

***Spatial transformation in the City of Polokwane,
South Africa (1996-2016)***

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A PhD thesis submitted to the Department of Urban and Regional Planning in the Faculty of Science, Engineering and Agriculture for the award of PhD degree in Urban and Regional Planning.

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Prof P. Bikam

2021

DECLARATION

I Frank Moffat of student number 11616958, hereby declare that this PhD thesis titled “***Spatial transformation in the City of Polokwane, South Africa (1996-2016)***” has not been submitted previously for a degree at this or any other university, it is my own work in design and in execution, and that all reference material contained therein has been duly acknowledged.



Signature..... Date15/06/2021.....

DEDICATION

To my family, who showed me the road to school without despair.

ACKNOWLEDGEMENT

I am grateful to my promoters, Dr. James Chakwizira, my co-promoters Dr. Emmaculate Ingwani and Prof Peter Bikam for their unwavering support, guidance, patience, invaluable advice and encouragement during my PhD study. Their expertise and copious experience have made it possible for me to reach this far in academia.

My gratitude extends to the project team members (supervisors and PhD candidates) of National Research Foundation (NRF)'s Collaborative Postgraduate Training Programme which focused on Resilience and Spatial Justice in South Africa's Built Environment: Generating interdisciplinary transformative knowledge. Many thanks to the supervisory team of this project for their constructive criticism during the 2017, 2018 and 2019 project workshops. It comprised of my promoters Dr James Chakwizira, and Dr Emmaculate Ingwani from University of Venda (Univen) Department of Urban and Regional Planning; Prof. Monique Marks, Dr Kira Erwin, Dr Nomkhosi Gama, from Durban University of Technology (DUT) Urban Futures Centre; and Dr Gerald Chungu, Prof. Marie Huchzermeyer, Dr. Ariane Janse van Rensburg, Prof. Sarah Charlton from Witwatersrand (Wits) University's Centre for Urbanism and Built Environment Studies (CUBES). Thanks to the PhD candidates that participated in this project from the different institutions that made this PhD journey easier, namely; Wendy W Tsoriyo (Univen); Temba Middelman, David Duma, Simon Mayson (Wits); and Tanya Dayaram, Lindsay Bush, Doung Jahangeer (DUT).

I would also like to express my appreciation to Mr Tendai Gondo for his support and mentorship, and to the rest of staff members in the Department of Urban and Regional Planning at Univen.

Special thanks to key experts that assisted in shaping this study which include; Dr Richard Ballard, *Gauteng City Region Observatory, (GCRO)*; Johan Maritz and Mark Napier, *Council for Scientific and Industrial Research, (CSIR)*; and Gemey Abrahams, *Gemey Abrahams Consultants*. I would also like to thank officials from City of Polokwane for opening their doors and support in shaping the outcomes of this research.

I would also like to acknowledge the support that I received from my friends, and colleagues in this journey namely; Pr. Pln. Thapelo Tladi Mazwi, and Simbarashe Zhuwao. I am also grateful to my research assistants for their untiring efforts during the course of this research namely, Rendani Musetha, Rudolf Kaleka Mokolo and Tsetetsi Geelboy Thabo.

The financial assistance (R370 000 and counting, from the years, 2017 to 2019) of the NRF towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the researcher and are not necessarily to be attributed to the NRF. Additional

funding (R40 000) is also acknowledged from Univen Research and Publication Committee (RPC). Financial assistance of R4 560 and R5 000 for academic registration in 2017 and 2020 is greatly appreciated from my promoter Dr. James Chakwizira.

My heartfelt gratitude for making our 'couple goals' a reality, goes to my best friend, my wife, Dr Betina Moffat. Despite the difficult times we faced, you have been a pillar of strength and support since the onset of our tertiary education in 2011 at University of Venda. Thanks for your love. Special thanks to my sister in law, Melody Shayamano, your assistance is greatly appreciated.

I also express my gratitude to my family; my Grandmother, Conillia Mukange; mother Martha Mukange and father Tichaona Moffat, together with my siblings Tapiwa Moffat, and Princess Moffat. Thank you for believing in me and your unwavering support kept me going. I love you so much.

Lastly, I would like to thank my lovely daughter Breeann Moffat, we didn't know of your conception. We believe because of you, we survived a horrible car accident, a life chance to be there for you. Every time I looked at you it inspired me to work harder and complete this thesis. I want the best for you my daughter, Daddy loves you.

RESEARCH OUTPUTS

Moffat, F., Chakwizira, J., Ingwani, E., and Bikam, P. (2021). Policy directions for spatial transformation and sustainable development: A case study of Polokwane City, South Africa. *Town and Regional Planning Journal*, no.78, pp. 46-64.

Moffat F, Chakwizira J, Ingwani E, and Bikam P. (2020). *Exploring Urban Justice Practices in City of Polokwane*. [PowerPoint Presentation]. Southern Africa City Studies Conference August-September 31stAugust-4th September 2020. Virtual.

Moffat F, Chakwizira J, Ingwani E and Bikam P. (2018). *Use of Innovative Tools in Managing the Impacts of Built Environment on the Natural Environment*. [PowerPoint Presentation]. 1st International Conference on Sustainable Management of Natural Resources (ICSMNR2018). 15th-17th October 2018. Bolivia Lodge, Polokwane, South Africa.

Moffat F. (2019). *Spatial transformation and Just Urban Imaginaries a case study of Polokwane City*. [PowerPoint Presentation]. Just urban imaginaries colloquium.15th-16th August 2019. John Moffat Building Witwatersrand University, Johannesburg, South Africa.

ABSTRACT

The World urban population is increasing rapidly, in a context in which small, intermediate towns and cities have been found to be inadequately prepared to manage such pressures. One area in which cities have been underperforming is tracking spatial transformation. This study explores spatial transformation in the City of Polokwane from 1996 to 2016. The problem in the study area is that City of Polokwane lacks an integrated framework for tracking spatial transformation. The objectives of the study were to, (i) analyse the legislative and policy framework directions for spatial transformation in the City of Polokwane (ii) map spatial transformation in Polokwane City using spatial indicators, (iii) analyse the drivers of spatial transformation in the City of Polokwane (iii) establish the implications of spatial transformation in the City of Polokwane and (iv) develop an integrated framework for tracking spatial transformation in small and intermediate cities in South Africa. A pragmatic paradigm philosophical approach underpins the study, supplemented by mixed methods research approach and case study strategy. The sample size for the study comprised of 588 households, it was calculated using the Raosoft online sample size calculator. The sampling procedures adopted in this study include purposive sampling, snow ball sampling and stratified random sampling method, resulting in the proportional distribution of the sample in the following nodal areas; Polokwane (327), Seshego (184) and Mankweng (77). The primary data sources for this study included; household spatial transformation questionnaire survey, key expert interviews, observations, and mapping. Secondary data sources included institutional documents and records, key spatial transformation textbooks, geospatial data sets, internet and library datasets where the researcher accessed relevant information on spatial transformation in the City of Polokwane. Data analysis on the 116 mesozones polygons that are linked to the GIS databases containing 1996, 2001, 2011, 2016 census data was guided by the dimensions of spatial transformation mapping triad linked to relevant spatial indicators. The spatial indicators employed agglomerative hierarchical cluster analysis, to generate choropleth thematic maps using ArcGIS depicting empirical spatial transformation in the City of Polokwane from 1996 to 2016. Quantitative data analysis was aided with Statistical Packages for Social Sciences (SPSS) for descriptive statistics and exploratory factor analysis (EFA), to determine the drivers and implication of spatial transformation in the City of Polokwane. Qualitative data analysis in this study employed content analysis to gain an in depth understanding of spatial transformation and guide development of an integrated framework for tracking spatial transformation in small and intermediate cities. This was augmented with the use of Atlas.ti, for generating word cloud guided by deductive reasoning approach, and research questions from the study within the purview of critical discourse theoretical framework. The findings for the study provide the following contributions to knowledge on spatial transformation; (i) legislative and policy directions on spatial transformation in the City of Polokwane (ii) maps showing empirical evidence on spatial transformations in the City of Polokwane (1996-2016) (iii) drivers of spatial transformation in the City of Polokwane (iv) social, environmental, economic, government/policy and spatial planning implications of spatial transformation in the City of Polokwane (v) an integrated framework for tracking spatial transformation in small and intermediate cities in South Africa.

Key words: spatial transformation, legislative and policy frameworks, mapping, spatial indicators, drivers, implications, integrated tracking framework

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ABBREVIATIONS AND ACRONYMS

ACMS & FIC	African Centre for Migration & Society & Feinstein International Centre
ARC	Auckland Regional Council
AU	Africa Union
BE	Built Environment
BEPP	Built Environment Performance Plan
BID	Business Improvement Districts
BNG	Breaking New Ground
BRICS	Brazil, Russia, India, China and South Africa
BRT	Bus Rapid Transit
BSAC	British South Africa Company
C	Conditional
CBD	Central Business District
CCNLIS	Coordinating Committee for the National Land Information System
CD:NGI	Chief Directorate National Geo-spatial Information
CD's	Compact Discs
CDA	Critical Discourse Analysis
CEE	Central and Eastern Europe
CFL's	Compact Fluorescent Lights
CMA	Catchment Management Agencies
COGTA	Cooperative Governance and Traditional Affairs
CoGHSTA	Cooperative Governance Human Settlements and Traditional Affairs (Limpopo)
CS	Community Surveys
CSI	Committee for Spatial Information
CSIR	Council for Scientific and Industrial Research
CUBES	Centre for Urbanism and Built Environment Studies
CV	Covariance
DAFF	Department of Agriculture Forestry and Fisheries
DALRRD	Department of Agriculture, Land Reform & Rural Development
DC	Development Corridor
DED	Department of Economic Development
DEGURBA	Degree of Urbanization
DFA	Development Facilitation
DGP	District Growth Points
DHSWS	Department of Human Settlements, Water and Sanitation
DoT	Department of Transport
DUT	Durban University of Technology

DWS	Department of Water and Sanitation
EA	Enumeration Areas
Eco	Economic
EFA	Exploratory Factor Analysis
EMC	Electronic Metadata Catalogue
Env	Environmental
ESAP	Economic Structural Adjustment Programme
ETDZ	Economic and Technological Development Zone
EUROSTAT	European Statistics
Ext	Extension
FDA	Functional Development Areas
FET	Further Education and Training
FGDC	Federal Geographic Data Committee
FIFA	Federation of International Football Association
FTLRP	Fast Track Land Reform Programme
GCRO	Gauteng City Region Observatory
GDI	Geospatial Data Infrastructure
GHSL	Global Human Settlements Layer
GIS	Geographic Information Systems
GMC	Greenest Municipality Competition
GP	Governance and Political
GSDI	Global Spatial Data infrastructure
GT	Grounded Theory
GVA	Gross Value Added
HD	High Density
HDA	Housing Development Agency
HH	Household
ICT	Information Communication Technology Systems
IDP	Integrated Development Plan
IEC	Independent Electoral Commission
IGT	Informed Grounded Theory
IPPUC	Institute of Research and Urban Planning of Curitiba
IRPTS	Integrated Rapid Public Transport System
ISO	International Standards Organization
IUDF	Integrated Urban Development Framework
KMO	Kaiser-Meyer-Olkin
LDEDET	Limpopo Department of Economic Development Environmental and Tourism

LDO's	Land Development Objectives
LED	Local Economic Development
LM	Local Municipality
LSDFP	Local Spatial Development Framework Plan
LSP	Local Service Points
LUMS	Land Use Management Scheme
MDB	Municipal Demarcation Board
MGP	Municipal Growth Point
MPCC	Multi-Purpose Community Centres
NPC	National Planning Commission of South Africa
NGI	National Geo-spatial Information
NPC	National Planning Commission of South Africa
NQD	Number Of Questionnaires Distributed
NRA	National Roads Agency
NRC	National Research Council
NRF	National Research Fund
NSDF	National Spatial Development Framework
NSDI	National Spatial Data Infrastructure
NSIF	National Spatial Information Framework
NZTA	New Zealand Transport Agency
OCSG	Office of the Chief Surveyor-General
OECD	Organization for Economic Cooperation and Development
PC-IDEA	Permanent Committee For Geospatial Data Infrastructure of the Americas
PCP	Population Concentration Points
PDA	Potential Development Areas
PDF	Portable Documents Format
PGP	Provincial Growth Point
PHA	Polokwane Housing Association
PLAS	Pro-Active Land Acquisition Strategy
PPP	Public-Private Partnerships
RCG	Restructuring Capital Grant
RDP	Reconstruction and Development Programme
RSA	Republic of South Africa
RTCPA	Regional Town and Country Planning Act
SACN	South African Cities Network
SAEON	South African Earth Observation Network
SAGNC	South African Geographic Names Council

SAHO	South African History Online
SALGA	South African Local Government Association
SANBI	South African National Biodiversity Institute
SANRAL	South African, National Roads Agency Limited
SANS	South African National Standards
SANSA	South African National Space Agency
SARB	South African Reserve Bank
SASDI	South African Spatial Data Infrastructure
SBC	SPOT Building Count
SCBF	Spatial Characteristics/Biophysical Factors
SDA	Strategic Development Areas
SDF	Spatial Development Framework
SDG	Sustainable Development Goals
SEDGI	Standard Exchange of Digital Geo-referenced Information
SEM	Structural Equation Modelling
shp	Shape file
SHRA	Social Housing Regulatory Authority
SIC	Standard Industrial Classification
Soc	Social
SoCR	State of Cities Report
SPLUMA	Spatial Planning and Land Use Management Act of 2013
SPME	Spatial Planning Monitoring and Evaluation
SPSS	Statistical Packages for Social Sciences
Stats SA	Statistics South Africa
Stats	Statistics
STC	Spatial Transformation of Cities
STEPSA	Spatial Temporal Evidence Planning for South Africa
SWOT	Strengths Weaknesses Opportunities and Threats
TIFF	Tagged Image File Format
TLC	Transitional Local Council
ToC	Theory of change
TOD	Transit Oriented Development
TRC	Traditional Rural Councils
TUT	Tshwane University of Technology
UCL	University College of London
UDZ	Urban development zone
UN	United Nations

UNECA	United Nations Economic Commission for Africa
Univen	University of Venda
URBS	Urbanization Company of Curitiba [Urbanizacao de Curitiba SA]
USGS	United States Geological Survey
VSA	Village Service Areas
WITS	University of Witwatersrand
ZCC	Zion Christian Church

CHAPTER 1: RESEARCH ORIENTATION

1.1 Introduction

This chapter provides an overview of this thesis on spatial transformation in the City of Polokwane, South Africa. Section 1, introduces this thesis by highlighting the structure and organization of chapter 1 as presented in figure 1.1. Section 2, provides the study background leading to the context of this thesis. Section 3, rationale of the study, provides justification for conducting this research on spatial transformation in the City of Polokwane. Section 4, provides a concise description of the identified relevant issues around which this study is framed. This is then followed by section 5, on research aim, objectives and questions as informed by the problem statement. The study significance and contribution to knowledge is highlighted in section 6, followed by description of the study area in section 7. Section 8, provides delineation of this thesis, focusing on temporal, conceptual and geographical scope. The general assumptions underpinning this thesis and associated limitations are presented in section 9. Sections 10, 11, 12 and 13 highlight the general literature overview, definition of key terms, thesis layout and chapter summary respectively.

