture and forestry. These data at the level of an individual stand or land-parcel is, however, too detailed for the purposes of a strategic and cross-city level comparison of land-use mix measures. Enumerator areas (EAs) represent the smallest unit of spatial analysis used for census purposes by Statistics South Africa, and were deemed a more appropriate unit of spatial analysis. Its use also allows for comparative data analysis with official census population data. The land-use data at individual stand level for both the base year and the end year were then aggregated to the 2011 EA boundaries for the purposes of spatial and

statistical analysis. This resulted in a land-use mix classification for each EA within the various cities using the same 13 main land-use classes. To account for the modifiable areal unit problem (where larger neighbourhoods are prone to more land-use types than smaller ones), only EAs <100 ha in size were included in the statistical and spatial data analysis (<2% of the total EAs in the study areas are larger than 100 ha). In the metropolitan areas of Johannesburg, Cape Town, Durban and Pretoria, the analysis covers the entire municipal areas of jurisdiction as defined in 2011. In the case of Bloemfontein, Pietermaritzburg, Nelspruit and Witbank, the municipal area consists of a dominant urban core, as well as a number of smaller towns and/or dense traditional settlement areas scattered across the jurisdiction of the municipality. In these four cities, only the urban core areas were included, and not the isolated and scattered settlements.

An important aspect in the analysis of the data and interpretation of results is how the addition of new developments subsequent to 1993/1994 is handled. In the case of the intensity-based indicators in [Table 3](#), the values are expressed in proportional terms including all areas of both the base and end years (including new developments) of the analysis. The situation is, however, somewhat more complicated in the case of the spatial analysis of the pattern-based indicators reflected on [Figure 2](#). Two methods of spatial analysis were thus undertaken. The first method only used the areas of development that existed in 1994 and compared the change between 1994 and 2009/2010 in these areas only (excluding any new development). The second method also included all new developments subsequent to 1994, and the indicator values of these areas for 1994 were thus taken as zero. The two methods yielded spatial patterns that were broadly very similar although the areas influenced by greenfield development were somewhat emphasized in the results of the second method. The second method was deemed to resemble the current reality more accurately and was thus used for the analysis results presented here.

The aim of this research implies a focus on intensity- and pattern-based land-use mix measures, as summarized in [Table 1](#), and not the measuring of accessibility patterns of specific facilities or land uses. The selected indicators thus include three intensity-based land-use mix measures and three pattern-based land-use mix measures as described in [Table 2](#). The analysis is based on a two-dimensional view of land-use mix only and do not include the third dimension, which accounts for the vertical mix of land uses on the same footprint or within the same buildings. Consequently, the levels of land-use mix in areas such as the central business districts of the cities will generally result in an underestimation of land-use mix values in these areas. The limited availability of land-use data for South African cities in three dimensions, however, limits the possibility of this application within the current context.

Intensity- and pattern-based land-use mix indicators of selected cities

A comparative overview of the intensity-based land-use mix measures is outlined in [Table 3](#). This information compares the occurrence of different land-use types (any of the 13 land-use categories used) within EAs according to three categories: percentage EAs within each city containing only a single land use (low levels of land-use mix), percentage EAs containing four² or more types of land uses (moderate levels of land-use mix) and EAs containing six or more types of land uses (high levels of land-use mix). The characteristics of the four larger metropolitan cities, and the four intermediate-sized cities represent two very distinct profiles with high levels of similarity within each of the two groups. In the case of the four large metropolitan cities, the proportion of EAs containing only one land-use type (2009/2010) ranges between 27.7% and 38.8%, with the

Table 2. Selected land-use mix indicators.

Indicator	Rationale	Unit of measurement	Interpretation
1. Intensity-based land-use mix measures			
% EAs containing only one land use	Provides indication of number of spatial units characterized by complete homogeneity of land use	Percentage of EAs (0–100)	Higher percentages are indicative of urban areas characterized by a larger proportion of units of complete homogeneity of land use
% EAs containing four or more land uses	Provides indication of the proportion of spatial units containing one third of all potential land-use classes used in the study	Percentage of EAs (0–100)	Higher percentages are indicative of urban areas characterized by a larger proportion of units of moderate levels of land-use mix
% EAs containing six or more land uses	Provides indication of the proportion of spatial units containing at least half of all potential land-use classes used in the study	Percentage of EAs (0–100)	Higher percentages are indicative of urban areas characterized by a larger proportion of units of high levels of land-use mix
2. Pattern-based land-use mix measures			
Ratio of residential to non-residential land use	Provides a measure of the balance between residential and non-residential land uses	A ratio of either larger or smaller than 1	Ratio > 1 indicative of the larger degrees of dominance by residential land uses Ratio = 1 indicative of perfect equality between residential and non-residential uses
Land-use balance index	A measure of balance between the various land uses present in a unit of analysis	Index on a scale of 0 to 100	Ratio < 1 indicative of larger degrees of dominance by non-residential land uses Values = 0 indicate existence of only one land use Values closer to 0 indicate low levels of balance and larger degrees of dominance by the main land-use category Values = 100 indicates perfectly equal distribution between all land-use categories present within unit of analysis

(Continued)

Table 2 – *continued*

Indicator	Rationale	Unit of measurement	Interpretation
Land-use diversity index	A combined measure taken cognizance of both the number of land-use types and the balance of distribution of those land-use types as expressed by the land-use balance index	Index on a scale of 0–100 expressed as the product of the number of land uses and the land-use balance index relative to the theoretical maximum value if all land-use categories were present in the unit of analysis in equal proportions	Value = 100 if all land-use categories are present in perfectly equal proportions. Values closer to 100 indicate higher levels of land-use diversity and closer to 0 less diversity (both in terms of intensity and diversity of land uses).

Table 3. Intensity-based land-use mix indicators.

City	Percentage EAs containing one land use			Percentage EAs containing four or more land uses			Percentage EAs containing six or more land uses		
	1994	2009/2010	Change	1994	2009/2010	Change	1994	2009/2010	Change
Cape Town	27.6	27.7	0.1	21.6	20.4	-1.2	3.0	3.0	0.0
Johannesburg	32.9	27.3	-5.6	15.2	18.2	3.0	1.6	2.0	0.4
Tshwane	35.7	38.8	3.1	14.4	13.4	-1.0	1.4	1.2	-0.2
eThekweni	30.2	30.3	0.1	18.0	18.6	0.6	2.5	2.4	-0.1
Bloemfontein	45.6	38.5	-7.2	5.1	4.8	-0.3	0.2	0.3	0.1
Pietermaritzburg	43.9	43.2	-0.7	12.3	11.7	-0.6	1.7	1.4	-0.3
Witbank	49.3	49.9	0.6	5.9	7.4	1.5	0.4	0.3	-0.1
Nelspruit	47.3	44.3	-3.0	9.7	8.2	-1.5	1.1	0.8	-0.3

comparative figures for the four intermediate cities much higher between 38.5% (Bloemfontein) and 49.9% (Witbank). Conversely, the percentage of EAs containing four or more land-use types are notably higher in the four metropolitan cities (between 13.4% and 20.4%) compared with the intermediate-sized cities (between 4.8% and 11.7%). This implies generally higher levels of land-use mix in the larger cities. At the level of individual cities, Cape Town represents the highest levels of land-use mix, with 20.4% of EAs in 2009 containing four or more land uses. Pietermaritzburg clearly stands out amongst the intermediate cities with 11.7% of EAs with four land-use types or more with the lowest value recorded in Bloemfontein (4.8%). When shifting the attention to the extent of changes that occurred between 1994 and 2009/2010, the results indicate that there were no significant changes in the intensity of land-use mix between 1994 and 2009/2010 in any of the eight cities, with the most significant increase in Johannesburg with a modest 3% increase in EAs with more than four land-use types.

These intensity measures of land-use mix are conceptually simple to communicate but sensitive to different levels of aggregation, and reveal relatively little about the pattern, diversity and distribution of the various uses. The selected pattern-based land-use mix measures (Table 4) add a further dimension to this analysis. The ratio between residential and non-residential land uses provides a measure of the balance between residential and non-residential land uses. Cape Town, Tshwane, Bloemfontein and Nelspruit show a roughly equal distribution of residential and non-residential land uses in 2009/2010, with some marginal increases in the ratio between 1994 and 2009/2010 in favour of residential uses. In the case of Johannesburg, eThekweni and Pietermaritzburg, residential land uses substantially dominate non-residential land uses in a ratio of 2:1 or more. This ratio also increased substantially in favour of residential uses, especially in Johannesburg (from 1.31 in 1994 to 2.27 in 2009). Witbank is the only city where non-residential land uses dominate (ratio of 0.51 in 2010) and should be interpreted against the background of the urban structure of Witbank, characterized by large areas of mining and industry-related activities interspersed with other land-use types.

The second pattern-based indicator is the land-use balance index, which measures the level of balance between the various land uses present in a unit of analysis (or put differently the level of dominance of the main land-use category in each EA in relation to the other categories). A value equal to 0 indicates the occurrence of only one land-use category, lower values closer to 0 imply larger degrees of dominance by the main land-use category, and a value equal to 100 would indicate a perfectly equal distribution between all land-use categories present within a specified unit of analysis (perfect balance). The results depicted in Table 4 imply relatively similar patterns across all eight cities albeit with slightly higher percentages of EAs in the intermediate-sized cities with low land-use balance index values. The figures for the four metros range between 40.3% of EAs with low levels of land-use balance in Cape Town and 51.1% in Tshwane. The comparative figures for the four intermediate-sized cities are somewhat higher, with levels ranging from 57.3% in Pietermaritzburg to 59.8% in Witbank. The changes between 1994 and 2009/2010 have generally been modest with slight decreases in the percentage EAs with low land-use balance values in five of the cities, ranging from a 6.2% decrease in Bloemfontein to 0.7% in Pietermaritzburg. The mean land-use balance index value of all EAs provides an aggregate summary measure at city level and largely mirrors the patterns as reflected by the percentage of EAs with low land-use balance index values. The mean land-use balance index values for the four metros range between 23.1 and 27.5, with comparative figures for the four intermediate cities somewhat lower at levels between 18.2 and 19.3. This implies higher levels of balance between different land uses in the four

Table 4. Pattern-based land-use mix indicators for eight cities.

City	Res-nonres ratio		% EAs low land-use balance index (<10) ^a		Mean land-use balance index		% EAs high LUMI (>15) ^a		Mean LUMI value						
	1994	2009/2010	Change	1994	2009/2010	Change	1994	2009/2010	Change	1994	2009/2010	Change			
Cape Town	0.96	1.07	0.11	41.6	40.3	-1.4	26.5	27.5	1.0	15.4	15.7	0.3	6.7	6.9	0.2
Johannesburg	1.31	2.27	0.96	48.6	43.9	-4.7	23.9	26.0	2.1	10.8	13.4	2.6	5.5	6.2	0.7
Tshwane	0.91	1.14	0.23	50.6	51.1	0.5	22.6	23.1	0.5	10.6	11.1	0.5	5.2	5.3	0.1
eThekweni	2.14	2.33	0.19	44.4	44.7	0.4	25.9	25.6	-0.3	13.7	13.9	0.2	6.2	6.2	0.0
Bloemfontein	1.18	1.33	0.15	64.0	57.8	-6.2	16.9	18.2	1.3	4.9	5.2	0.3	3.4	3.6	0.2
Pietermaritzburg	3.41	3.72	0.31	58.0	57.3	-0.7	19.1	19.3	0.2	7.3	7.3	-0.1	4.4	4.4	0.0
Witbank	0.48	0.51	0.03	59.8	59.8	0.0	19.0	18.5	-0.5	7.4	7.6	0.2	3.8	3.9	0.1
Nelspruit	1.11	1.09	-0.02	60.2	59.0	-1.2	18.3	18.5	0.2	5.4	5.7	0.4	4.1	4.1	0.0

^a Cut-off value selected based on comparative values of a five-category natural break classification of each city based on Jenks' algorithm (1967).

larger metropolitan areas. This indicator confirms marginal increases in the land-use balance index between 1994 and 2009/2010, with the most notable changes in Johannesburg (+2.1), Bloemfontein (+1.3) and Cape Town (1.0).