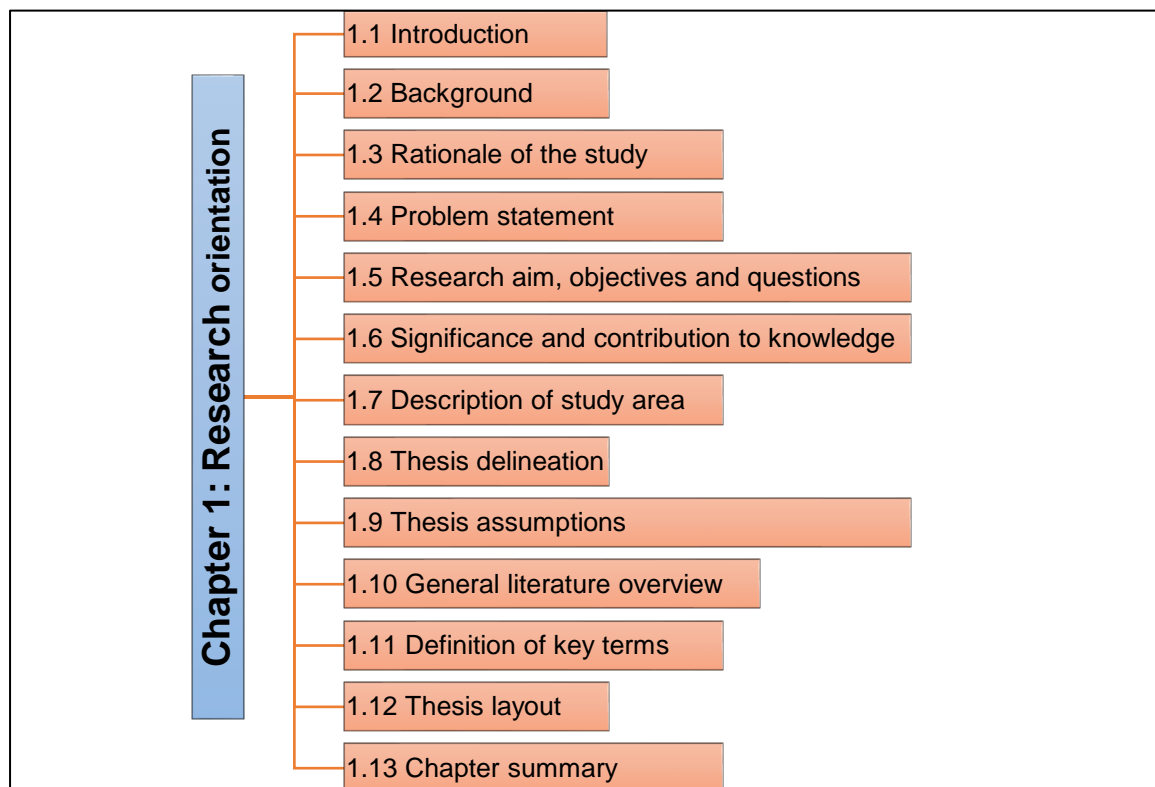


Figure 1.1: Chapter 1 Orientation

Source: Author, 2020

1.2 Background

According to the United Nations (UN) the World urban population is growing rapidly and is projected to rise from 56% in 2014 (UN 2014, p.1), to 68% in 2050 (UN 2019a, p.1). Urban critics from both the Global North and South have expressed concern that urbanisation is occurring in cities that are spatially transforming in the absence of proper management particularly in developing countries (Amindarbari and Sevtsuk, 2012, p. 2). Christmann (2014, p.236) pointed out that there is insufficient attention being paid on tracking spatial transformation of cities. Amindarbari and Sevtsuk, (2012, p. 1); Mubiwa and Annegarn, (2013, p. 3) posit that in the Global South most cities rarely monitor their spatial transformation compared to Western Cities. Furthermore, the 7th European Conference on African studies (2017), reiterated that in Sub Saharan Africa spatial transformations taking place in most small and intermediate towns, are not given adequate attention by most academics and policy makers. This is attributed partly to the fact that there is no standard approach or framework for tracking spatial transformation for cities and by extension small and intermediate cities. Additional challenges include inadequate application of existing tools, inability to develop necessary tools/frameworks, lack of easily available and interoperability of data, capacity constraints, and insufficient resources required to track spatial transformation (Amindarbari and Sevtsuk, 2012, p. 2; Maritz *et al.*, 2016, p. 3; Maritz *et al.*, 2017, p. 408). Authors such as Roitman *et al.*, (2010 p.3) stresses that “clearer frameworks for empirical investigations are needed”, in particular to guide tracking of spatial transformation. However, Roitman *et al.*, (2010) does not provide an integrated framework for tracking spatial transformation informed by empirical evidence and in this case contextually relevant for small and intermediate cities in South Africa. The outcome of inadequate spatial transformation tracking frameworks has manifested itself in terms of social, economic and environmental challenges which are at the core of what the UN Sustainable Development Goals (SDG's) seek to address. Hence this study seeks to develop a framework for tracking spatial transformation in small and intermediate cities which is able to integrate the sustainable development goals.

In seeking to unpack spatial transformation, one key challenge that exists is the lack of a universally agreed definition of spatial transformation. The word spatial transformation is used loosely to refer to both extensive and small scale urban changes or restructuring over time (Maritz *et al.*, 2017, p. 409; Maritz *et al.*, 2016, p. 4; South African Cities Network (SACN), 2015, p. 23; Bickford, 2014, p. 107; Turok, 2014, p. 74; Orange, 2014, p. 39; Gülersoy and Güler, 2011, p. 10; William, 2000, p. 169; Peck, *et al.*, 2009, p. 94). This definition is however, inadequate as it does not highlight the elements or indicators that have been spatially transformed. The school of thought in South African context, generally understand spatial transformation as the process of urban restructuring aimed at creating opportunities and

redressing the “physical manifestations of apartheid planning”, (Maritz *et al.*, 2016, p. 4; Oranje, 2014, p. 36; Bickford, 2014, p. 107). Furthermore, Maritz *et al.*, (2016, pp. 4-5); Turok, (2014, pp.74-79) adds that spatial transformation consists of the following aspects; social integration and racial mixing, urban structure and local texture. While this initial identification is encouraging, what is missing is how social integration and racial mixing, urban structure, and local texture can be measured and tracked spatially over time. As a follow through, the focus of this research is to analyse spatial transformation from a South African perspective in the context of City of Polokwane as the case study area.

Harrison and Todes (2015 p.148); Harrison and Todes (2013 p.2), point out that there have been “far-reaching spatial transformations” of different forms and rate across various scales of South Africa’s towns and cities. In light of this, South African cities are increasingly being called to track their spatial transformation in redressing apartheid legacy and implications of rapid urbanization. SACN (2015 p.24) corroborates this stating that, State of the Cities Report (2011), raises questions related to, “the nature and pace of spatial, social and economic transformation...”. This entails the need for empirical evidence on spatial transformation to help understand the nature and rate at which spatial transformation is happening in South African cities. It is estimated that 71.3% of South Africa’s population will be living in urban areas by 2030, reaching nearly 80% by 2050, (Maritz *et al.*, 2016 p.2; Cooperative Governance and Traditional Affairs (COGTA) 2014 p.12). The apartheid legacy and implications of rapid urbanisation are manifesting into issues of spatial injustice, inequality, and unsustainable growth paths among others (Kitching *et al.*, 2015 p.136; South African Cities Network (SACN) 2016, pp.49-50; Schensul and Heller, 2010 p.3; Williams, 2000, p. 7). Various progressive policy frameworks have seen light since the dawn of post-apartheid South Africa stressing the need for spatial transformation to redress apartheid legacy (Maritz *et al.*, 2016, p.1). In particular, the Spatial Planning and Land Use Management Act (SPLUMA) 16 of 2013, emphasises tracking spatial outcomes to measure the effectiveness or performance of the planning frameworks developed to facilitate spatial transformation (Mashiri *et al.*, 2017, p.155; Maritz, 2016, p.1). Maritz *et al.*, (2016, p.1) point out that to explore the progress of spatial transformation in South African cities, there is need to investigate or track the spatial changes of the cities landscape and by extension the rural country side. Whilst the government provides for an enabling environment to facilitate spatial transformation tracking, it does not provide the details or specifics on how spatial transformation should be tracked in South Africa.

Within the context of South Africa, the need for measuring spatial transformation has been long identified, what has been missing is an identified standardized framework for tracking spatial transformation. As a result, there exist different, duplicate, parallel, and fragmented spatial transformation tracking initiatives. In particular, the Built Environment Performance

Plan (BEPP) an outcome-led spatial transformation plan targeted at South African metropolitan municipalities (Metros), was first introduced in 2011/12 (Department of National Treasury, 2017 p.9). Through this BEPP initiative, a set of built environment outcome indicators to track the progress of spatial transformation were identified which are broadly categorized as; well governed, sustainable, productive and inclusive cities. The downside of the BEPP built environment outcome indicators is that it is only targeted at Metros in the country, thereby excluding secondary cities such as Polokwane. At the same time emphasis in measuring the outcomes has concentrated on allocation of infrastructure development grants, creating integration zones between township economies and the core of the cities. While this is critical as part of accelerating spatial transformation in post-apartheid era, the challenge is that the spatial investment approach is skewed towards addressing the problems of the previously marginalized communities without achieving the correct balance of integrating communities and cities. In addition, the Council for Scientific and Industrial Research (CSIR) in the ambit of Spatial Temporal Evidence Planning for South Africa (STEPSA) initiative, identified and explored spatial indicators on the Metros contributing to the 2016 State of Cities Report (Maritz *et al.*, 2016 p.8). The identified mesozone scale socio-economic indicators of spatial transformation focus on; accessibility, urban footprints, race, poverty, density, unemployment, youth, human capital development, energy, social vulnerability, and population growth. Furthermore, another initiative, is that South African Local Government Association (SALGA) tasked the Council for Scientific and Industrial Research (CSIR) to develop an index for measuring neighbourhood spatial transformation for use by South African Municipalities to determine progress in spatial transformation of human settlements (CSIR 2019). The indicators identified focus on tracking; density, transport, security of tenure, land ownership, economic opportunities and social amenities among others. Another notable research initiative is between University of Free State's Centre for Development Studies and South African Cities Network on secondary cities including City of Polokwane which started around 2013 (Marais and Nel 2019 p.vii). This initiative among other areas, tells the complex story on spatial transformation whether if it's "somehow unique" in the context of South African small and intermediate cities. In Marais and Nel (2019) book "Space and planning in secondary cities: a reflections from South Africa", there is no generic integrated set of spatial indicators that were employed in this narrative of spatial transformation. The methodology employed to describe the nature of spatial changes was limited to studying relevant data on population, housing and access to infrastructure. Clearly the above referenced project-based approach and interventions present evidence of fragmentation, mis-alignment, and differential scales on initiatives and application of spatial transformation indicators in South African small and intermediate cities. This warrants the

need for developing an integrated framework for tracking spatial transformation in small and intermediate cities in South Africa.

The City of Polokwane like any other South African cities is experiencing spatial transformation. It is also characterized by apartheid legacy and implications of rapid urbanization as expressed by Kitching *et al.*, 2015; SACN 2016; Schensul and Heller, 2010. Kotze and Donaldson, (1998, p. 469); Donaldson and Kotze (2006, p.571), supports this by stating that the city was established with the principles of spatial segregation embedded in the social fabric, residential and business sectors. The end of apartheid and the transformation from the then Pietersburg municipality to the current comprehensive City of Polokwane resulted in a quantum leap of more than twelvefold population increase. The population increased from 43 000 to 530 000 (de Villiers and Madu, 2003 cited in de Villiers and Kalema 2005 p. 83), and it's projected to rapidly increase to 942 962 in 2030 (Polokwane LM 2016a, p.2). The City of Polokwane is experiencing what the UN (2014), stated as rapid urbanization that has contributed to spatial transformation in most cities. The downward side to this rapid urbanisation is that it is happening against a background in which the City either lacks proper management or is under-prepared for the resulting challenges that emerge from a rapidly urbanising environment.

Furthermore, Polokwane LM (2020 p.340; 2016a p.233; 2014a) indicated that the municipality is grappling with challenges that include rapid urbanization, ageing infrastructure, outdated policies, lack of policy implementation, inadequate service delivery, land use management, limited skills, capacity, and expertise in Geographic Information Systems (GIS). These inadequacies exacerbated by poor Information Communication Technologies (ICT) mean that the City faces challenges in integrating the municipal spatial planning systems with the GIS. At the same time, human capital and limited funding to conduct further studies and policy development to resolving informal settlements and incomplete townships among others have become daunting challenges. In any case, the City is also grappling with challenges of illegal land uses and illegal townships. If one adds the issues of outdated land use management policies and outdated GIS data, the result is the poor integration of human settlements in the City of Polokwane. This is one reason why the past land use management policy in the study area has continued to exclude areas outside the 1st order node Seshego-Polokwane among others (Polokwane LM 2020 p.340; 2016a, p.87). All these myriad of challenges are hindering the municipal capacity to track spatial transformation in the City of Polokwane

1.3 Rationale of study

Parnell and Oldfield (2014, p.4) highlights that there is a knowledge gap on how cities from the global north and global south have rapidly shifted or spatially transformed over time.

However, Amindabhari and Sevtsuk (2012, p.2) argue that the knowledge gap on spatial transformation of cities is attributed to the fact that the 'extent and growth pattern' of metropolitan cities in the Global South have been under studied compared to Western cities. In addition, similarly with the concept and theory of circular cities, spatial transformation of smaller and intermediate cities is even less explored, (Steel, 2013 p.239) and usually not included in the realm of understanding cities (Robinson 2002 cited in Marais and Visser 2008, p.iii). In the South African context, the understanding of realities of spatial transformation in urban areas has been skewed towards the top nine primate cities (Marais and Nel 2019; Marais *et al.*, 2019; State of Cities Report (SoCR) 2016; 2011; 2006 and 2004). Parnell and Oldfield (2014 p.iii); Jeniffer Robinson cited in Parnell and Oldfield (2014, p.8) suggest that to fill the knowledge gap in the global ways of thinking about spatial transformation of cities, there is need for the production of southern city knowledge, a challenge faced by most academics. Therefore, the purpose of this study is to bridge the knowledge gap on cities from the global south by providing empirical evidence of spatial transformation in post-apartheid City of Polokwane of South Africa.

There have been attempts at tracking spatial transformation in post-apartheid City of Polokwane. However, such attempts are limited in scope to racial diversity (Kotze and Donaldson, 1998, Donaldson and Kotze, 2006) and land use change between 1994 and 2002 (Nemukula, 2013). These studies do not capture the multi-dimensional aspects of spatial transformation in the City of Polokwane. Hence the purpose of the study is to analyse the various aspects of spatial transformation and to generate an integrated framework for tracking spatial transformation in the City of Polokwane.

1.4 Problem statement

There have been attempts at tracking spatial transformation across South Africa at various scales which include BEPP initiative (Department of National Treasury, 2017), CSIR and STEPSA initiative (Maritz *et al.*, 2016), Neighbourhood spatial transformation Index (CSIR 2019), University of Free State's Centre for Development Studies and SACN secondary cities research initiative (Marais and Nel, 2019). Thus, different, duplicate, parallel and fragmented project based approaches on spatial transformation tracking initiatives exist, which also fail to identify an integrated framework for tracking spatial transformation. Wang and Liu 2017; Maritz *et al.*, 2017; Maritz *et al.*, 2016; Amindarbari and Sevtsuk 2012; Roitman *et al.*, 2010; echoes that the problem is absence of a standardized approach or lack of an integrated framework for tracking spatial transformation. This leads to a failure to adequately track, trace and better manage spatial transformation dynamics in the City of Polokwane. It is therefore important

that a baseline set of spatial transformative indicators contextually relevant to City of Polokwane be developed if sustainable plans and management of cities is to be realised.

Literature survey on the City of Polokwane, shows that attempts at tracking spatial transformation were limited in scope to racial diversity (Kotze and Donaldson, 1998, Donaldson and Kotze, 2006), household dwelling type (Harrison and Todes 2015) and land use change between 1994 and 2002 (Nemukula, 2013). The problem identified here is that these studies do not capture the multi-dimensional aspects of spatial transformation in the City of Polokwane. Hence the purpose of the study is to analyse the various aspects of spatial transformation and to generate an integrated framework for tracking spatial transformation in the City of Polokwane.

The processes and drivers of spatial transformation are complex and their level of significance differs between cities (Turok, 2014, p. 81; Landman, 2006, p.2). Understanding the processes and forces driving spatial transformation is vital for making informed decision on the formulation of possible strategies and tools towards redressing apartheid legacy, development trajectories and impacts associated with rapid urbanization (Coetzee et al., 2014 p. 1; Mubiwa and Annegarn 2013, p. 4; Wray et al., 2013 p. 6; Lauf, et al., 2011, p. 71; Sadiki and Ramutsindela, 2002, p. 57). Bruyns (2018); Muhammed and Onuche (2017); Thorns (2002) reiterates that dominant neoclassical theories, are ideological and deficient in explaining the complex drivers of spatial transformation. Hence this study, shift from classical quasi-biological metaphor analysis to structuralist analysis of the complex web of urban systems to understand the spatial, environmental, economic, political and social dynamics driving, as well as implications of spatial transformation in the City of Polokwane.

The problem of the study area is that City of Polokwane lacks an integrated framework for tracking spatial transformation. Given the projected rapid rate of urban population growth, there is need to track, understand the drivers, and implications of spatial transformation to inform planners and policy makers.

1.5 Research aim, objectives, and questions

This section outlines the research aim, objectives and questions for this study.

1.5.1 Research aim

This study seeks to explore spatial transformation in the City of Polokwane from 1996 to 2016;

1.5.2 Research objectives

The objectives of this study are to:

- i. analyse the legislative and policy frameworks on spatial transformation in the City of Polokwane (1996-2016)
- ii. map spatial transformation using spatial indicators in the City of Polokwane (1996-2016)
- iii. determine the drivers of spatial transformation in the City of Polokwane
- iv. assess the implications of spatial transformation in the City of Polokwane
- v. develop a framework for tracking spatial transformation in small and intermediate cities in South Africa

1.5.3 Research questions

- i. What are the policy directions for spatial transformation in the City of Polokwane?
- ii. How can spatial transformation be characterized using spatial indicators in the City of Polokwane (1996-2016)?
- iii. When, how and why did spatial transformation occur in the city of Polokwane?
- iv. What are the drivers of spatial transformation in the City of Polokwane?
- v. What are the implications of spatial transformation in the City of Polokwane?
- vi. Who are the major stakeholders influencing spatial transformation in the city of Polokwane and why?
- vii. Which areas of the city of Polokwane have witnessed spatial transformation?
- viii. When and why did spatial transformation occur in those identified spatial location areas/zones and not elsewhere?
- ix. Which framework can be used for tracking spatial transformation in small and intermediate cities in South Africa?

1.6 Significance and contribution to knowledge

This research is significant because its part of bigger project on Resilience and Spatial Justice in South Africa's Built Environment: Generating Interdisciplinary Transformative Knowledge under the National Research Foundation (NRF's) Collaborative Postgraduate Training Programme.

The major contributions to knowledge in terms of conceptual clarifications, models, frameworks, and methods applied as noted or deciphered from individual from chapters making up this thesis are summarised as follows:

Chapter 2 presents the following contributions on notion and theories of spatial transformation; figure 2.2 notion of space; table 2.1 dimensions of spatial transformation; figure 2.3 notion of transformation, figure 2.5 spatial transformation notion mind-map; figure 2.6: conceptual spatial transformation mapping triad; table 2.2: aspects and indicators for mapping spatial

transformation; figure 2.7: theory of change; figure 2.8: critical spatial transformation conceptual framework.

Chapter 3 presents contributions that emerged from lessons learnt on spatial transformation discourses: international experiences and perspectives which include: influence of policy directions on spatial transformation; table 3.1: spatial transformation indicators, table 3.2: drivers of spatial transformation and table 3.3: implications of spatial transformation.