The third and most versatile pattern-based indicator is the Land-Use Mix Index (LUMI). This index represents a combined measure taking cognizance of both the number of land-use types (intensity) and the balance of distribution of those land-use types (diversity) within a specified unit of spatial analysis. It is expressed as an index value between 0 and 100 normalized relative to the theoretically perfect land-use mix value, if all 13 land-use categories were present in perfectly equal proportions within a specific unit of analysis. The results in [Table 4](#) show a clear distinction between the four metropolitan cities and the four intermediate-sized cities. The percentage of EAs in the four metropolitan cities with high LUMI values in 2009/2010 ranges between 11.1% in Tshwane and 15.7% in Cape Town, and the mean LUMI values range between 5.3 and 6.9. The comparative figures for the four intermediate cities are much lower with values between 5.2% in Bloemfontein and 7.6% in Witbank and with mean LUMI values between 3.6 and 4.4. The land-use mix patterns remained relatively unchanged between 1994 and 2009/2010 with the percentage of EAs with high LUMI values increasing marginally in seven of the eight cities, and the mean LUMI showing small increases in five cities. The most substantial increase occurred in Johannesburg with a 2.6% increase in EAs with high LUMI values and an increase of 0.7 in its mean LUMI value. These changes in Johannesburg mostly occurred in the northern parts of the city and outside the identified spatial development focus areas. These changes were mostly the result of large-scale market-driven development with limited influence from the spatial proposals.

Spatial analysis of land-use mix

A spatial analysis of the LUMI values is reflected in [Figures 1](#) and [2](#), respectively. Two prominent spatial patterns are emerging from this analysis. First, the structuring influence of the centripetal forces along the main transport routes in the four metropolitan areas is clearly evident. The accessibility, visibility and other benefits attract a high concentration of different land uses along many of these major routes, especially in the larger metropolitan areas. Second, high levels of land-use mix are prevalent in the fringe areas around the Central Business Districts, and some of the emerging decentralized nodes.

Arguably more important from a spatial planning and policy perspective is the changes in land-use mix that occurred between 1994 and 2009/2010. The most significant increases between 1994 and 2009/2010 occurred at prominent decentralized nodes, such as Umhlanga in eThekweni, Centurion and Menlyn in Tshwane, and Fourways and Midrand in Johannesburg, as well as along major transport routes such as the N2 in Durban and the N1 in Johannesburg and Tshwane (see [Figure 2](#)). This pattern is also evident at a smaller scale in the four intermediate-sized cities. A second significant emerging pattern is the increases in land-use mix in some historically low-income suburbs, particularly in Khayelitsha and Mitchells Plain in Cape Town and KwaMashu in eThekweni. Interestingly, these three areas all formed part of the national Urban Renewal Programme (URP) launched in 2001 as part of a nationally initiated policy to renew eight urban nodes of deprivation in South African cities. This may be indicative of the positive influence of this area-based programme in the post-1994 era, resulting in the provision of a wider range of social and institutional facilities and supporting at least some private sector investment