Chapters 4 and 5 contributions on research methods include; use of mobile software applications to aid in field data collection i.e. plate 4.1: field observation video recording using AutoBoy BlackBox application and plate 4.2: geospatial mapping with SW Maps; figure 5.6: geospatial data scale comparison for spatial transformation analysis; table 5.2: assessment of geospatial data fitness for mapping spatial transformation; and figure 5.7: GIS components and mapping spatial transformation.

Chapter 6 contributions from legislative and policy framework directions for spatial transformation in the City of Polokwane include; table 6.1 spatial transformation directions from the legislative and policy objects discourses; figure 6.2 DFA of 1995 spatial transformation tenets; figure 6.3 an overview of legislative policy principles directing spatial transformation; and figure 6.6 proposed new approach to local spatial development framework plans (LSDFP's) for spatial transformation.

Chapter 7 contributions on capabilities and interoperability of big geospatial data to generate empirical evidence on spatial transformation in the City of Polokwane guided by the mapping triad include; i) population distribution changes: figures 7.2 to 7.12, table 7.1 and table 7.2; ii) city structure changes: from figures 7.13 to 7.18; and tables 7.3 to 7.5; and iii) city texture changes: from figure 7.19 to 7.23 and table 7.6. The other key knowledge contribution from this chapter is figure 7.24, an integrated spatial transformation tracking framework.

Chapter 8 provides knowledge contribution on drivers of spatial transformation in the City of Polokwane namely: governance and policy drivers (table 8.4); spatial characteristics/biophysical drivers (table 8.8); social and cultural drivers (table 8.12); economic drivers (table 8.16).

Chapter 9 provides knowledge contribution on implications of spatial transformation in the City of Polokwane namely: environmental implications (table 9.4); economic implications (table 9.9); social implications (table 9.14); governance and political implications (9.20) and spatial planning, monitoring and evaluation implications (9.24).

The above-mentioned knowledge contribution will benefit a wide array of audiences from all walks of life. These audiences include academics, practising planners, City of Polokwane

municipality, policy makers, and researchers among others. Oranje (2014, p.38) highlights that empirical evidence on spatial transformation is a critical contribution because the macro-picture of spatial changes in cities is absent in the academic discourses. Therefore, there is need to take advantage of available big data to analyse how the City has been spatially transformed. Furthermore, in view of Marais and Visser (2008, p.iv) empirical contributions from this thesis on spatial transformation in the City of Polokwane, which fall in the category of small and intermediate cities ‘off the map’ is significant. These contributions, provide a baseline for further researches and for comparison with other small and intermediate cities which lead to the broadening of perspectives on the theorisation of spatial transformation of cities to be more rigorous and inclusive of cities from the Global South.

1.7 Description of study area

The City of Polokwane is one of the four local municipalities located within Capricorn District municipality, in the central part of the Limpopo Province in South Africa. It shares boundaries with Bloubaerg, Molemole and Lepelle-Nkumpi local municipalities as shown in figure 1.2.

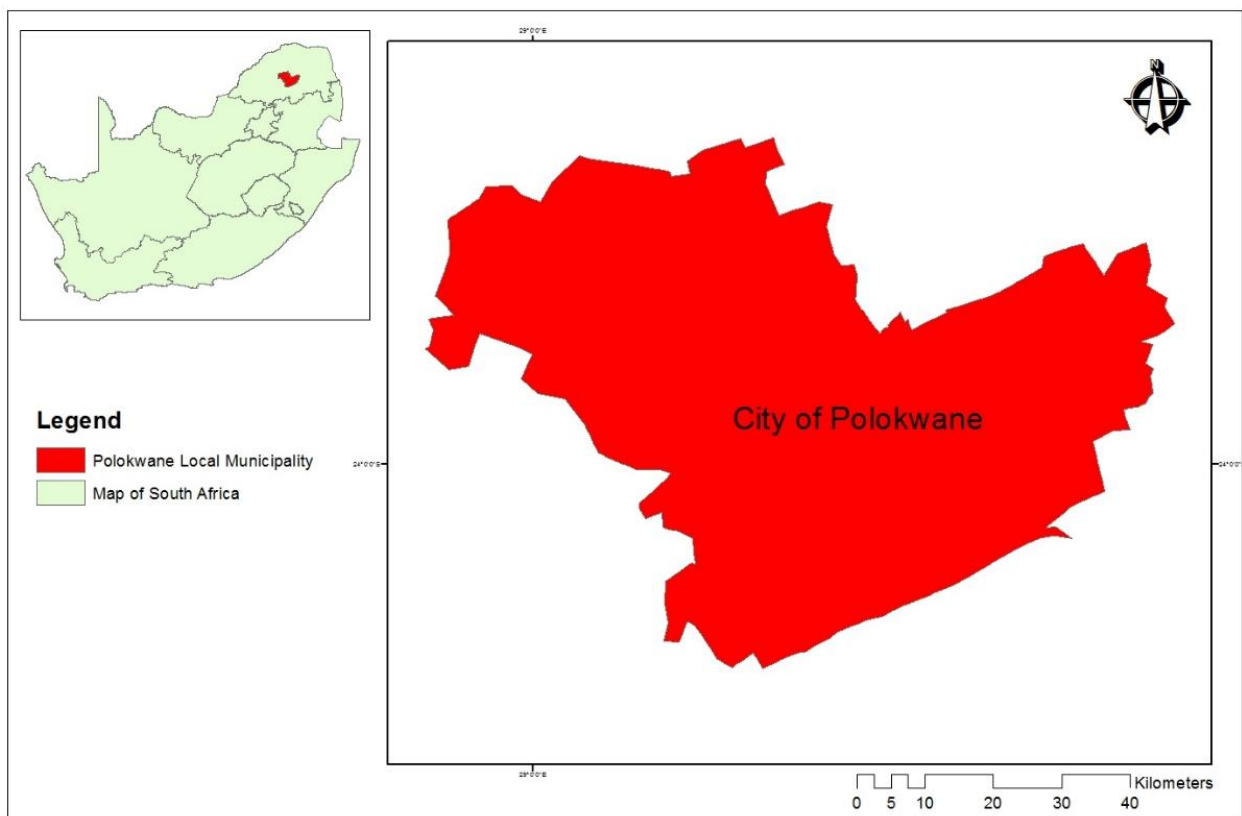


Figure 1.2: Location of study area, City of Polokwane

Source: Author, 2018

The Polokwane LM occupies a surface area of 3 766 km² which is approximately 3% of the total area of Limpopo Province. Its total population of 797 127 is over 10% of the overall

population of the province (The Local Government of South Africa, 2017 p.155). City of Polokwane is the economic hub and administrative capital of the province (Polokwane LM 2016a, p. 79). The City of Polokwane is experiencing spatial transformation of different forms and scale. In August 2016 it was merged with part of the disbanded Aganang local municipality (The Local Government of South Africa, 2017 p.155).

1.8 Thesis delineation

The boundaries within which this thesis is kept is presented in the context of temporal, conceptual, and geographical scope.

1.8.1 Theoretical and conceptual scope

The theoretical underpinnings for understanding spatial transformation interpretive discourse in this study is anchored on several theories namely, spatial justice, right to the city theory, critical urban theory, spatial triad, spatial dialectics and didactics, spatial turn, discourse analysis theories, complexity theory and theory of change. These theories augment the understanding of spatial transformation from different theoretical perspectives and implications thereof in the City of Polokwane.

Spatial transformation as a concept is contestable and multi-dimensional. According to Williams (2000), the notion of (spatial) transformation in the context of South Africa relates to the restructuring of urban form to address apartheid legacy into spatially just, and sustainable areas (Oranje, 2014, p.60; Williams, 2000, p.173). Furthermore, spatial transformation comprises the following aspects (i) local texture, (ii) urban structure and (iii) social integration and racial mixing (Maritz *et al.*, 2016, pp. 4-5; Turok 2014, pp.74-79). Thus, the focus of this study is on urban structure, social integration, and local texture to generate maps which help to understand spatial transformation in the City of Polokwane between 1996 and 2011.

1.8.2 Geographical scope

The geographical scope for this study takes two different spatial scales of application at the city scale and micro scale (Roitman *et al.*, 2010, p.5) in order to attain the study research objectives stated in section 1.5. To attain the first objective of mapping spatial transformation the geographical coverage is the whole of Polokwane LM narrowing down to a micro scale on specific areas exhibiting intensive spatial transformation. In order to understand drivers and implications of spatial transformation, two areas were strategically selected. The areas were selected on the basis of empirical findings from the second objective, which pointed out two areas that experienced massive spatial transformations between 1996 and 2016. These areas also align to the hierarchical clustering in the City of Polokwane namely 1st order node

Seshego-Polokwane an urban area and 2nd order node Mankweng-Badimong which is largely rural.

1.8.3 Temporal scope

The temporal scope or time horizon of a research is viewed as either cross-sectional or longitudinal (Saunders *et al.*, 2009 p.155). The time horizon of this study is longitudinal in nature, as underpinned by Bouma and Atkinson 1995 cited in Saunders *et al.*, (2009 p.156) that, such studies seek to answer the question, “Has there been any change over a period of time?” Similarly, the aim of this study is to explore spatial transformation in the City of Polokwane between 1996 and 2016 to answer the question raised earlier, on whether there have been any changes or not, if so of what nature? Rising up to this question, the study employed spatial transformation indicators broadly categorized as demographic distribution, urban structure and urban texture, to map out the nature of spatial changes. In another perspective, the reason for strategically selecting the time frame 1996 to 2016, was informed by availability of longitudinal census data i.e. 1996, 2001 and 2001, together with 2007 and 2016 community surveys (CS) which allowed the researcher to undertake a trend analysis to track spatial transformation. Therefore putting the pieces together, the census and community survey data between 1996 and 2016 assisted in understanding the dynamics on spatial changes in the City of Polokwane.

1.9 Thesis assumptions

The assumption of this study is that spatial transformation is occurring in the City of Polokwane just like any other South African city and that geo-spatial data required to track spatial transformation is available and accessible. In addition, the study also assumes that tools or spatial indicators can be identified and can be employed to track spatial transformation in the City of Polokwane. Furthermore, the study assumes that there is no standard framework for tracking spatial transformation. The study also assumes that the City of Polokwane is representative of small and intermediate cities in South Africa and that the study recommendations can be applied to similar and related cities in South Africa and developing countries in general subject to customization.

1.10 General literature overview

Literature survey shows the pattern that, the need for tracking spatial transformation has been long identified. Various policy frameworks provides cues on spatial transformation which include UN Sustainable Development Goals (SDG's), Africa Union (AU) Agenda 2063, Reconstruction and Development Programme (1994), Development Facilitation Act (1996), Urban Development Framework (1997), National Spatial Development Perspective (2006),

National Development Plan Vision 2030 (2012), Spatial Planning and Land Use Management Act (2013), Integrated Urban Development Framework (IUDF) (2016) and the draft National Spatial Development Framework (2019). However what has been missing is an identified standardized framework for tracking spatial transformation. Hence, this thesis seeks to develop an integrated framework for tracking spatial transformation in small and intermediate cities in South Africa. In another perspective, available literature on realities of spatial transformation is skewed towards major cities around the world (Marais and Nel 2019; Marais *et al.*, 2019; Parnell and Oldfield 2014; Steel, 2013; Amindabhari and Sevtsuk 2012; Marais and Visser 2008). This has resulted in a growing research interest on spatial transformation dynamics among other issues in small and intermediate towns to fill this knowledge gap since 2011 (Marais *et al.*, 2019). Hence, this thesis seeks to bridge the knowledge gap on small and intermediate cities by providing empirical evidence of spatial transformation in post-apartheid City of Polokwane of South Africa.

1.11 Definition of key terms

City- refers to the whole area of a municipality both urban and rural areas, (SACN 2012 p.8). Therefore, City of Polokwane is used in reference to Polokwane local municipality as also categorized by the settlement hierarchy typology of South Africa on the bases of its 2-5 rank on Government and Economic Services Index and also because of its population which ranges between 500 000 to 1million (Abrahams 2017 p.7; Van Huyssteen, *et al.*, 2016 p.6).

Spatial transformation – “An interrelated series of material driven practices, whereby the form, substance and overall dimensions of the urban space are purposefully changed to reflect the principles of a more equitable social order (SACN 2017a p.15).

Spatial indicators- refers to “the quantitative or qualitative variables that provide a simple and reliable means to measure achievement, to reflect the changes connected to an intervention, or to help assess the performance of an organization against the stated outcome” (Maritz *et al.* 2017 p.2).

Intermediate cities- “is a term that emphasises the functional role of larger, non-metropolitan urban areas” (SACN 2014 p.vii). They are also known as secondary cities because they are ranked second after the prime cities. However the difference is that the term secondary city is concerned with size, where as intermediate city is concerned with functions, services, facilities and infrastructure (Tacoli and Satterthwaite, 2002 p.1).

Urbanization – “refers to the physical growth, and transformation of urban areas attributed to global and local changes such as rural-urban migration” (Lewin *et al.*, 2011 p.5).

1.12 Thesis layout

This section highlights the layout of the thesis in exploring spatial transformation in the City of Polokwane, South Africa. The core structure of this thesis is graphically presented in figure 1.3, summarising this document into ten chapters.

Chapter 1 highlights the orientation of this thesis. It provides an introduction and background of this study in the context of spatial transformation of small and intermediate cities. This chapter also highlights the rationale for undertaking this study pointing out knowledge gaps motivating and strengthening this thesis, followed by the problem statement, research aim, objectives and research questions. This chapter also explains the study significance and knowledge contribution to the academia, and the wider audience. It also sets out the thesis delineation, assumptions, general literature overview and definition of key terms in this study.

Chapter 2 reviewed literature on the notion and theories of spatial transformation with the view of identifying an analytical and theoretical frameworks that guided this study. This assisted in developing the conceptualized critical spatial transformation theoretical framework that was employed in this study.

Chapter 3 also reviews literature on background evolution and development of spatial transformation discourses. This sets the tone on review of empirical case studies literature from both developed and developing economies and an elaboration of emergent lessons that are relevant to the broader objectives set out in this study.

Chapter 4 explains the research methodology adopted in this study guided by the overarching pragmatic research paradigm. This chapter highlights the mixed methods research approach, case study research strategy and research design adopted in this study. This chapter also explains the details on methods and instruments for data collection and methods of data analysis and presentation employed to attain the research objectives. Furthermore, this chapter also discusses the research limitations, reconnaissance, and ethical considerations relevant to this research study.

Chapter 5 is an extension of research methodology with specific focus on analysis of geospatial methodology and datasets required to map out spatial transformation in the City of Polokwane. Literature is also reviewed to understand the role of South African Spatial Data Infrastructure (SASDI) and its adequacy in providing interoperable geospatial data. This is then followed by comparative assessment of various geospatial data sets leading to selection of best suited longitudinal data to map spatial transformation in the City of Polokwane.

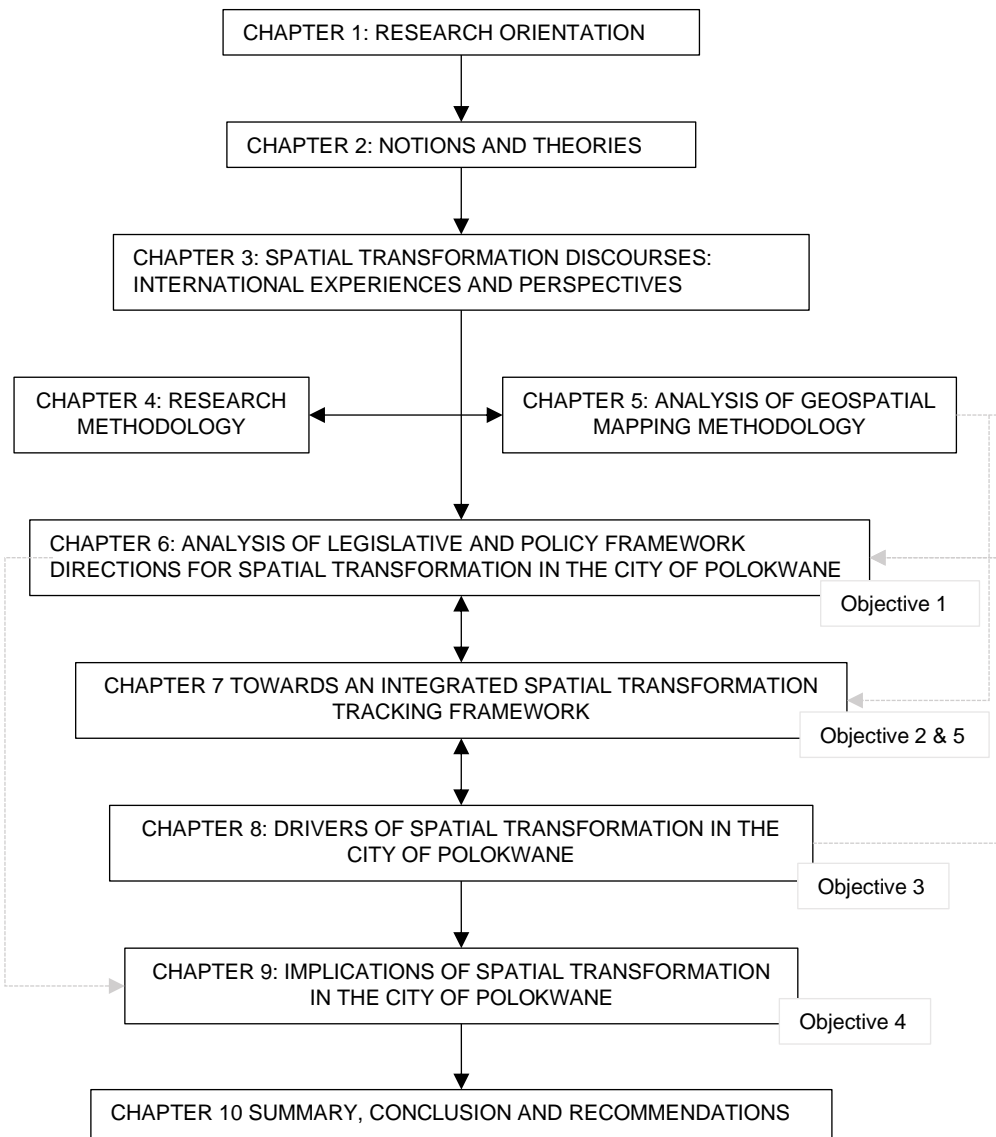


Figure 1.3: Thesis layout

Source: Author, 2020

Chapter 6 is an analysis of legislative and policy directions for spatial transformation in the City of Polokwane. It discusses the overarching legislations and policies, objectives, normative principles, tools and concepts directing spatial transformation in the City of Polokwane.