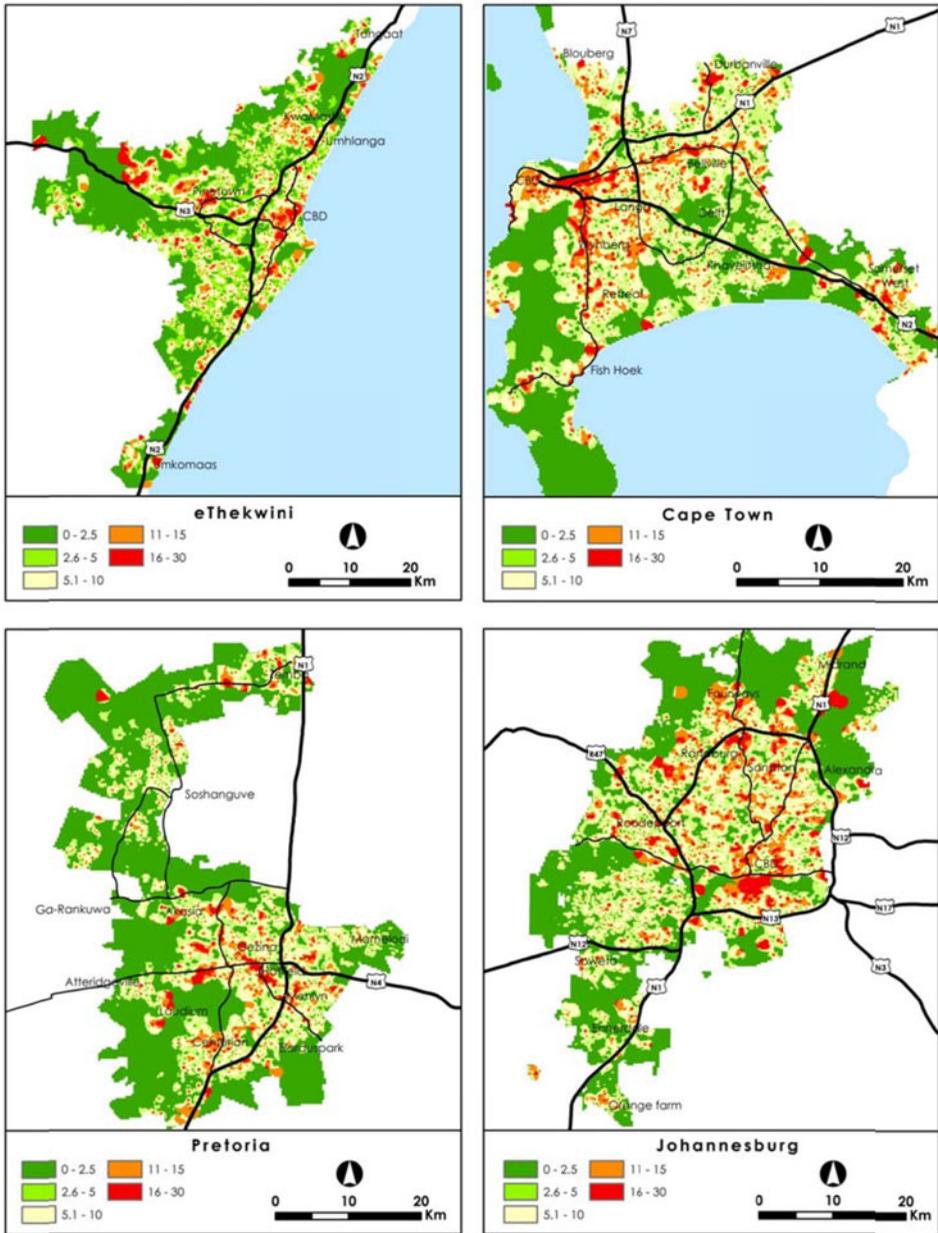


Figure 1. Spatial analysis of LUMI values (2009/2010) – eThekweni, Cape Town, Pretoria and Johannesburg.

Note: Own analysis based on GeoTerraImage (2012).

in commercial development. This observation is also confirmed by detailed assessments of the impact of the URP programme in the City of Cape Town (Donaldson, du Plessis, Spoeter, & Massey, 2013). These changes in land-use mix are, however, not equally prominent in other large low-income suburbs such as Soweto in Johannesburg and Mamelodi and Atteridgeville in Pretoria not forming part of this programme.

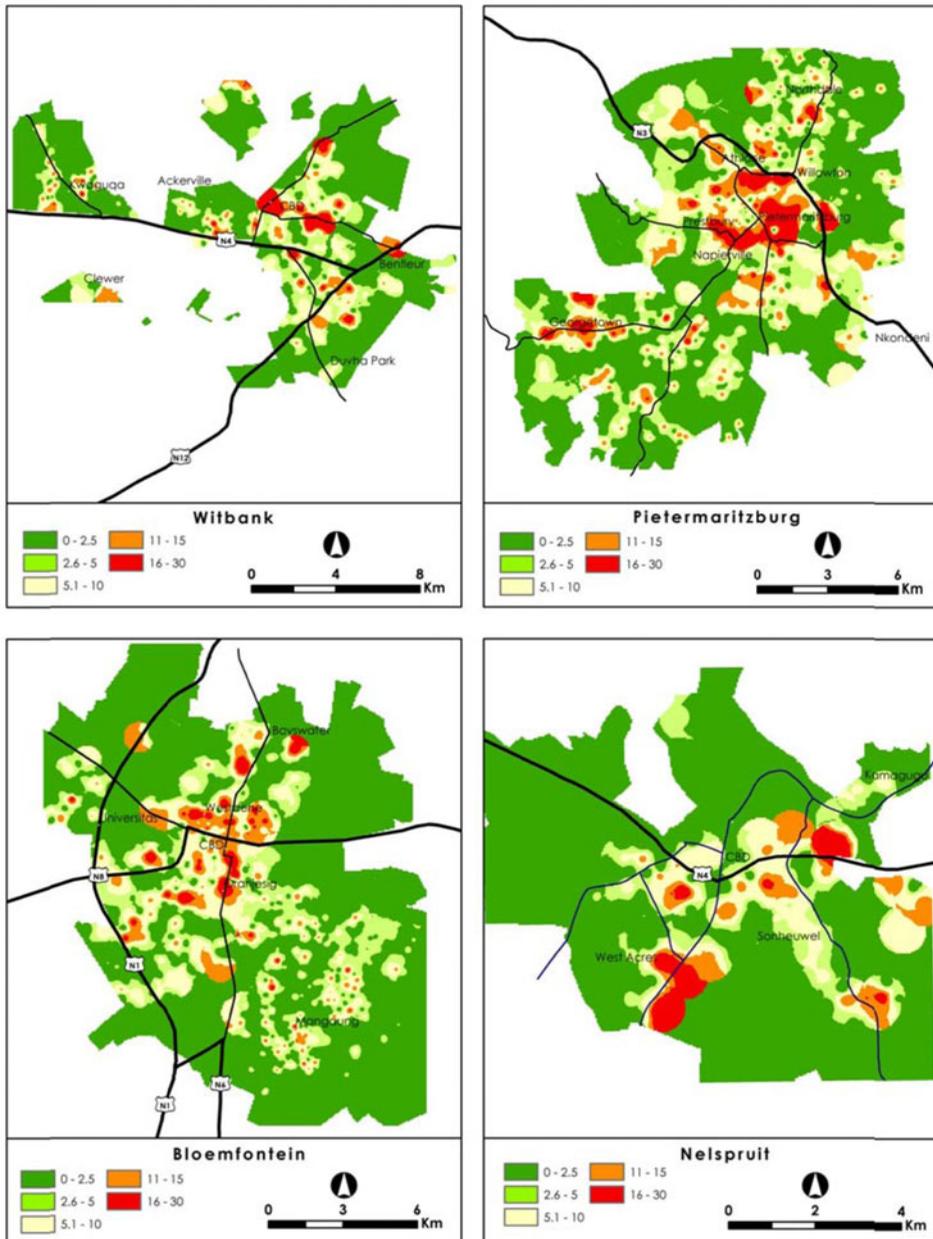


Figure 2. Spatial analysis of LUMI values (2009/2010) – Witbank, Pietermaritzburg, Bloemfontein and Nelspruit.
 Note: Own analysis based on GeoTerraImage (2012).

The influence of spatial planning principles and concepts on land-use mix

Spatial planning context and principles

One of the objectives of this study is to establish whether the key spatial structural elements of the SDFs represent focal points of higher levels of spatial land-use mix

patterns based on the indicators used in this study. Due to the complex nature of urban growth management strategies, Song and Knaap (2004, p. 223) noted that it is difficult to isolate the impacts of any one instrument, or to determine which specific instruments of an urban growth management programme are connected to identified urban form changes. Within the confines of the existing available data and evidence presented in the preceding sections, an attempt was made to isolate the key principles and spatial planning concepts contained in the SDFs of the eight cities, and then through a simple spatial analysis, evaluate the relationship between these concepts and the patterns and trends in land-use mix. This does not imply a rather naïve assumption that spatial planning is the only or even dominant process determining land-use mix and diversity patterns. Todes (2008, p. 11) clearly articulated the opinion that 'infrastructure planning with its own spatial logic was more powerful in shaping the spatial structure of cities than spatial planning'. However, at the same time it must be recognized that substantial resources and attention aimed at transforming the spatial patterns of South African cities have been allocated to spatial planning and related processes since the dawn of the democratic era (Pieterse, 2004). Moreover, recent research confirmed considerable alignment between the key elements of SDFs and the public sector capital investment patterns in cities such as Johannesburg and Cape Town (Laldaparsad, Geyer, & du Plessis, 2013). Their findings indicate that SDFs did significantly influence municipal budgetary capital spending patterns between 2007 and 2012. Although the prominent role of market processes in the evolving structure of South African cities is recognized, the extent of resources directed at spatial planning processes over a period of nearly 20 years and its growing influence on public sector capital spending patterns confirms a clear case to be made for considering the potential influence of spatial planning processes on land-use mix patterns.

The priority spatial development principles of the eight urban SDFs are summarized in [Table 5](#) and clearly highlight the consistent prominence of three elements across most of these plans: spatial and land-use integration, densification and intensification, and environmentally sustainable development. The dominant spatial-structuring concepts applied in the overall strategic-level SDFs (or metropolitan SDFs in the case of the four metros) include elements such as development or activity corridors, mobility corridors, mixed-use nodes or areas, urban nodal structure and hierarchy, future strategic urban development areas and urban regeneration or renewal zones. Three of these concepts, in particular, are applied consistently in all the SDFs. These are development or activity corridors (used as a structuring element in all eight SDFs), urban nodal structure and hierarchy (applied in seven of the plans) and mixed-use nodes or areas (applied in six of the plans). The use of these concepts is in line with the vision for South African cities as articulated in the National Development Plan (NDP). The NDP identified two elements of this vision: new urban development and infrastructure investment focused on mass-transit corridors and existing and emerging economic nodes, and the linking of the urban poor into the mainstream of city life through investments in connecting corridors of development (National Planning Commission, 2012).

The level of detail provided in the overall metropolitan or municipal-level spatial plans of the selected cities differs widely and ranges from only broad conceptual indications to more refined proposals aligned with cadastral entities. In cities where the boundaries of the corridors and nodes were clearly defined, these boundaries were used for the purposes of spatial analysis. In those cases where the nodes and corridors were only conceptually indicated, the guidelines for SDFs (Republic of South Africa, 2011, p. 21) were used as a point of departure, using a distance of 1 km around nodes to implement the principle of economic and functional integration and a distance of 500 m either side of the primary

Table 5. Spatial planning principles and priorities identified in SDFs.

Spatial principles/priorities	Johannesburg	Cape Town	Ethekewini	Tshwane	Bloemfontein	Pietermaritzb	Witbank	Nelspruit
Spatial and land-use integration	✓	✓		✓	✓	✓	✓	✓
Densification, intensification and infill development	✓	✓	✓	✓	✓	✓	✓	
Strategically located economic growth			✓	✓	✓	✓	✓	
Improved access to economic opportunities		✓	✓	✓				
Sustainable development	✓	✓	✓	✓	✓	✓	✓	✓
Inclusiveness		✓						
Create opportunities for the poor			✓	✓				
Optimum use of current capacity			✓					✓
Efficient movement system	✓	✓		✓				

road defining the activity corridors. It should be noted that the dates of the SDFs from which these elements have been synthesized range between 2006 and 2011, and it could be argued that there was limited scope for these plans to have influenced the land-use mix patterns between 1994 and 2009/2010. However, many of the key spatial principles and concepts (such as densification, integration, diversity and compaction) and structuring elements (corridor and nodal structure) remained largely consistent through the various versions and revisions of these plans since 1994.

Influence of spatial planning concepts on land-use mix patterns and trends

The land-use mix patterns and trends within these nodes and corridors were compared with the total overall city-level indicator values of each of the eight cities, based on three land-use mix indicators. It can be hypothesized that if the identified spatial principles and concepts contributed to increased levels of land-use mix, higher average values can be expected within these defined areas relative to the overall figures for the city as a whole. Second, and more importantly, the intuitive expectation is that the land-use mix trajectories between 1994 and 2009/2010 within these defined focus areas will show higher levels of change compared with the total overall trends of each city.