Chapter 7 is oriented towards an integrated spatial transformation tracking framework. It begins by mapping out spatial transformation in the City of Polokwane guided by the conceptualized spatial transformation triad framework and relevant spatial indicators to show the typologies of spatial changes in the City of Polokwane between 1996 and 2016. This is followed by the conceptualization of an integrated spatial transformation tracking framework.

Chapter 8 discusses the drivers of spatial transformation in the City of Polokwane. It elaborates on the governance and policy, spatial characteristics/biophysical factors, social and cultural, and economic drivers of spatial transformation in the City of Polokwane.

Chapter 9 explains the implications of spatial transformation in the City of Polokwane. It discusses the environmental, economic, social, governance and political, spatial planning, monitoring, and evaluation implications of spatial transformation in the City of Polokwane.

Chapter 10 presents a summary of findings, conclusion and recommendations emerging from the previous chapters in line with the broader research objectives.. This is also followed by highlighting the knowledge contribution and future research areas.

1.13 Chapter summary

This chapter introduced the concept of spatial transformation with particular focus on City of Polokwane as case study area. This was followed by the study rationale, problem statement, research aim, objectives, questions, and hypotheses. This chapter also discussed the contribution to knowledge, study area, scope of the study on the following key aspects; time frame, theory and geographical scale. Furthermore, the chapter provided, thesis assumptions, general literature overview, definitions of key terms and outlined the thesis layout.

CHAPTER 2 NOTIONS AND THEORIES OF SPATIAL TRANSFORMATION

2.1 Introduction

The purpose of this chapter is to explore the conceptual and theoretical undertones of spatial transformation that underlies this study. The first section is an introduction providing the structure of this chapter as illustrated in figure 2.1. The second and third sections of this chapter highlights the notion of space and transformation respectively. The fourth section combines these two aspects and discusses the notion of spatial transformation. Section 5, discusses the spatial transformation mapping triad employed in this study. In addition to this, section 6, discusses concepts and theories that forms the basis of this study namely; spatial justice, right to the city, critical urban theory, spatial triad, spatial dialectics and didactics, spatial turn, discourse analysis, complexity theory and theory of change. Building on these, section 7 puts forward a critical spatial transformation theoretical framework adopted in exploring spatial transformation in the City of Polokwane.

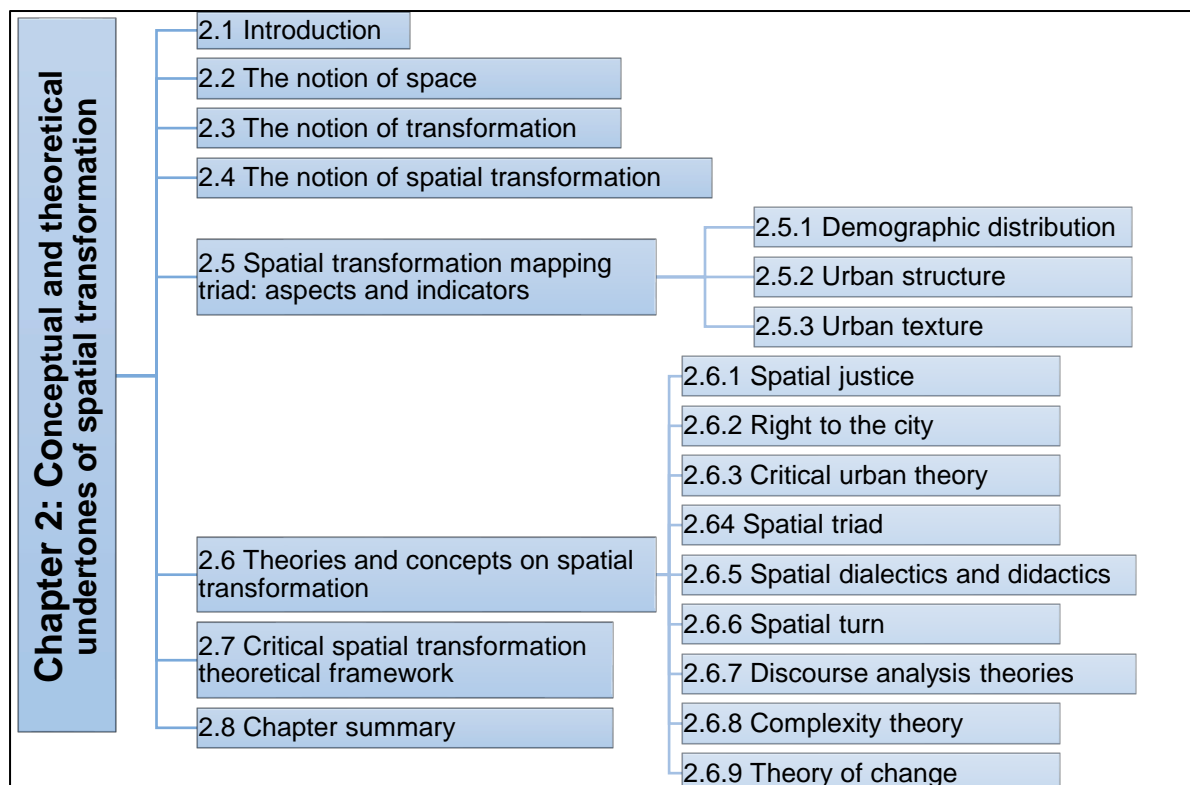


Figure 2.1: Chapter 2 Orientation

Source: Author, 2020

2.2 The notion of space

To enhance the understanding of the concept of spatial transformation, the terms spatial and transformation are discussed separately. The term space is tantamount to spatial. There is no universally agreed definition of space (Campbell, 2018p.e27; Hubbard 2012 p.24; Thrift 2003

p.96; Mazur 1983 p.139). Generally space refers to, “a continuous area or expanse which is free, available, or unoccupied; the dimension of height, depth and width within which all things exist and move; an interval of time; the portion of a text or document available or needed to write about a subject; the freedom to live, think, and develop in a way that suits one...” (Oxford Dictionary, 2019). In this approach, therefore space includes dimensions of i) size: the space in consideration vary in size it can be large or a small portion and does not exist in isolation of the broader whole. ii) vacant: free, not having any activity, there are no land use activities, iii) boundary: space under consideration is supposed to be identified, contained, demarcated; iv) time frame: space cannot be separated from time, that is when analysing space there is need to indicate the period being considered because space change with time and at different timeframes; v) occupied: space can also be in use, occupied, people can live in it “lived spaces’ vi) change: the stakeholders or agents living in it space can transform, change or develop it to suit their interests. Space can also be viewed as the whole area in which things exists.

In another view, Mazúr *et al.*, (1983 p.139), are of the view that in geographical perspective space is conceptualized as absolute and relative. Absolute space, refers to empty space in Euclidean geometry (Marúz et al 1983 p.139; Lefebvre 1991 p.236). Furthermore, an absolute space “is represented with relative precision by the system of topographical coordinates” (Marúz *et al.*,1983 p.140). This entails that space being considered blank is not necessarily blank, scientifically the geographical coordinate system “unambiguously and precisely divides” this absolute space. Thus using geographical information systems (GIS) the empty space becomes important for localization of landscape elements, and features. This localization is crucial as it also facilitates tracking of landscape elements over time, which in turn ushers an opportunity to unravel spatial transformation dynamics. Thus, absolute space provides for the production of abstract, scientific understanding of space (Watkins 2005 p.210). In another perspective, space as viewed by Philippopoulos-Mihalopoulos (2011 p.189) in relation to ‘new spatial semiotics’ implies that methodologically, absolute space provides for an in depth analytical approach of reality with reference to, “mapping, scale, horizon, domain, field, space/place, boundary, crossing, topology and so on”. This form of space and it’s conceptualization is significant as it provides means and methodology to unravel the reality of spatial transformation dynamics in small and intermediate cities in South Africa. Lefebvre (1991 p.285-287) conceptualized this space as i) geometrical formant: which is also similar to mental space, ‘imaginary’ representation of space, space of reference, also has a mark, boundary, and a reference point. Furthermore, this space is considered as reductionism of three dimensional reality of the world, “natures and social space” into two dimensions such as plan, map, or other graphical projections. Thus, in geometrical perspective and methodologically, space is used to represent the reality of spatial transformation. ii) optical

(visual) formant; relates to visualization as 'metaphoric' it informs social practice and 'metonymic' representing the totality of things seen. Hence, understanding the written message requires decipherment by the eyes from the visualizations (Lefebvre 1991 p.287). This implies visualization of both the desired morphology of cities and the totality of existing state of cities is important for professional and practicing planners not only for understanding the spatial patterns but also allows for questioning the visualized social development patterns.

iii) phallic formant; a totality representative of an objectal absolute which metaphorically and metonymically instigate spatial practice (Lefebvre 1991 p.287).

In another perspective space becomes important only if development takes place. Thus space is relative, relational, concrete (Hubbard 2012 p.41; Merriman *et al.*, 2012 p.4; Thrift 2003 p.96; Marúz *et al.*, 1983 p.140), it derives meaning when linked to other concepts. This relative space is also linked to other terms such as "empirical reality"- portion of land on earth that can be georeferenced Hubbard (2012 p.24); "jurisdictional"- boundaries, national, municipal Philippopoulos-Mihalopoulos (2011 p 190). Landman (2006 p.4) also suggested that "space refers to the unbound natural or existing man-made space and is usually formed by particular needs at a specific time, which directly relates to the specific context." This resonates with relative space which can be conceptualized as i) individual landscape elements or ii) totality, a synergy of all landscape elements (Marúz *et al.*, 1983 p.140). Mitchell (2012 p. 49) further defines landscape as the specific arrangement or pattern of things on land such as buildings, factories, streets, trees, open spaces, meadows and so forth. In addition, landscape is also characterized as, 'look or style of land'- this aspect focuses on understanding the socio-cultural significance of the pattern on land; 'built morphology'- the structure and shape of a place, a representation of a complex system of meanings fixed in space. Landscape as a representation and also as an 'ideology', a different perspective of seeing land as a structuring element that contributes to alienation in society. All these meanings and senses create a social totality of space. Thus, this totality of landscape elements as it exists in cities does not just happen spontaneously, it is socially produced.

Different authors attach different meanings, and conceptualizations to this relative space. According to Thrift (2003 p.96) from a geographical perspective, literature shows a common ambition; "...for an idea of space as undergoing continual construction exactly through the agency of things encountering each other in more or less organized circulations". Thus the focal interest is on relative space that is spatially transforming driven by the agents of change. According to Thrift (2003 p.96-104), there are four types of these spaces namely; empirical constructions, unblocking space, image space and place space. Empirical space; how "the mundane fabric of daily life is constructed" (Thrift 2003 p.105). Critical about this empirical construction is the standardization of space, technological advancements such as GIS

provides tools which allows us to locate, track and trace activities, objects in space and at different time frames. This in turn is crucial because it allows us to track spatial transformation of cities over time. Unblock space; relates to “the routine pathways of interaction set up around which boundaries are often drawn” (Thrift 2003 p.105). The argument is that the traditional representation and generalization of space at larger scales leaves much overshadowed. Hence the need to disaggregate and unblock the larger bounded spaces into smaller representations of spaces that would help explain and understand other qualities missed by overgeneralization of spaces. Image space; relates to “the proliferation of images has produced new apprehensions of space” (Thrift 2003 p.105). Images are a key aspect of space, they capture information about the elements of space around us and are used to imagine how the spaces should look like in future. Thus, image space is being viewed from a postmodernism approach, where in the discourse of images is being used to inform desired future pattern of spaces. Place space; “spaces are ordered in ways that open up effective and other embodied potentials” (Thrift 2003 p.105). Thus, space acts as place providing a platform for understanding existing injustices in everyday life towards directing changes to attain desired objectives of the agents of space.

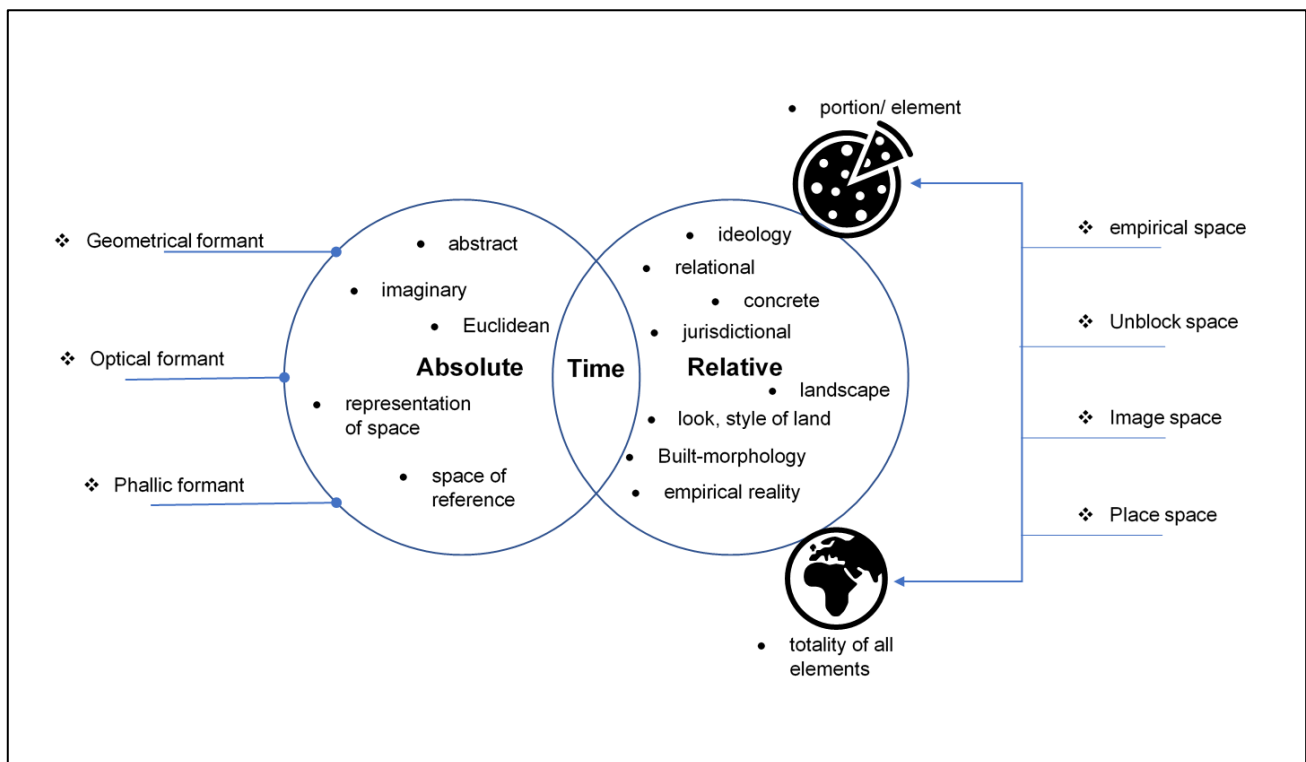


Figure 2.2: Notion of space

Source: Author, 2020

The discussion on notion of spatial transformation evidences that various authors view space differently. Building on the works of the various authors figure 2.2 shows the derived notion of

spatial transformation from such discussion. It is apparent that space is absolute or relative and bounded by time. This implies space cannot be analysed without relating it to a particular time frame thus, spatiotemporal dimension of space. Particularly, when analysing spatial transformation, there is need to specify the spatiotemporal time frames being focused on. In addition, space as absolute is considered abstract, representation of space, imaginary, abstract, space of reference and Euclidean. Space is also considered empty, but in geographical perspectives it is not blank space rather it is divided by geographic coordinate system that represent each element of relative space. Therefore, space is relative, it relates to something. Thus it is referred to, imply, ideology, relational, concrete, jurisdictional, landscape- built morphology, an empirical reality. This reality of relative can be represented as a portion, or totality of all elements. Furthermore, this relative space is viewed as empirical, unblock space, image space and place space. There is a synergy between time, absolute and relative space they must be considered together. Thus, absolute space seeks to represent relative space using various tools such as GIS and that imagined ideas also inform societal change in relative space.

2.3 The notion of transformation

Transformation refers to, “a marked change in form, nature or appearance; a process by which one figure, expression or function is converted into another one of similar value; a process by which an element in the underlying logical deep structure of a sentence is converted to an element in the surface structure; the genetic alteration of a cell by introduction of extraneous DNA, especially by a plasm” (Oxford Dictionary, 2019). This definition shows that transformation is viewed differently in relation to different disciplines i.e. biology, linguistics, mathematics and logic. What is emerging from these definitions is that transformation is a process and an end result or outcome. That is as a process refers to how an element or structure is changed and as an end result or outcome, refers to the emerging form, structure, or visualization of a changed or converted element.

Literature shows that there are varied notions of transformation. Delz (2018 p.188); Hettne (2009 p.30) pointed out that the notion of, “transformation is a structural change into something yet unknown”. This view emerges from the book by Polany 1944 the Great Transformation, the author “did not know the outcome of the process- only a set of contradictory interventionist strategies treated as universalist projects” (Hettne 2009 p.35). The underlying assumption here is that the outcome of transformation is unknown, contrary to this, Jevremovic (2011 p.1) argues that transformation in post-socialist countries in the Central and Eastern Europe is central to place identity, rebranding of cities. In reality, the physical restructuring is certain it is known as indicated by the maps, plans and policy frameworks, what is not certain, ‘unknown’

is how such physical developments impact the community such as manifestation of (in)just developments. To add on, Kollmorgen (2010 p.1) suggests that social and political ruptures after 1989 in the Central and Eastern Europe (CEE) gave rise to transformation, with the notion of social changes in the post-communist society. In addition, Muller (2019 p.4) argues that post-communist is an “agnostic term to describe an ambiguous present and an uncertain future.” Drawing on Hettne (2009)’s ideas on notion as discussed earlier, this perspective implies that the notion of transformation in CEE was to guide societal changes towards an unknown developmental path, given the societal situation that existed which could cause chaos and uncertainty. This perspective does not provide any cues on whether such desired changes are a quest to address any social injustices. Similarly, Thorns (2002 p.2) adds that the notion of “transformation also implies changes over time”. Thus, time and changes happening in society cannot be separated. Thus, when analysing and discussing societal changes, it is crucial to specify the time frame being considered, because meaningful changes do not happen overnight.

On the other hand, Orange and van Huyssteen (2011 p.7) argues that the notion of transformation, is a ‘radical agenda’ for restructuring of “space economy” to improve quality of life at all scales from local to national level, by means of shared, inclusive growth, equitable and sustainable development. The underlying assumption is that, economic activities are not equitably distributed in our cities particularly small and intermediate cities. Thus the notion entails deconcentrating the economic activities into previously disadvantaged communities, to facilitate access to opportunities, improve peoples lives thereby promoting sustainable development.

Furthermore, the notion of transformation includes “spatial and social” change in our society, which requires stakeholders support and collaborative partnerships (Spatial Transformation of Cities (STC) 2014 p.14). The STC (2014 p.15); Oranje (2014 p.36) reiterates that the key pillars of transformation are, spatial- investment in physical restructuring and society- ensuring people’s needs are put first. This implies, transformation of both the physical structure, society and systems impact on how our settlements change over time. Furthermore, spatial and social changes evidenced in our cities are also attributed to the role played by the public, private sector and residents. In another perspective, the notion of transformation is to attain societal, “need for inclusivity, mobility and access, economic development that drives local and national growth prospects and transforms space in a manner that is socially and environmentally sustainable” (SACN 2015 p.4). The assumption here is that there is lack of inclusiveness, poor access and mobility, lack of sound economic development initiatives required to initiate a sustainable development path for our cities. In addition, the notion of transformation is, “to democratise governance and improve service provision”, (Sadiki and Ramutsindela 2002

p.63). In addition, Turok (2014 p.75) reiterates that, “transformation implies making the main institutions of government, the economy and civil society representative of the demographic make-up of the country. This notion implies changing the model of governing society from top-down approach, towards a bottom up approach involving meaningful” representation and participation of the previously marginalized communities and also adopting public private partnerships to improve service delivery.

Furthermore, Bremner (2000) cited in Sihlongonyane and Lewis (2016 p.258-262), points out that transformation can be grouped into three kinds namely; social transformation: which focuses on racial integration; economic transformation: in the city through public and private funded regeneration programmes which established social housing, urban development zones, city improvement districts, precincts among others to counter the implications of business decentralization experiences; and image transformation; through branding, marketing and reimagining initiatives from the former self of racial exclusiveness to a ‘World Class African City’. This conception narrates that transformation is broad and can be disaggregated into different forms such as social, economic, image, physical, among others. Moreso, Sihlongonyane and Lewis (2016 p.264-265), suggested a conceptual framework for transformation which emphasises on transforming the i) mind transformation: which then decolonise or change people’s mindset on how they imagine, think and conceptualize transformation ii) space transformation: emphasis is on total change of cities to create new urban form, structure, material aspects, and functions iii) practice transformation: relates to improving capacities, changing behaviours, developing progressive policies and approaches towards transformation, and iv) society transformation: relates to complete change setting values, principles, structures, policies and attitude to work and respecting diversity. Thus from this framework the notion of transformation implies changing peoples mindset, practice, space and society fighting against inequality and injustice which is existential in small and intermediate towns in Africa among others.

According to Williams (2000 p.169) the notion of transformation is focused on “social change in South Africa”. Although transformation has a constitutional validity, and its success in meandering in legislations policies, and implementation is centred on two ends. At one end, it’s about the way its interpreted and understood by policy makers; and on the other end it relates to the feasibility, enforceability of the idea as guide to direct societal development. Despite, being problematic as evidenced by differing notions discussed earlier, in South African context, the notion of transformation is suggested to comprise the following dimensions discussed in table 2.1.

Table 2.1: Dimensions of transformation

Dimension of transformation	Description
Epistemological	<p>Epistemologically, transformation is centred on awakening peoples understanding on knowledge about the changing city. Origin and nature of knowledge about social change is linked to rallying cry of the marginalized, as opposed to the domination of global north notion of “progressive advancement and development”. As an African renaissance, and rendition, it validates the origination and advancement of global south, in particular African experience, insights and consciousness of different dimensions and forms of human development. Westernization is always problematized, giving precedence to exogenous Western ideologies overshadowing exigent reality, truth, knowledge formulations that are rooted in indigenous communities (Delz 2018 p.189; Williams 2000 p.169). In addition, this does not replace western ideologies, but to indicate the paradoxical and dialectical perspectives between the global north and south ideologies on social change. The epistemology of transformation is heuristic and hermeneutic to bridge the gap of missing, overshadowed indigenous perspectives on social practices driving change in our societies. (Williams 2000 p.169-170). In another perspective, Grubbauer (2012 p.36) reiterates the need to account for differentiation of transformation in city space and diversity of planning approaches, policies and urban experiences which is missing from available literature. In addition to this, epistemologically, local knowledge on spatial transformation in South Africa is highly centred on primate cities overshadowing social changes happening in small and intermediate cities. Thus, the notion of transformation from an epistemological stand point is generation of knowledge from small and intermediate cities on spatial transformation to broaden the understanding of urban restructuring in cities.</p>
Conceptual	<p>Conceptually, transformation is a mental concept, a vision. The vision of an ideal world without injustices, marginalization, segregation rather characterized by freedom, equality, democracy, attained through the mission of reconfiguration of the spatial order, substance, form and overall dimensions of cities. The tools, concepts, and methods put forward to reconfigure the spatial order includes; corridor development, mixed land uses among other tools. Also, Williams (2000 p.171) pointed out that the notion of transformation is different from reformation. Reformation is considered as piecemeal, ad hoc cosmetic changes that do not change the social injustice status quo. Thus, the conceptual notion of transformation is well thought out “pragmatic, plan oriented, project-directed effort” geared to reconfigure, change, restructure the differentiated socio-political space and spatial order in South African cities. This notion provides cues that to understand spatial transformation dynamics in small and intermediate cities in South Africa, there is need to adopt the conceptual lens, in order to identify the transformation concepts put forward years back such as corridor developments, mixed land uses and assess that against the urban reality. This will help understand if our cities are spatially transforming towards the ideal world envisioned at the beginning of post-apartheid era.</p>
Historical, moral	<p>The moral notion of transformation is driven by the desire to do something that is just, good, right for the society and is mandated and enshrined in the constitution, legislations and policy frameworks. Thus in the context of South Africa, the moral notion of transformation arise from the need to redress historically embedded, inherent apartheid planning legacy of spatial segregation, marginalization, inequality in resource distribution, injustices, racial segregation among others. This moral notion is enshrined in the constitution and the various post-apartheid progressive policy frameworks in South Africa. Thus, this moral notion does not only have a spatial dimension, it also relates to improving participation of the marginalized in planning matters that affect them thereby redressing power imbalances (Orange and van Huyssteen 2011 p.7; Williams 2000 p.171). Historically, certain areas were excluded from planning frameworks, thus the notion here is to ensure that all areas within a municipal jurisdiction including previously excluded areas are now included in planning frameworks. Contrary, to this moral notion of transformation, issues of injustice, inequality, segregation,</p>

	<p>marginalization are still inherent in South African cities by extension small and intermediate cities. On the other hand, this dimension entails the need to analyse discourse in legislative and policy frameworks to identify and understand the moral obligations and implementation of the notion of transformation in small and intermediate cities in South Africa.</p>
Empirical	<p>Empirically the notion of transformation is politically contested for demarcation of new municipal boundaries. This process and its dialectic political, power relations affects the progress and extent of changes in South African cities. In another perspective, the empirical notion of transformation of juridical boundaries is still seeing light not only because of de-ethnicization in particular establishment of Collins Chabane local municipality. It is also a result of non-functional municipalities which are disbanded for financially distressed among other reasons. This implies that empirically to understand spatial transformation in small and intermediate cities in South Africa, part of the approaches or methods is to trace and track how the boundaries have changed over the years.</p>
Institutional	<p>Institutional notion of transformation is focused on changing governance systems and practices to comply with transformative planning. However, this notion is not without heavy resistance, defiance, ignorance in most local authorities. The planning legislative frameworks before the advent of Spatial Planning and Land Use Management Act 16 of 2013, were characterized by fragmentation, some favoured previous apartheid planning directives, delaying implementation of measures that facilitate transformation of space. Furthermore, the current conjecture is also lack of capacity and technical skills required to drive spatial transformation. Furthermore, most municipalities in South Africa are receiving unqualified audit report and bad capital underspending of above -15%, an institutional failure to utilise available financial resources to implement transformation projects.</p>
Managerial	<p>The notion of managerial transformation relates to employing and deploying experts and educated personnel with required skills to facilitate transformation. Indeed, elected and appointed officials were receiving training from institutions of higher learning on governance matters. With the advent of new spatial planning policy framework SPLUMA 2013, municipal readiness assessment templates were used to identify municipalities that require assistance and capacity training to facilitate the implementation of the corner stone Act for transformation in South Africa.</p>
Programmatic/ practical	<p>The programmatic/practical notion of transformation is directly related to manipulation of the relative, concrete, urban reality, landscape towards an ideal vision. The vision encompasses creating social democratic order, non-racial, better morphology, reconfiguring political, economic and power relations, changing spatial segregation forms, redistribution of fiscal resources, refining development procedures, and right to the city. These aspects, elements of land provides for tracing and tracking of changes in relation to transformation projects and key programmes. Despite, the concerted efforts to achieve the pragmatic notion of transformation, the existential reality of spatial segregation among others is still inherent in South African cities. This is due to lack of vacant land located closer to opportunities, because such land is too expensive for local authorities to acquire, and that increasing densities are faced with resistance (Williams 2000 p.173). In addition, areas where social houses are being developed are far away from areas of opportunities perpetuating spatial segregation. In another perspective, what is being pointed out is that socio-spatial indicators of spatial transformation include, racial changes, built morphology, vacant land, density among others.</p>

Source: Adopted from Williams 2000

Table 2.1 provides dimensions of transformation in South African context, for instance the epistemological perspective of transformation entails the need to narrate indigenous perspectives on how our cities are changing unlike relying on exogenous western ideologies of transformation.

What's emerging from this whole discussion is that the notion of transformation is relative to 'social change' and that the motive behind transformation depends on the developmental context of the writers case study. In the perspective of the global North, Central and Eastern Europe its seen as change into something unknown. However this conception is not without flaws, the intended outcomes of the changes are known, they are terms of references when implementing transformation programmes. What is uncertain is the implications of such proposed changes on people's lives. On the other hand, in the global south with specific reference to South Africa, transformation is viewed as much needed radical change to redress the apartheid legacy of injustices inherent in the cities. Thus change is expected at the governance systems, space economy, urban structures among others. Figure 2.3 provides a summary of the notion of transformation.

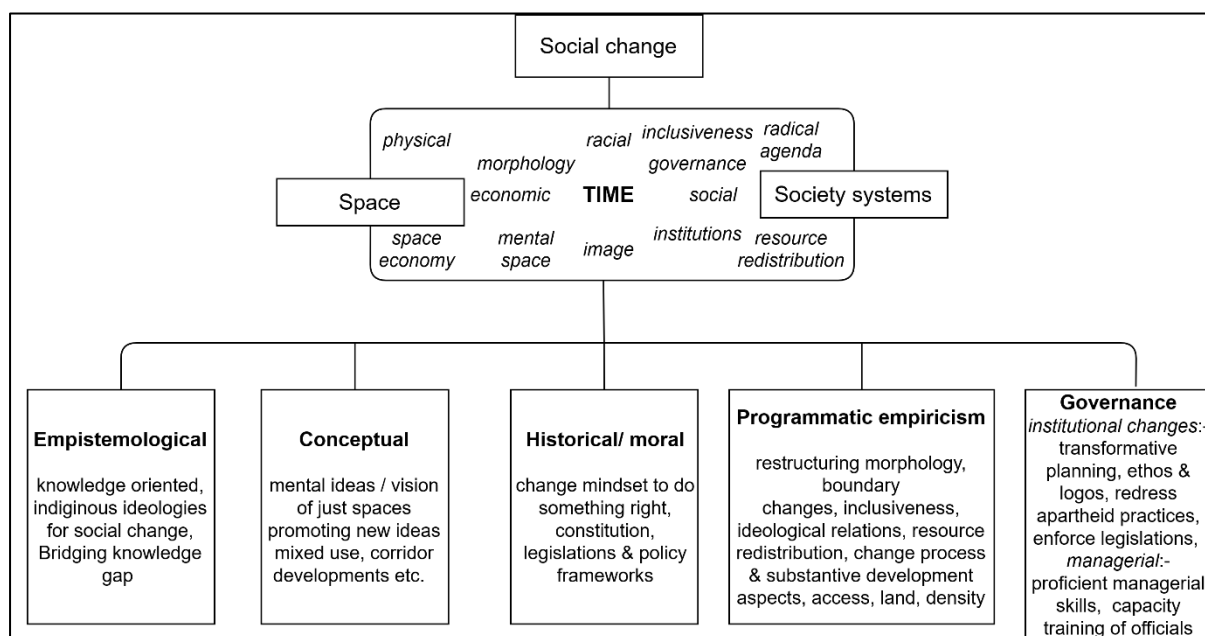


Figure 2.3: Notion of transformation

Source: Author, 2020

Figure 2.3, shows that the notion of transformation is linked to social changes, in space and societal systems to create order over certain period of time. Building on Williams (2000) transformation has the following dimensions; epistemology, conceptual, historical/moral, empirical, institutional, managerial and practical/pragmatic dimensions. These dimensions together provides an integrated framework of understanding the notion of transformation. Although, the notion of transformation is diverse, it can be broadly categorised as having the following aspects within the ambit of spatial/space and process or social system. The various aspects are presented in Figure 2.4 as outlined by Eglin (2015 p.4-5)

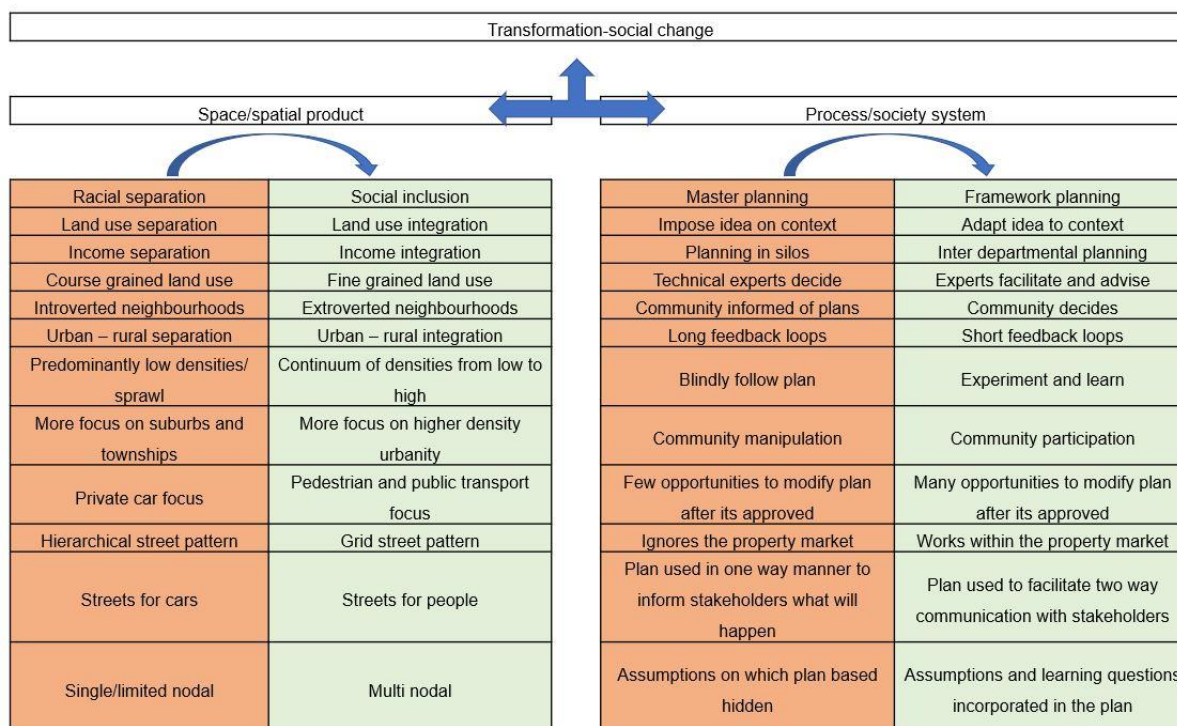


Figure 2.4: Aspects of transformation

Source: Eglin 2015 p.4

2.4 The notion of spatial transformation

Literature survey reveals that other terms are used in reference to spatial transformation, these include; urban transformation, (Turok 2014 p.74; Gulersoy and Gurler, 2011 p.10; Schensul and Heller 2010 p.2; Landman 2006 p.1; Robinson 2006 p.251; van der Toorn Vrijthoff 2006 p.61; Castells 2001 p.548), urban or spatial restructuring (Chakwizira *et al.*, 2018 p.85; Oranje 2014 p.37, 39; Banerjee-Guha, 2002 p.121), spatial change (Pieterse *et al.*, 2016 p.2, Dowall and Treffeisen 1991 p.202) and spatial fix (Jessop 2006 p.142). This shows that spatial transformation is viewed differently in publications, but the underlying theme is that there are changes in space and overtime.