The information portrayed in [Table 6](#) validates the first element of the hypothesis and confirms higher levels of land-use mix within the defined spatial focus areas. The values within the defined focus areas are in most instances notably higher than the comparative figures for the entire city, both in terms of the intensity-based indicator (percentage of EAs containing four or more land-use types) and the pattern-based indicators (land-use balance and land-use mix indices). The largest difference between the spatial focus area values and the overall city-level figures is in Pietermaritzburg, where the values within the defined focus areas are double that of the entire city. The spatial planning focus areas in eThekweni also show significantly higher values for all three indicators compared with the overall city-level figures. The spatial distribution of the LUMI values reflected in [Figures 1 and 2](#) confirms that the development focus areas outlined in the SDFs do largely correspond with areas of historically high land-use mix.

However, more important from a planning and policy perspective is the changes in the spatial patterns of land-use mix that occurred between 1994 and 2009/2010. The results reflected in [Figures 3 and 4](#) and outlined in [Table 6](#) do not support the second element of the hypothesis, and instead reveal that the areas with the most significant increases in LUMI values do not necessarily coincide with the focus areas defined in the SDFs. None of the cities revealed any increases in LUMI values in these focus areas that are notably higher than the overall city-level figures. Only in the case of the intermediate-sized city of Witbank is the increase in land-use mix within the defined spatial focus areas significantly higher than the city-level figures. This trend is also spatially reflected on [Figures 3 and 4](#), which illustrate the levels of correspondence between the land-use mix change patterns and the key elements of the SDFs.

These results confirm two important but somewhat contradictory conclusions. On the one hand, it confirmed significantly higher levels of land-use mix (2009/2010) within the defined spatial focus areas compared to the overall city-level figures. On the other hand, there is no clear evidence of any significant increases in land-use mix in the spatial planning focus areas between 1994 and 2009/2010. This suggests that these spatial focus areas largely follow established historical patterns of land-use mix and conform more closely to what can be described as 'trend planning' based on the outcome of market forces rather than reflecting innovative planning responses pursuing the need for spatial restructuring.

Table 6. Comparison of aggregate city level indicator values with indicator values in SDF focus areas.

City	Percentage EAs \geq 4 land uses						Mean land-use balance index						Mean LUMI value								
	Entire city		Within SDF focus areas		Entire city		Within SDF focus areas		Entire city		Within SDF focus areas		Entire city		Within SDF focus areas		Entire city		Within SDF focus areas		
	1994	2009/2010	Change	1994	2009/2010	Change	1994	2009/2010	Change	1994	2009/2010	Change	1994	2009/2010	Change	1994	2009/2010	Change	1994	2009/2010	Change
Cape Town	21.6	20.4	-1.2	28.1	25.2	-2.9	26.5	27.5	1.0	32.0	32.0	0.0	6.7	6.9	0.2	8.6	8.4	-0.2	8.6	8.4	-0.2
Johannesburg	15.2	18.2	3.0	16.8	21.8	5.0	23.9	26.0	2.1	29.2	30.4	1.2	5.5	6.2	0.7	6.7	7.4	0.7	6.7	7.4	0.7
Tshwane	14.4	13.4	-1.0	12.9	12.9	0.0	22.6	23.1	0.5	26.2	27.8	1.6	5.2	5.3	0.1	5.8	6.1	0.3	5.8	6.1	0.3
eThekweni	18.0	18.6	0.6	28.2	28.6	0.4	25.9	25.6	-0.3	36.3	35.9	-0.4	6.2	6.2	0.0	9.3	9.2	-0.1	9.3	9.2	-0.1
Bloemfontein	5.1	4.8	-0.3	8.6	8.5	-0.1	16.9	18.2	1.3	22.8	23.4	0.6	3.4	3.6	0.2	4.8	4.9	0.1	4.8	4.9	0.1
Pietermaritzburg	12.3	11.7	-0.6	31.9	33.1	1.2	19.1	19.3	0.2	31.5	31.0	-0.5	4.4	4.4	0.0	8.6	8.5	-0.1	8.6	8.5	-0.1
Witbank	5.9	7.4	1.5	5.1	15.2	10.1	19.0	18.5	-0.5	23.3	25.7	2.4	3.8	3.9	0.1	4.4	5.9	1.5	4.4	5.9	1.5
Nelspruit	9.7	8.2	-1.5	8.0	8.6	0.6	18.3	18.5	0.2	22.5	25.5	3.0	4.1	4.1	0.0	5.2	5.8	0.6	5.2	5.8	0.6