In another perspective, literature corroborates that spatial transformation has no universally agreed definition (Turok 2016 p.22; SACN 2015 p.4,10; Turok 2014 p.74,80; SACN 2013 p.1; Gulersoy and Gurler, 2011 p.10; Suzuki, *et al.*, 2013 p.116; Landman and Badenhorst 2012 p.35). This raises the question, how is spatial transformation imagined, perceived, or understood as? Rising to this challenge, jointly in 2013 the South African Cities Network (SACN) and Department of Economic Development (DED) of South Africa embarked on a series of social dialogue sessions (SACN 2013 p.1). The subject matter at the core discussion of the first session was centred on “the notion of spatial transformation in South African cities” (SACN 2013 p.1). What prompted this dialogue is the increasing call for spatial transformation

corroborated by the various progressive policy frameworks in post-apartheid South Africa. In light of this background, various talks and presentations by planning academics, actors and practitioners expressed a some-what different perspective on the notion of spatial transformation in South African cities (SACN 2013 p.2). The emerging pattern is that peoples perceptions of the notion of spatial transformation is multifaceted, competing, contradicting and at times contested (SACN 2013 p.1). The conflicting views and lack of agreed understanding of the notion of spatial transformation is a drawback towards redressing a myriad of challenges evident in our cities. This calls for a “radical different practice in pursuit of spatial transformation of South Africa” (SACN, 2013 p.2). In light of this, the study sought to conceptualize spatial transformation to deepen the understanding and dynamics of the concept.

The notion of spatial transformation, as widely and loosely used in legislative policies, academia, books and journal publications, simply refers to restructuring or changes in urban areas over time (Maritz *et al.*, 2017, p. 409; Maritz 2016 p.4; SACN, 2015, p. 23; Bickford, 2014, p. 107; Turok 2014 p.74; Orange 2014 p.36; Orange and van Hyussteen, 2011 p. 7; Gülersoy and Güler, 2011, p. 10; William 2000 p.167,169). This conception is limiting and there is a conundrum in this notion. Is spatial transformation exclusionary to rural areas and confined to urban changes only? It does not specify or indicate what has changed into what form and either such changes are negative or positive in social, economic and environmental terms. Also, the post socialism transformation in Eastern and Central Europe evidences spatial transformation towards bringing out the city image, place identity. Similarly at international scale, spatial transformation also refers to change in, city structure under the onslaught of neo-liberalism covering small changes and interventions Oranje (2014 p.3; Peck, *et al.*, 2009, p. 94); basic upgrading projects in a specific locality to large-scale regional policy intervention (SACN 2015 p.23).

On the contrary, spatial transformation has a different notion, scale in South African context. According to National Spatial Development Framework (NSDF) (RSA 2019 p.20) spatial transformation refers to, “the carefully-planned and well-managed process for the provision, rehabilitation and maintenance of infrastructure, social services and economic activities in settlements in such a way that (1) the segregated spatial patterns inherited from colonial and apartheid times are broken down, and (2) the inefficiencies, injustices and inequalities in access to opportunities resulting from these past patterns are corrected”. This implies special consideration on restructuring, change, fixing of the urban form through socio-economic investment to eradicate apartheid and colonial legacy that manifests in spatial segregation, marginalization, inequalities, inefficiencies and injustices inherent in our cities. Thus, the notion of spatial transformation is not only limited to redressing colonial and apartheid

manifestations, it is also aimed at changing the current spatial form of post-apartheid cities development and growth trajectory which exacerbates fragmentation, inefficiencies towards encouragement of cities that are compact, dense, integrated through means such as high-density, infill developments, transit oriented developments among others (Chakwizira *et al.*, 2018 p.85).

What is evident from the discussion on spatial transformation, is that it is a concept, “with rather abstract and fluid meanings”. It is a process aimed at; socio-spatial change or restructuring of human settlements (Landman and Badenhorst 2012 p.4), city form Beauregard (1989 p.198); Turok (2014 p.77), redistribution and creation of opportunities for disadvantaged groups Bickford (2014 p.108); forging new spatial forms in economic, social and transport areas IUDF 2014 cited in SACN (2015 p.23); addressing past and post-apartheid injustices SACN (2016 p.58); STC (2014 p.29). In addition to spatial transformation for redressing injustices, another salient notion not emerging is to lead a sustainable growth path to protect the environment. This form of intervention is clearly stated in post-apartheid progressive legislations and policies, strategic development plans such as IDP’s, SDFs and precinct plans just to mention a few. The different perspectives emerging on notion of spatial transformation are presented in figure 2.5.

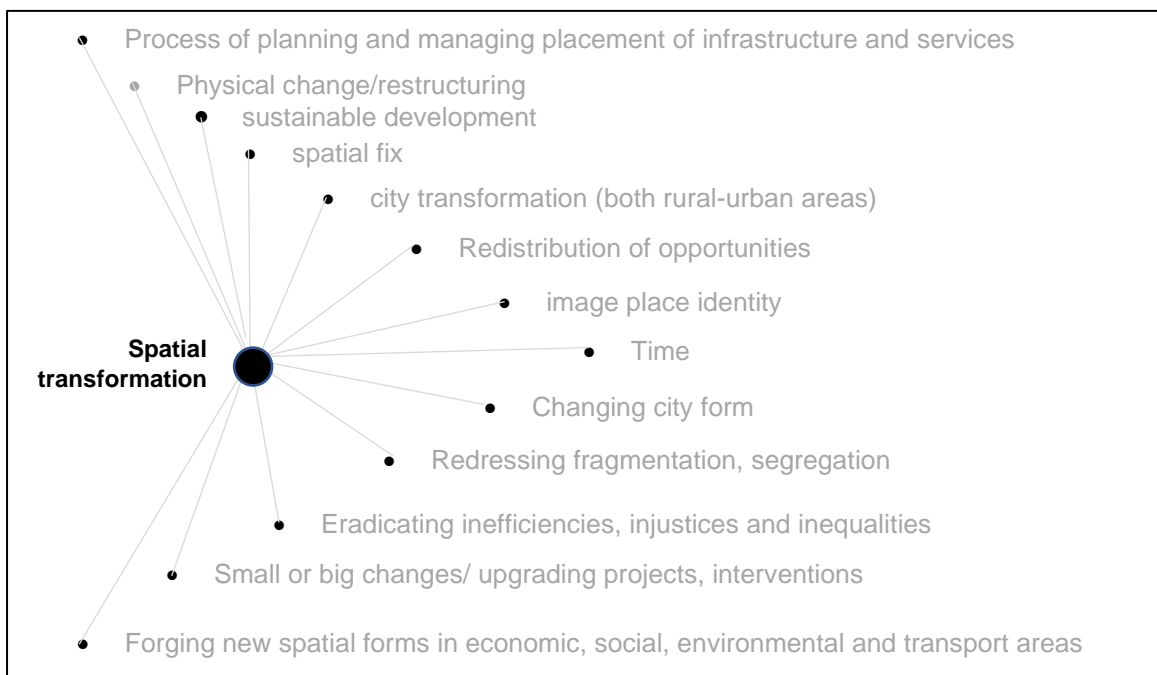


Figure 2.5: Spatial transformation notion mind-map

Source: Author, 2020

Figure 2.5 a mind-map of the notion of transformation from the discussion shows how multifaceted spatial transformation is. This evidences that indeed spatial transformation is viewed differently depending on the development context of case study area. In the context of

South Africa, spatial transformation is viewed from the development perspective of redressing colonial and apartheid planning legacy of injustice, which is also a manifest of new post-apartheid development trajectories. To effect these desired spatial changes, planning and management of socio-spatial investments is guided by the normative development principles set out in the post-apartheid progressive policy frameworks. Thus, taking the lens of developmental principles set out in SPLUMA (RSA 2013), spatial transformation implies restructuring of human settlements into spatially just, efficient, sustainable, resilient, and good governed communities. However the challenge is that SPLUMA does not provide how this desired form of spatial transformation is measured. Hence there is need to develop tools for tracking and measuring the progress of spatial transformation in South African cities.

2.5 Spatial transformation mapping triad: aspects and indicators

This section builds from the discussion on the notion of spatial transformation. It seeks to conceptualize a spatial transformation triad by identifying key aspects and measurable outcomes that can be mapped using spatial indicators to generate empirical evidence of spatial changes over time. Turok (2014 p.74-79), conceptualizes spatial transformation in the context of South Africa in a triad of significant aspects namely; social integration and racial mixing, urban structure and local texture. Although, racial mixing or social integration is a crucial indicator of understanding progress of redressing injustices, focusing on it alone does not provide a complete picture of the various spatial transformation dynamics in cities. Turok (2014 p.75), acknowledges this perspective, stating that, “racial mixing is not a sufficient indicator of fundamental urban changes”. Conceptually, racial mixing is an attribute of demographic distribution, as such this study considers demographic distribution as a broader key aspect that accommodates other issues being overshadowed by the former aspect. In that case, the study therefore, conceptualizes that the interrelated and interconnected key aspects or puzzles of the spatial transformation mapping triad are, demographic distribution, urban structure and urban texture as presented in figure 2.6.

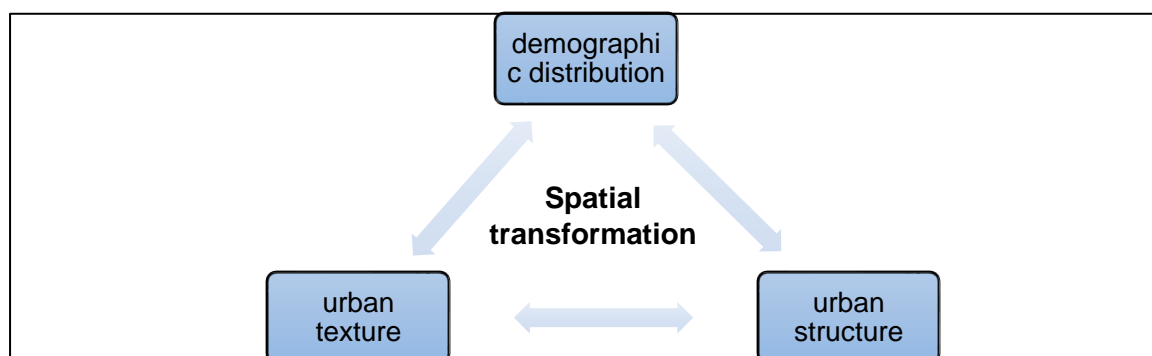


Figure 2.6: Conceptual spatial transformation mapping triad

Source: Author, 2020

In addition to the identified broad aspects of the spatial transformation triad presented in figure 2.6, this study also identifies indicators that can be employed to map the changes in each aspect. Spatial indicators are ideal for this study because, an indicator is different from other types of data, it refers to a model that simplifies subjects that are complex for easy understanding by the public and policy makers. Another perspective is that indicators are connected to policy, and they are regarded as an interface between data and policy (Newton, 2001, p.17). Furthermore, indicators encountered in policies are broadly categorized as i) performance based indicators intended to measure the extent to which objectives are being met ii) issue based indicators, to show issues that requires attention such as unemployment, inequality, spatial segregation, land cover change among others and iii) needs based indicators, to inform resource distribution or allocation such as deprivation and poverty (Newton, 2001, p. 17). Therefore, spatial indicators are relevant in the South African context to generate empirical evidence required to measure, model, or track and evaluate the progress or performance of post-apartheid policy frameworks in facilitating the ear marked spatial transformation in South African cities (Bickford 2014, p. 107; National Planning Commission (NPC) 2012, p. 289). In another perspective the spatial indicators aid in generating empirical evidence to reflect on the needs and issues such as spatial injustice, inequality, segregation among others, being faced in post-apartheid City of Polokwane.

2.5.1 Demographic distribution

This aspect relates to the analysis of change in composition, and structure of human population, which include race, age, youth, deaths, education, just to mention a few. Integrating the various demographic attributes provide empirical evidence, and a better picture of understanding spatial transformation in cities. Thus, de-racialisation, social mixing or integration of different racial groups is a good attribute for understanding progress of redressing imposed colonial and apartheid racial segregations (Turok 2014 p.74). Turok (2014 p.75) further points out that preliminary findings from South Africa second national census of 2011 evidences de-racialisation of other neighbourhoods particularly lower income suburbs than in higher income suburbs. Consequently, STEPSA (2016a) suggested indicators that can also be adopted, and tested to measure spatial transformation in South African cities. These indicators include analysing spatial changes in; racial diversity, household poverty, (un)employment, percentage youth, human capital development, and population growth. Similarly, Wang and Liu (2017) article titled; 'Evolution of Urban Socio-Spatial Structure in Modern Times in Xi'an, China' employed the following demographic attributes; distribution of age, education background, distribution of occupation, housing environment, population scale: sizes of family, sex ratio and total population; household registration types: urban and rural population.

2.5.2 Urban structure

Urban structure refers to arrangement of; i) land use activities, and ii) private and public spaces, and degree of connectivity and density (Lehner and Blaschke 2019 p.2; Martin and March 1972 p.1), spatial configuration of activities Batty and Longley (1986 p.1144). Furthermore, urban structure also refers to; “i) the geographical distribution and fabric of the building stock (the pattern of development); ii) the mutual location of different functions (residences, workplaces, public institutions and service) within the building stock (the pattern of location); iii) the transport system (road network, public transport provision, and parking conditions); iv) water, sewage and energy supply and telecommunications systems; v) the urban green and blue structures (more or less natural areas within and close to the city, and lakes, rivers and creeks)” (Turok 2014 p.76; Næss 2006 p.2).

Similarly, the city structure that emerged from colonial and apartheid planning and spatial distribution of activities manifested in segregation, injustices, inequalities in South African cities, by extension small and intermediate cities. Therefore, analysing spatial transformation of city structure helps understand progress towards redressing segregation, unequal distribution of activities, opportunities and injustices inherited and further exacerbated by post-apartheid development trajectories. It provides empirical evidence, to evaluate the success and failures of redressing the colonial and apartheid city structure by means of comparison between the past and present relationship between places of residents and areas of opportunities and transport connectivity networks. The spatial structure of the city manifests through development directions from the government and other stakeholders as outlined by the normative development principles outline in post-apartheid legislative policy frameworks such as RDP, NDP, SPLUMA, SDFs, IDPs, housing develop projects, infrastructure investments, among others.

Literature survey shows that various spatial indicators have been employed in different studies focusing on understanding spatial transformation of city structure. Wang and Liu (2017 p.7) employed the following urban structure indicators of spatial transformation i) *Industry distribution*- estate; agricultural and fishery; finance, insurance; mining and timber; electricity, gas, tap water production and supply; geological survey; manufacturing; transport and communications; construction; social services; wholesale, retailing and catering; education, culture and arts; health, sports and social welfare; state, political parties, organizations; scientific research and comprehensive technical service; ii) *Occupation distribution* - professional and technical; government, institution, managers/officers, and enterprise managers; commercial; clerical and related; production and transport; farming, forestry, herding and fishery. Literature also reveals that other urban structure indicators include; *Urban footprint* :- built environment (Maritz *et al.*, 2016; Harrison *et al.*, 2014; STEPSA, 2016b;

CSIR Built Environment (BE) 2015a; Næss 2006 p.2); *Boundary*:- change in city boundary, urban edge, (Harrison *et al.*, 2014); *Determinants of urban form*:- roads, physical environment (Harrison *et al.*, 2014); *Residential sites*:- residential neighbourhood, (formal houses, Townhouse units, Estate and Security village housing), gated communities, new township, informal settlements, Turok 2014 p.76; Harrison *et al.*, 2014; *Land use pattern*:- residential, commercial, industrial, agricultural, institutional, (Mierzejewska 2017); *Transport networks*:- Public roads, private roads, (Turok, 2014 p.76); *Utility facilities*:- energy, water, sanitation infrastructure, (Turok 2014 p.76; STEPSA, 2016c; CSIR BE 2015b; Næss 2006 p.2); *Urban land cover change*:- growth per km², Harrison *et al.*, 2014; *Poly-centricity (clusters)*:- employment density, population density (Amindarbari and Sevtsuk 2012 p.4; Anas *et al.*, 1998); *Property value*:- property prices bands, (Harrison *et al.*, 2014).

2.5.3 Urban texture

Texture refers to “the feel, appearance or consistency of a surface or substance” (Oxford Dictionary 2019) ; “the structure of a surface” Gibson cited in Grange (1999 p.50). This implies the physical and qualitative details of sensory experiences of a space, visual arrangement of urban features, their replication and deviation from the normal. Webster’s Encyclopedic Dictionary cited in Wei and Wang (2014 p.32) further defines texture as, “the characteristic structure of substances and the characteristic physical structure by the size, shape, arrangement, and proportions of its parts”. Thus depending on the scale of analysis of urban texture, it is possible to illuminate the size of blocks as either big or small, their shape square, rectangle, among others and the geographical magnitude of such details.