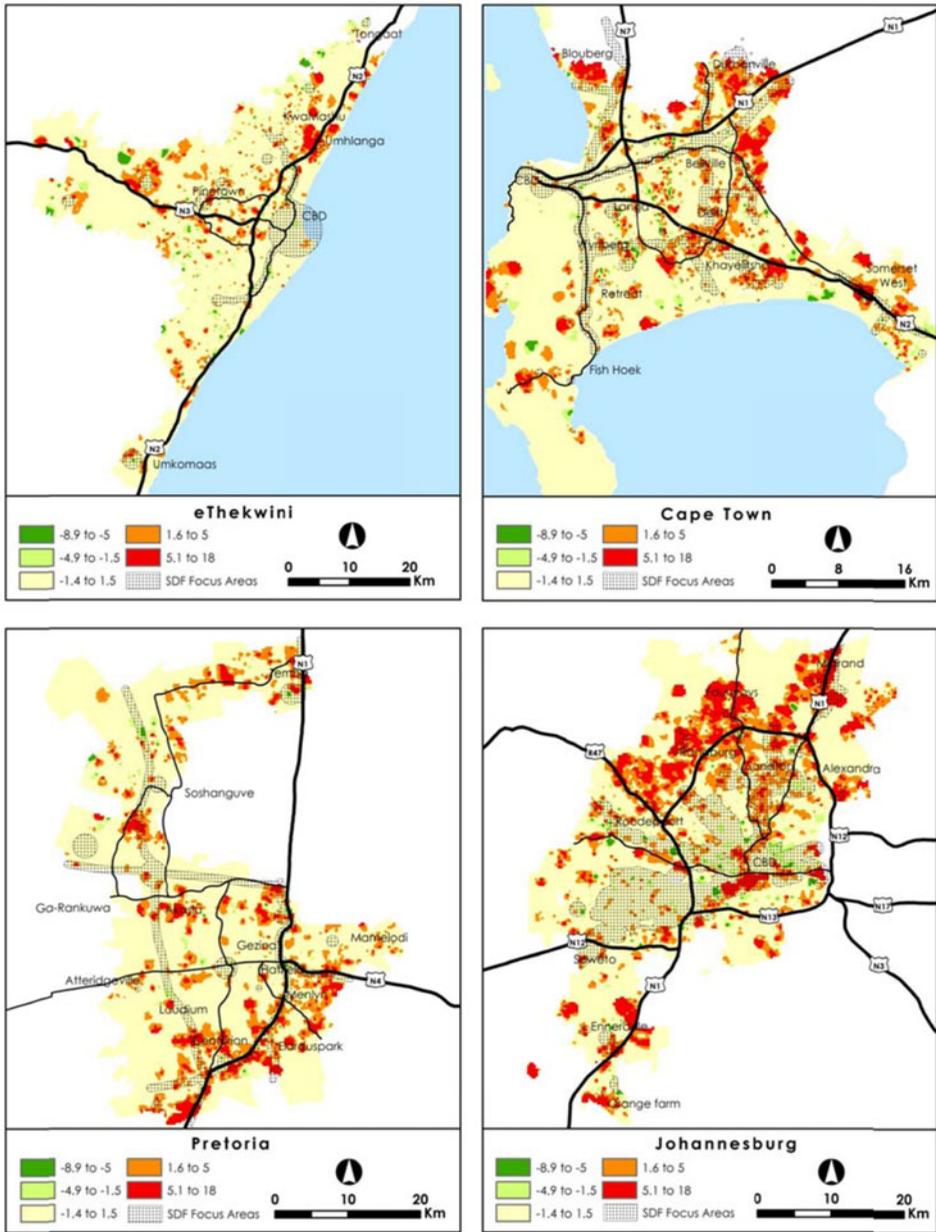


Figure 3. Change in LUMI values between 1994 and 2009/2010 – eThekweni, Cape Town, Pretoria and Johannesburg.
 Note: Own analysis based on GeoTerraImage (2012).

Conclusion

Although the findings presented in this article confirm a number of traditional views on land-use mix patterns in South African cities, it, however, also provided some evidence to suggest a much more limited influence of spatial planning principles and concepts on the

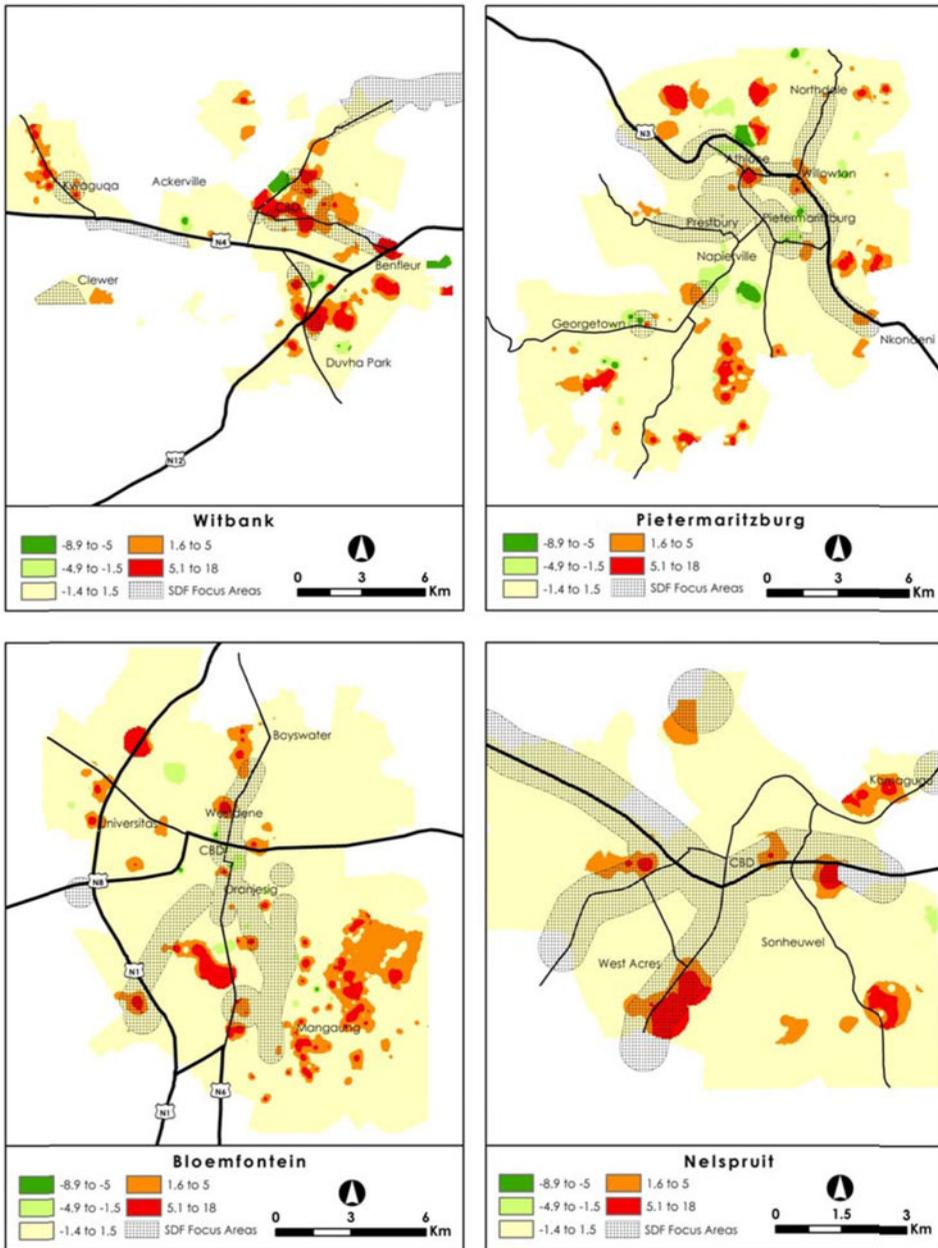


Figure 4. Change in LUMI values between 1994 and 2009/2010 – Witbank, Pietermaritzburg, Bloemfontein and Nelspruit.
 Note: Own analysis based on GeoTerraImage (2012).

land-use mix characteristics of South African cities than generally believed. These results can be summarized in terms of four key findings. The first aspect confirmed higher levels of land-use mix in larger metropolitan cities compared with the intermediate-sized cities, both in terms of intensity- and pattern-based land-use mix indicators. The study also

revealed that the land-use mix characteristics of the four cities within each of these two groups are very similar. Second, the results indicated that there were only marginal changes in the overall levels of land-use mix between 1994 and 2009/2010 in the eight cities. This implies that city structure as expressed by land-use mix indicators changes relatively slowly over time. A third notable trend over this period has been the increase in land-use mix in some historically low-income suburbs that formed part of the national URP. This may be indicative of the positive influence of this area-based programme on these areas in the post-1994 era, facilitating the provision of a wider range of social and commercial facilities in these areas resulting from both focused public-sector intervention and increased private-sector investors' confidence. The changes in land-use mix are, however, not equally prominent in other large low-income suburbs not benefitting from this programme. Fourth, both the intensity- and pattern-based indicators revealed generally higher levels of land-use mix within the SDF focus areas compared with overall aggregate city-level figures. The levels of change in land-use mix between 1994 and 2009/2010, however, indicate that the areas with the most significant increases show only limited correlation with the focus areas defined in the SDFs.

A number of observations are also relevant from a methodological perspective. First, the methodology and analysis results presented in this article are based on a two-dimensional view of land-use mix and do not include the third dimension, which accounts for the vertical mix of land uses on the same footprint or within the same buildings. Consequently, the levels of land-use mix in areas such as the central business districts of the cities will generally result in an underestimation of land-use mix values in these areas. The limited availability of land-use data for South African cities in three dimensions limits the possibility of this application within the current context. Second, the question of classification of detailed land-use categories into higher level aggregated land-use classification schemes also presents some challenges that are in principle related to the modifiable areal unit problem of different levels of spatial aggregation. Third, there is no official or commonly accepted definition of land-use categories deemed appropriate or suitable for inclusion in mixed land-use areas or nodes. The LUMI as applied in this article assumes that all land-use categories used in the analysis are deemed acceptable in mixed land-use areas. From a practical point of view, it may, however, be necessary to exclude certain land-use categories such as some types of industrial, transport or utility uses from consideration in the measurement of land-use mix patterns. The definition of 'appropriate' land uses may also differ between cities, and from area to area within an individual city. Fourth, it is recognized that any empirical analysis of urban structure, specifically land-use diversity, generally under represents the qualitative aspects within the range of indicators. There is a strong subjective element in the perceptions involved in the experience of density and land-use mix at a specific location (Burton, 2002, p. 246). These subjective perceptions are not accounted for in the indicators used in this research.

Despite these methodological challenges, it is believed that the results presented in this article provide a robust point of departure for debate and a more rigorous analysis of land-use mix patterns and trends in South African cities. The findings suggest that the spatial focus areas largely follow established historical patterns of land-use mix and conform more closely to 'trend planning' based on the outcome of market forces rather than reflecting innovative planning responses to the requirement for spatial restructuring. The study results provide the foundation for relevant role-players such as city planning and management officials, policy-makers, academics and other actors involved in city building to reflect critically upon the use and application of the principles and spatial structuring elements used in SDFs, with a view to achieving increased levels of land-use integration in

South African cities. Two aspects, in particular, require attention. First, some measure of differentiation is required between different types of ‘mixed use’ nodes or corridors. The type of land uses suitable for these mixed-use nodes will differ between cities and at different scales and localities within the same city. At least some indication is required of the intended dominant nature of the identified nodes and corridors (e.g. mixed residential focus, institutional focus or commercial focus). Second, some broad indications of the ideal balance between the various uses deemed appropriate within each type of node or corridor are required (e.g. what is the ideal proportion of different residential density types, social facilities and commercial activities within a specific node). This will also enable a normative evaluation of the levels of success of these instruments, based on a robust set of indicators as part of a spatial governance evaluation framework, suggested by the NDP.

The results presented in this article suggest that the location of spatial focus areas for intensified mixed land use is unlikely to achieve any significant local or overall urban spatial restructuring by merely aligning these areas with historical development patterns and may require more bold and innovative proposals. The results also suggest that the level and rate of impact in achieving a greater mix of land uses may be more readily achieved within historically marginalized townships if forming part of a broader urban renewal or restructuring initiative. It is envisaged that findings presented here will contribute to a meaningful debate on developing and enriching the implementation of mixed land-use concepts in the restructuring of South African cities.

Acknowledgements

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Notes

1. The available base year data in all cities is 1994 except for Nelspruit (1992) and Cape Town (1993), and the end year 2009 except for Bloemfontein (2008) and Witbank (2010).
2. A sensitivity analysis was undertaken to evaluate the impact of using different numbers of land uses (three, four and five uses) to determine the cut-off point for this category. The percentage EAs containing three or more uses varies between 19.7% and 43.4%, those with four uses between 4.8% and 20.4%, and those with 5 or more uses between 1.3% and 8.9%. Although the values differ for the various categories, the overall comparative patterns between the various cities remain largely similar. The rank order of only two cities differed by one position amongst the three alternative measures.

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