According to Turok (2014 p.78) urban texture relates to, “a range of finer-grained, qualitative features of the built environment that affect the everyday lived experience of households and the operating environment of firms.” According to Mei (2019, p.129) urban texture relates to city details, which affect human vision and perceptions of a particular space, such as buildings, greenery, courtyard plots and roads among other elements which make a city as a whole. Urban texture is crucial as it helps illuminate the following features of a city; material carrier of historical information i.e building design, roads, economic, cultural and social contents of the city; guides local development, to retain city cultural aspects texture to maintain place identity; reflects the physical characteristics of the city, natural structuring elements, rivers, slopes, mountains just to mention a few; and reflection of citizens activities in the city (Mei 2019 p.136).

Apartheid planning ensured single rigid land use zones segregating work places from residential areas, and the blacks had to travel from the townships to the city core for employment opportunities. This resulted in an urban texture characterised by concentration of economic opportunities, jobs in the city’s central business district (CBD), industrial areas

excluding other areas. Such form of urban texture is further reinforced by post-apartheid development trajectories of RDP houses, gated communities, shopping malls, office and precincts. Therefore, analysis of urban texture helps understand the progress made in redressing such development imbalances and unjust spatial distribution of economic opportunities and services among others.

The indicators that can be employed to map spatial transformation in terms of urban texture includes; *Density*:- population, houses/built-up, jobs, settlement density (STEPSEA 2016d; CSIR BE 2015c; Turok, 2014 p.79; Fan *et al.*, 2012 p.10); *Diversity*:- mixed use developments, social and economic activity (Turok 2014 p.79); *Proximity and access*:- access to public services and other facilities, (Turok 2014 p.79; STEPSEA 2016e; CSIR BE 2016) *Quality of public realm*:-quality of public spaces and opportunities for social interaction (Turok, 2014); *Safety*:- risks of fires, flooding, and other hazards, settlements at risk, social vulnerability; (STEPSEA 2016f; CSIR BE 2015d; Turok, 2014). *Connectedness*:- links with other localities (Turok 2014 p.79); *Housing environment*:- mean building area per household, mean number per household Wang & Liu, 2017; *Brownfields development*:- infill developments, (Turok 2014 p.80).

The discussion on conceptualization of spatial transformation, shows that this concept is multifaceted. Thus in this study spatial transformation is conceptualized as comprising three key aspects namely changes in demographic distribution, urban structure and texture as outlined in table 2.2.

Table 2.2: Aspects, and indicators for mapping spatial transformation

Aspects	Indicators	Indicators (% Change in :) if x then y measurement criteria	Sources
Demographic distribution	Race	Black, White, Indian, Coloured and other	STEPSEA 2016g; Maritz <i>et al.</i> , 2016; CSIR BE 2015e; Harrison <i>et al.</i> , 2014,
	Employment	Unemployment, employment, number of employees per km ² ,	STEPSEA 2016h; CSIR BE 2015f; Harrison <i>et al.</i> , 2014
	Deprivation-index	Income, employment, transport, qualifications, owned home,	Harrison <i>et al.</i> , 2014
	Population scale	Sex ratio, Mean family size, total population	Wang & Liu, 2017; STEPSEA 2016i; CSIR BE 2015g
	Household registration types	(%) Rural population, Urban population	Wang & Liu, 2017
	Age distribution	% ≤ 14; % 14-59; % ≥ 60; change in youth	Wang & Liu, 2017; STEPSEA 2016j; CSIR 2015h
	Educational background/ human capital development,	(%) illiterate or semiliterate, primary education, junior education, senior education, university education, postgrad education	Wang & Liu, 2017; STEPSEA 2016k; CSIR BE 2015i
	Change in poverty	Household poverty, change in % living in poverty	STEPSEA 2016l; CSIR 2015j, 2015b
City structure	Urban footprint	Built environment	Maritz <i>et al.</i> , 2016; Harrison <i>et al.</i> , 2015; STEPSEA 2016b; CSIR 2015a; Amindarbari and Sevtsuk 2012 p.4; Næss 2006 p.2
	Boundary	Change in city boundary, urban edge,	Harrison <i>et al.</i> , 2014
	Determinants of urban form	Roads, physical environment	Harrison <i>et al.</i> , 2014

Aspects	Indicators	Indicators (% Change in :) if x then y measurement criteria	Sources
	Site of economic development	Business districts, industrial estates, commercial, number of businesses per km ² , (manufacturing firms, finance, insurance, real-estate sector firms, wholesale, retail trade, catering, accommodation, construction firms), industrial building by type, commercial building by type, new industrial buildings, disappearance of industrial buildings, new commercial buildings, disappearance of commercial buildings, communication, social services, health, sports and social welfare, education, culture and arts, scientific research and comprehensive technical services, estate, political parties, state, organizations.	Turok 2014; Harrison <i>et al.</i> , 2014; Wang & Liu, 2017;
	Residential sites	Residential neighbourhood, (formal houses, Townhouse units, Estate and Security village housing), gated communities, new township, informal settlements.	Turok 2014; Harrison <i>et al.</i> , 2014
	Land use pattern	Residential, Commercial, Industrial, Agricultural, institutional.	Mierzejewska 2017
	Transport networks	Public roads, private roads,	Turok, 2014
	Utility facilities	Energy, water, sanitation infrastructure	STEPSA, 2016c; CSIR BE 2015b; Turok 2014
	Urban land cover change	Growth per km ² ,	Harrison <i>et al.</i> , 2014
	Poly-centricity (clusters)	Employment density, population density	Amindarbari and Sevtsuk 2012 p.8; Anas <i>et al.</i> , 1998;
	Property value	Property prices bands	Harrison <i>et al.</i> , 2014
City texture (neighbourhood scale)	Occupation distribution	Production & transport, fishery, herding, forestry, farming; commercial, clerical and related, technical and professional, enterprise managers, managers/officers, institution, government.	Wang & Liu, 2017;
	Density	Population, houses, jobs, settlement density	STEPSA 2016d; CSIR BE 2015c; Turok, 2014
	Diversity,	Mixed use, Social and economic activity	Turok, 2014
	Proximity and access,	Access to public services and other facilities,	STEPSA 2016e; CSIR BE 2016; Turok, 2014
	Quality of public realm,	Quality of public spaces and opportunities for social interaction	Turok, 2014
	Safety	Risks of fires, flooding, and other hazards, settlements at risk, social vulnerability	STEPSA 2016f; CSIR BE 2015d; Turok, 2014
	Connectedness	Links with other localities	Turok, 2014
Housing environment	Mean building area per household, mean number per household	Wang & Liu, 2017;	

Source: Author, 2020

Table 2.2 shows the conceptualization of spatial transformation and the measurable indicators. In particular the first aspect of spatial transformation is demographic distribution, the spatial indicators that can be employed include mapping of de-racialisation or changes in race composition in post-apartheid era. This allows a comparison of race composition in an area between different time frameworks, a significant indicator of redressing instituted apartheid racial divisions.

2.6 Concepts and theories on spatial transformation

This section elaborates on the theories and concepts on spatial transformation guiding this study. It is noted that there are contestations which drives away from the context of the study in trying to separate a blurring thin line between certain concepts and theories. To avoid this, the focal point of this study is not on separating these, but rather augmenting the various

theories and concepts in developing a critical framework to guide the understanding of spatial transformation dynamics. These theories and concepts are; spatial justice, right to the city, critical urban theory, spatial triad, spatial dialectics and didactics, spatial turn, discourse analysis theories, complexity theory and theory of change.

2.6.1 Spatial justice

Spatial justice is contested, it is used as both a notion, theory, as well as a methodological approach. This study employs spatial justice as a theory in exploring spatial socio-economic dynamics in urban areas. The term spatial justice is a shorthand for “social justice in space”, (Pirie 1983 p.471) and there is a close relationship, between “socio-spatial specificities and conceptions of justice....” (Dikec 2001 p.1789). This implies that in this study on understanding spatial transformation dynamics in the City of Polokwane, there is no need to separate the terms social justice and spatial justice because they have the same undertone on how justice is perceived in space. Thus, the underlying assumption is that space and justice related matters are tangled together. In another perspective, Pirie (1983 p.470) points out that “the prefix spatial denotes concept context”. Thus, justice as a concept is being used in the context of space, spatiality, meaning justice in relation to space. Similarly, with the context of spatial changes that are happening in space desirable or not and manifesting into different forms of spatial (in)justices. Moving on to the concept of justice in this point view, Dikec (2001 p.1799), adds that it is difficult, and not desirable, to distinguish the line between (in)justice “justice and injustice” as they are used in relation to spatial practices.” The underpinning behind this ideology is that differentiating these intertwined terms we lose the subject matter under consideration. In particular, when discussing hypothetical just scenario such as that of increasing accessibility to public transport makes an explicit assumption there is an unjust access to public transport.

In another perspective, Dikec (2001 p.1789) posits that “approaches to and principles of justice are time and space specific”. However the nature of (in)justice is place and time specific. This implies that, there is dissensus on the notion of spatial justice, it’s non-totaled. It’s interpretation and application differs between different time period under consideration, and space, in particular the case study of reference. Pirie (1983 p.465) reiterates that, “Different notions of justice have emerged in diverse settings” which include but not limited to religion, continents, capitalism, post-capitalism, and disciplines. In particular, continents relate to space, geographical specificities such as “Africa, Asia, and Europe” (Pirie 1983 p. 465). This implies that the notion of spatial justice differs with geographical context and differences in disciplines such as political philosophers, social scientists, geographers, planners. This then raises the quest to understand the perceived notion of spatial justice in different time frames,

disciplines and also its relation to spatial transformation in the City of Polokwane and smaller and intermediate cities in general.

(In)justice is a “condition” (Pirie 1983 p.467). A condition is defined as; “the state of something with regard to its appearance, quality or working order; the circumstances affecting the way in which people live or work, especially with regard to their safety or well-being; a situation that must exist before something else is possible or permitted” (Oxford Dictionary 2019). Thus spatial (in)justice in context of this study relates to the state of social things i) as they are seen, understood in terms of distribution as process and ii) as perceived in negative connotation as something that exist which is bad that which the process and spatial outcome of spatial transformation seeks to address to improve the well-being of society.

According to Pirie (1983 p.467) justice can be encapsulated in line with following principles; i)“..a distribution is just if the position of the worst-off individual is the best it can be.” Justice is implied as the just spatial distribution of resources to improve the lives of the marginalized, worst, disadvantaged individuals in a society; ii) “justice may be decided by reference to absolute principles selected and imposed by an external evaluator”. In this case justice index, indicators, yardstick or parameters are set or measured against an idealistic utopia ideology by the person assessing the existing conditions in space; iii) justice as “a way of life”, relates to how (in)justice is subjectively perceived by the individuals being affected, living and experiencing the everyday life in their places.

In another perspective, Pirie (1983 p.465) “fashioned concept of spatial justice from notions of social justice and territorial justice.” This notion meant spatial (in)justice happens in space, and the space reference denotes the spatial scale of a territory or region. However, the set spatial scale is limiting, (in)justices can not only relate to a territory or region rather they happen at all scales of person depending on the person interpreting the meaning. In this study the spatial scale where the dynamics of spatial (in)justices will be analysed as a manifestation of spatial transformation is the City of Polokwane municipal area wide scale.

Furthermore, Davies (1968) cited in Dikec (2001 p.1786) conceptualized spatial justice notion in relation to evaluation of the distribution of service needs in local areas. Particularly, “the distribution of, for example, income, wealth, schooling opportunities, free time, car ownership, and health care in society” Pirie (1983, p.465). This point of view directly links to Pirie’s principle on (in)justice being assessed against principles identified and applied by the researcher. This, clearly indicates that distribution of infrastructure, facilities and personal materialities not only facilitates spatial transformation, rather should also be viewed as a lens for understanding the dynamics of spatial (in)justices in the City of Polokwane. In addition to this, Pirie (1983 p.470) argues that reference to space “is quite appropriate for comparative

regional research and for framing corrective policy.” In line with this perspective, a survey of literature pointed a knowledge gap on spatial transformation of cities in specific regions or spaces and classes, i.e. the Global South (Parnell and Oldfield 2014 p.4; Amindabhari and Sevtsuk 2012 p.2), particularly, small and intermediate (Marais and Nel 2019; Steel 2013 p.239). Thus, space reference focus on City of Polokwane which is categorized as an intermediate city in South Africa and from the Global South provides empirical evidence which is essential in knowledge generation adding to the genealogy of understanding cities. In addition, the empirical evidence assists policy markers, planners and researchers in policy evaluation on the progress of spatial transformation in redressing spatial injustices in post-apartheid era.

Pirie (1983 p.470) viewed the notion of justice “as a condition of procedural or constitutional decision making about spatial matters..”, which are directly linked and are “responsible for spatial disparities in people’s lives” (Smiths 1994, p.5, cited in Dikec 2001 p.1786). This view provides a different perspective, a turn from the usual focus on spatial outcomes of spatial transformation as they manifest into spatial (in)justices towards process itself as responsible for reproducing spatial (in)justices through deciding the place to provide certain infrastructure and public facilities among others. This implies that as the study analyses the institutional drivers or decision making processes on spatial transformation there is need to extend that note towards understanding the resultant spatial (in)justices inherent in the City of Polokwane and other small and intermediate cities in South Africa. Similarly, Harvey (1973) cited in Dikec (2001 p.1786) raised a new point of view to his earlier works that spatial (in)justice is a result of “structural dynamics of the capitalist society.” In this view spatial (in)justice manifests just like spatial transformation, it manifest as an ideology of the ruling government. This view echoes Dikec (2001) earlier suggestion that the notion of (in)justice is “time and space specific”, meaning at the time of their writing it was towards the end of late-stage capitalism, where in capitalism ideologies were responsible for production and reproduction of unjust spaces. This perspective implies that spatial (in)justice manifests itself differently at different times. In particular, apartheid planning ideologies of spatial segregation resulted in spatial injustices, however this injustice is still inherent in South African cities attributed to the structural dynamics of the post-apartheid democratic governance systems.

Furthermore Harvey, (1973, p. 15) cited in Pirie (1983 p.465) regards spatial injustice “as something contingent upon the social processes operating in society as a whole” A contingent, implying, a future desired form of just spaces attained through spatial transformation of communities directed by societal organisations and their institutional processes. Furthermore, Dikec (2001 p. 1786) points out that Harvey (1992)’s perspective building on Yong (1990), centred the notion of (in)justice on the conception of domination and oppression as another

source of injustice. Thus, through capitalism production and reproduction of space resulted in unequal, uneven, unjust developments geographically because of domination and oppression. This conception directly relates to the context of colonial and apartheid era in South Africa, where in white domination and oppression resulted in uneven geographical developments and unfair distribution of resources and services. Similarly, injustices are still inherent in the post-apartheid era democratic governance system manifesting itself in the form of distributive injustices and uneven developments between the different social classes. The underlying assumption is that all forms of governance systems perpetuates spatial (in)justices. This, raises the need to analyse and understand how the post-apartheid governance systems in the City of Polokwane is also resulting in spatially unjust and uneven geographical spatial transformation.

In another perspective, Dikec's (2001 p.1785) argument denotes that space in particular, at the city scale is the spatial reference where society comes together to rise against repression and injustices. In doing so, spatial (in)justice is conceptualized through the triad, "which brings together the spatial dialectics of injustice, the right to the city and right to difference" (Dikec 2001 p.1785).

Spatial dialectics of injustice comprises of spatiality of (in)justices and (in)justice of spatiality (Dikec 2001 p.1792). Spatiality of (in)justice- "implies that justice has a spatial dimension". Thus, analysing distribution of socio-economic, physical and locational aspects of space helps understand (in)justice as it exists in space. On the other hand, (in)justice of spatiality "implies the existing structures in their capacities to produce and reproduce (in)justice", (Dikec 2001 p.1792-93). This underpins that governance systems or processes are responsible for inherent (in)injustices, thus there is need to understand how the dynamic institutional process are contributing to (in)justices and spatial transformation in the City of Polokwane. In addition, Dikec (2001 p.1793), points out that spatiality of (in)justice and (in)justice of spatiality, frames research to not only consider one limited aspect but rather all the components and that form is inseparable to the processes. Thus, the focus on (in)justice should not only be limited to 'space' but should extend to the processes responsible for production and reproduction of space, and associated political, economic and social implications thereof.

Dikec (2001 p.1790) second pillar of the triad views spatial (in)justice, using the lens of 'right to the city' arguing that it, "implies not only the participation of urban citizen in urban social life, but more importantly,...active participation in political life, management and administration of the city..". What is emerging here is that spatial (in)justice manifests itself through the existing governance systems in cities as alluded by earlier discussions. This reiterates the need to

assess the governance systems, in order to broaden the understanding on spatial transformation, the production and reproduction of spatial (in)justices in the City of Polokwane.

On the third pillar of the triad, Dikec (2001 p.1790) views the notion spatial (in)justice through the lens, “‘the right to difference’,...” which is better translated as ‘the right to resist/struggle’ and ‘equality-freedom’. The argument is that (in)justice is a result of the imposed social groupings, an expression of unjust domination and suppression. Thus, domination is seen in space, particularly the visible built environment and less visible spaces such as institutions, networks, flows and distributions. Furthermore, suppression in space and process of spatialization manifests in production and reproduction of domination and spatial injustices. Thus, viewing right to difference as right to ‘equality-freedom’, implies that equality in resource distribution in space and having freedom to be part of the process that are influencing spatial (in)justices in space.

The narrative, shows that spatial justice is similar to social justice, territorial justice, however the interpretation of the concept differs between time and space. Despite, the concept being viewed as an enigma, in general spatial (in)justice is a condition whether good or bad. Several key aspects emerge from literature surveyed, that are crucial in this study to understand spatial (in)justice as a manifestation of spatial transformation using City of Polokwane as the spatial referent. These aspects provides a lens that spatial (in)justice can be assessed by means of analysing the following; distribution of services in an area; indicators of (in)justice are set by the investigator; unjustness can be subjectively viewed from the perspective of residents being affected; space; governance system and processes; idealised contingent from representation of space; domination and oppression, and the triad putting together right to be different, right to the city and spatial justice dialectics.

2.6.2 Right to the city

The right to the city concept is a representation of cities and urban areas as contested territories, with different meanings in different disciplines (Pithouse 2013, p. 330; Attoh, 2011; Görgens and Donk, 2011). The different, multiple meanings and interpretations have implications for the spatial transformation discourse. It was popularized provocatively in France in 1968 by Henri Lefebvre in a piece of work, “Le Droit à la ville” (Görgens and Donk, 2011, p. 2; Mathivet, 2010, p. 21). According to Lefebvre, (1967, p. 158) cited in Marcuse (2012, p. 24); Marcuse, (2009, p. 189;) “... the right to the city is like a cry and a demand. This right slowly meanders through the surprising detours of nostalgia and tourism, the return to the heart of the traditional city, and the call of existent or recently developed centralities”. With respect to the spatial transformation debate the right to the city raises fundamental questions on how city space is produced and reproduced, allocated and redistributed with

implications for density, tenure and economic growth. Marcuse (2012, p. 29) posit that the right to the city is a moral claim founded on the basis of fundamental principles of justice and it refers to right to social justice. In addition, the term city is not used in conventional sense of the existing city, but refer to a future city and the society as a whole both urban and rural (Marcuse 2012 p. 29). The assumption here is that current cities structure, resource distribution, areas of opportunities just to mention a few are not justly distributed. Hence the future city is expected to incorporate principles such as sustainability, accessibility, public space, democracy, equity and justice, among others needed to develop human potentials or capabilities, to meet their needs despite their differences (Marcuse 2012 p. 29). Thus, right to the city has been steering spatial transformation to redress spatial injustice, and unsustainable growth paths inherent in cities. Hence there is need to track spatial transformation of cities to aid planners and policy makers in achieving right to the city.

According to Mathivet (2010, p. 26) the right to the city concept is also referred to as the search for solutions or new urban development approaches towards resolving city struggles, such as spatial injustice, inequality, segregation among others. This implies that the right to the city acknowledges the shortcomings of existing strategies in steering spatial transformation and allows adoption of new approaches to direct spatial restructuring of cities. Although, the 'right to the city' ushers a platform, a 'new praxis' for citizens to express and address city struggles, however it runs short of suggesting solutions, or methodology on how citizens can participate in the use, and appropriation of space (Kitching *et al.*, 2015, p. 138, Görgens and Donk, 2011, p. 1; Brown and Kristiansen, 2009, p. 17; Lefebvre, 1996 p. 150). In particular, post-apartheid progressive policy frameworks have been put in place to promote this new approaches to planning, however spatial injustice remains inherent in our cities despite more than 25 years of democracy in South Africa. Leading organizations collectively through the 2005 World Charter for the right to the city and the 2016 UN-Habitat III Policy on right to the city and cities for all, have put forward a framework purported to be a new paradigm, a transformative new urban agenda that can be used to implement the concept of the right to the city for inclusive sustainable planning, production and management of the city.

The right to the city discourse serves as a tool or lens that local institutions, and academics can use to advance suggestion for spatial transformation to address spatial injustice entrenched in South African cities (Kitching *et al.*, 2015, p. 136; Görgens and Donk, 2011, p. 18; Marcuse, 2010, p. 87). Building across the given different perspectives, this study seeks to adopt the right to the city concept to understand the role of different agents in spatial transformation and its manifestation in different spatial typologies or forms, driving spatial transformation, and associated implications therefore with particular focus on City of Polokwane.

2.6.3 Critical urban theory

The critical urban theory is used to refer to the post 1960s work of radical urban scholars or leftist which include Peter Marcuse, Manuel Castells, David Harvey, Henry Lefebvre, and others (Brenner, 2009, p. 198; Brenner, *et al.*, 2012, p. 3). Although these philosophers had political, methodological and theoretical differences, they "...shared a common concern to understand the ways in which, under capitalism, cities operate as strategic sites for commodification processes" (Brenner *et al.*, 2012, p. 3). This entails a critique, of policy ideologies, post-apartheid policy frameworks, development plans in the attempt to redress spatial injustices and the manifestations of post-apartheid development trajectories. According to Marcuse (2012, p. 20), to understand the phrase 'critical urban theory' there is need to define each term separately. The term 'critical' refers to "an evaluative attitude towards reality, a questioning rather than an acceptance of the world." 'Critical' also mean both positive and negative criticism to foster possibilities for change through identifying what is wrong or right and that which requires change to create better communities where everyone has right to the city. 'Urban' refers to "the societal as congealed in cities today... the intersection of everyday life with the socially created systemic world about us..." 'Theory' refers to "the attempt to understand, to explain, and to illuminate the meaning and possibilities of the world in which practice takes place."

In addition, Brenner (2009, p. 198) points out that critical urban theory refers to the criticism of power, ideologies, injustice, inequality and exploitation, inherent in cities. Furthermore, this theory offers that criticism plays important functions; it exposes the role of government, and different agents as functions of inequality, exclusion, power, and injustice. It also intends to illuminate or explore alternative ways of shaping societal capacities and relations to do away with capitalism both in practical and theoretical perspectives (Brenner, 2009, p. 198; Roy, 2015, p. 6). Thus, critical urban theory refers to the analysis of the society to understand and inform or guide the process of spatial transformation.

The key question posed by Brenner, *et al.*, (2012, p. 2) is how to decipher the contemporary challenges and possible alternatives towards the desired future cities? The critical urban theory offers a platform for implementing the right to the city concept to develop desired future cities that embed the principles of spatial justice, resilience and sustainability. It suggests that the action to implement or achieve the vision of the right to the city concept is to follow three steps namely; expose, propose and politicize (Marcuse, 2009, p. 185). Brenner *et al.*, (2012, p. 2) adds that to map emancipatory alternatives for social transformation towards desired future cities requires understanding the current urban phenomena and its implications.

Thus, critical urban theory informs the study methods to be adopted to understand the complex spatial transformation in the City of Polokwane to expose the historical changes through mapping spatial transformations, their drivers, and associated implications. Furthermore, the study guided by this theory proposes an integrated framework for tracking spatial transformation.

2.6.4 Spatial triad

Watkins (2005 p. 209) argues that although there are other theoretical conceptions of space, Lefebvre's considerations ushers richer and insightful ways to explore relative space unlike other approaches. Lefebvre's (1991 p.38) theoretical conception is explained using three interrelated aspects of space namely; representations of space-conceived space; spatial practices- perceived space and spaces of representation- lived spaces.

Spatial practice is also viewed as perceived space. According to Lefebvre (1991 p.38), "the spatial practice of a society secretes that society's space; it propounds and presupposes it, in a dialectical interaction; it produces it slowly and surely as it masters and appropriates it. From the analytic standpoint, the spatial practice of a society is revealed through the deciphering of its space." close association within perceived space, between daily reality (daily routine) and urban reality." Lefebvre (1991, p.33) "embraces production and reproduction and the particular locations and spatial sets characteristics of each social formation. This entails that the spatial practice, conceals the society's space, to alter the archaic, outdated, uncondusive matters of society, which is required as a precondition for investigating or discussing on societal truth which is then produced slowly, gets mastered and taken up to inform the production of space. Thus, to understand how society's space is produced and reproduced, there is need to make meaning of the social activities in society. Leary-Owhin (2015 p. 3) adds that "spatial practice has three major elements 1) the physical, material city and its routine maintenance; 2) major urban redevelopment in the context of existing neo-capitalist and state power structures; 3) routines of daily life that conform with official representation of space." Thus, through spatial practice societal activities, the physical developments, daily routines, are analysed, and interpreted at various scales in a way that makes people aware, conscious and understand urban reality (Campbell 2018 p.e27). In line with this perspective of space as understood from spatial practice provides the researcher with insights on how to understand urban reality on societal activities, physical developments and daily routines in the City of Polokwane.

Representation of space is also known as conceived space. It refers to "conceptualized space, the space of scientists, planners, urbanists, technocratic sub-dividers and social engineers... they identify what is lived and what is perceived with what is conceived... Dominant space in society" (Lefebvre 1991, p.33). This implies that spatial transformations being experienced

relative space, are a reflection of planners and other professionals conceptualizations of the lived-perceived spaces in relation to conceived spaces represented in the form of plans, maps just to mention a few. Leary-Owhin (2015 p. 3) also states that representation of space is “rational, intellectualised, official conceptions of urban areas for analytical, administrative and property development purposes.” Thus, understanding production of space from the perspective on representation of space in particular City of Polokwane implies the analysis of discourse on space as conceived by planners, other professionals and stakeholders contracted by the municipality. These discourses as conceived spaces include written text, land use plans, spatial development frameworks, maps, other visual representations, integrated development plans, design-guides, urban renewal/regeneration plans, Central Business District (CBD) improvement plans, and other policy documents.

The third form of space is representational spaces which also relates to lived spaces. According to Lefebvre (1991 p.33) representational spaces refer to “space as directly lived through its associated images and symbols and hence the space of ‘inhabitants’ and users but also of some artists and perhaps of those, such as a few writers and philosophers, who desire and aspire to do more than describe.” This implies viewing space from the lens of those who live in it, i) the general residents, inhabitants and ii) the philosophers, writers, artists (painters, poets) which are amidst of the residents as portrayed in their images, paintings, artistic performances (Leary-Owhin 2015 p. 3). Thus this imagination seeks to spatially transform, change or restructure the lived spaces to suite their own imagination. Lefebvre (1991, p.33) “embodying complex symbolism” “ has two major elements, 1) urban everyday space as directly lived by inhabitants and users in ways informed not so much by representations of space as by associated cultural memories, images and symbols imbued with cultural meaning; 2) emotional, artistic interpretations of city space by poets, writers and painters and others who create artistic representation of space.

Thus, to sum up the above discussion on production of space, spatial practices represents the relative space as the totality of activities in society. However, this relative space is dynamic, it is produced and reproduced by both forces of i) representation of space- conceived plans from planners and other professionals in the form of guidelines and maps among others and; ii) representational spaces as directly lived by inhabitants, and other interested stakeholders which expresses their views of space using images, paintings, poems and other artistic performances. What’s emerging from this discussion is that understanding relative space in the City of Polokwane and its spatial transformation dynamics, requires moving beyond mere observation of existing urban reality. This implies adopting an approach that allows analysing how this space has been spatially transforming as influenced by both representation and representational spaces.

2.6.5 Spatial dialectics and didactics

We need the truth substantiated by empirical evidence to understand and guide the realities of spatial transformation in small and intermediate cities. This theory provides a lens on how urban issues can be approached amidst differing notions and conceptions of spatial transformation from the diverse stakeholders interested in this concept.

Spatial dialectics provides an analytical approach which aims to expose and explain, why spatial strategy tensions, dilemmas, and contradictions develop (Halvorsen 2019 p.448). This implies cities are tension ridden areas comprising various agencies and their interaction influence spatial transformation. The post-apartheid progressive policy frameworks and associated normative principles therefore guides spatial transformation of cities, yet the current development trajectories perpetuates and manifests in similar apartheid injustices a contradiction, dilemma to the desired development path.

According to Farr (2008 p.2) Marcuse postulated that, “This world contradicts itself.” This contradiction can be reflected in two ways. Firstly, in relation to “social reality and.. perpetuation of injustice and inequality” the underpinning is that society is considered as having access to resources to overcome scarcity issues putting an end to exploitation, instead there is more oppression and widening of inequality in our cities. The second contradiction, relates to “own self-understanding” implying that “who we are contradicts with who we actually are” for instance we consider our system of governance as democratic yet the citizens are marginalized in participating on matters that affect them (Farr 2008 p.2). In another perspective, “Soja’s notion of socio-spatial dialectic is central to the understanding of space as a social product rooted in practices, disciplinary power and ideology” (Arias 2010 p.30). Hence, the dialectical theory is a useful tool sought after to “see things as they are” and then expose the existing contradictions on spatial transformation in small and intermediate cities.

Furthermore, socio-spatial progressive changes desired is hindered by accepting the nature and order of present business norm. We need the truth substantiated by empirical evidence to understand and guide the realities of spatial transformation in small and intermediate cities, this theory provides a lens on how the issues can be approached amidst differing notions and conceptions of spatial transformation from the diverse stakeholders interested in this concept. Particularly, the noticeable contradictions are that during oppressive apartheid era, apartheid spatial planning systems were blamed for the myriad of challenges faced in South African cities including small and intermediate cities such as City of Polokwane, yet in the independent democratic South Africa issues of spatial injustice and inequality are inherent.

2.6.6 Spatial turn

The spatial turn theory was propounded by various scholars, who sought to examine spatial space outside the “strictly positivistic framework” usual norm by triangulating different approaches from multiple disciplines (Guzman *et al.*, 2016 p.4). In particular, Henri Lefebvre in his study on production of space, viewed space in a different perspective as a social product that is “created, codified and used through social, political and everyday process” Guzman *et al.*, 2016 p.4). Similarly, Lefebvre developed a spatial triad, building on Tuan’s approach on critical analysis of space “as real (physical) and perceived” by adding a third dimension that coexists together with the other dimensions which is referred to as “the lived (experienced) space, and can be best understood by voices and actions of those who live in and use such spaces every day. This discourse on different perfectives on spatial turn shows that when engaging in critical analysis of space, there is need to analyse space beyond “the reality of what we see”. The notion of spatial turn as viewed by Soja, cited in Winkler *et al.*, (2012 p.1) in his mid-nineties writings called attention to be given to the neglected category of space, ‘spatiality’. This implies that research on space should engage with both spaces, the real and mental space and its implications on spatial transformation. Thus, considering Soja’s third space provides a better understanding of the influence between, cultural construction, mental, geographical and physical spaces in production, and reproduction of space. Thus spatial turn calls for the adoption of multiple approaches to probe on the social, political and everyday process that leads to the production of such spaces. In particular, the spatial triad is one such a tool that helps understand space beyond the “strictly positivistic framework” by means of the following dimensions; representational space, representations of space and spatial practice.

Moreover, “to turn implies retrospection, a process of stopping in the road and glancing backwards at the way by which one has come” (Guldi n.d). South Africa has been on spatial transformation path since the dawn of post-apartheid era, and there is increasing calls for tracking the progress of spatial transformation. A call which is a reflection of the spatial turn in itself that, we need to have a backward look and understand the reality of spatial transformation in our cities including small and intermediate towns in South Africa. However, the call runs short on prescribing the methods and tools that can be employed to unravel the spatial transformation dynamics being experienced. Hence, the spatial turn theory through the lens of the spatial triad (representational space, representation of space and spatial practice) can be adopted to deepen the understanding of spatial transformation in small and intermediate cities. The representational space is regarded as the ideal, imagined, vision and theorised space, in this perspective this would mean analysing policy frameworks to understand the idealized spatial transformation in South African cities. The dimension representations of space is conceptualized as the desired physical form of space

communicated as models, plans and maps by planners and other practitioners. This implies that the other spatial turn is the need to analyse and reflect on the physical plans, maps and models that were developed to guide spatial transformation in South African cities. Furthermore, the dimension spatial practice relates to everyday urban reality in our cities. In particular, a reflection on the urban reality of City of Polokwane will help assess and evaluate if the desired spatial transformation championed by the representational space policy intentions, ideologies, that were expressed by means of maps, plans and models as representations of space was attained or not.

2.6.7 Discourse analysis theories

The use of the term 'discourse' is varied in the arena of discourse analysis (Fairclough 2012 p.453). In general, discourse refers to "written or spoken communication or debate" (Oxford Dictionary 2019). In relation to this study, discourse therefore implies text and something said or talked about to convey a message or information about spatial transformation in the City of Polokwane. To add on, Anderson and Holloway (2020 p.190) reiterates that discourse broadly refers to, "talk, text and action, as well as more broadly circulating narratives, sets of beliefs and ways of seeing the world.... motivated by political interests, power relations, ideologies, rhetorical positioning, etc." Thus, in line with the view of Avgerou and Bonina (2019 p.72); Fairclough (2005 p.915), ideologies communicated through discourse have an effect on social changes, these changes happen in space resulting in spatial transformation. This implies that written and spoken communication circulates key issues, ideologies and perspective of viewing, understanding, and driving spatial transformation as motivated by the governance systems in the City of Polokwane. As a follow through, to understand this theory the broad question becomes; what are the sources of the discourses, 'text and spoken communication'?

As a response to the aforementioned question, there are multiple sources of discourses. Broadly published or not, the sources include but are not limited to the following; images, , graphs, artefacts, recording field notes, photographs, historical memoirs, diaries, interview transcripts, legislations and policies, legal briefs, textbooks, pictures, historical archives, government agencies, libraries and art galleries, internet, television (Avgeou and Bonina 2019 p.72; Jaipal-Jamani's 2014 pp.8-9; Shaw and Bailey 2009 p.413; Hodges *et al.*, 2008 p.570; Fairclough 2005). Basically, this entails that sources of text data to examine spatial transformation dynamics in the City of Polokwane are broad. The sources include policies and legislations, government documents, archives, journal articles, textbooks, interview transcriptions, interview recordings, images, aerial photographs, maps and different agencies.

Jaipal-Jamani (2014 p.4) posit that discourse analysis is regarded as "a methodological strategy that can be used to interpret data in situations where the researcher wants to

illuminate meanings in text.” Thus, through discourse analysis as a method and approach to examine text, the researcher will be able to gain insights on key matters of spatial transformation to attain the objectives of the study set out in chapter one. Just to recap; these objectives relates to; examining policy directions, maps of spatial transformation, drivers and implications of spatial transformation in the City of Polokwane.

According to Hodges *et al.*, (2008 p.570) approaches to; discourse analysis, or simply put the study of social life through text analysis (Shaw and Bailey 2009 p.413), to “illuminate problems and controversies in the world i.e. distributive inequalities” (Gee 2011 p.10), can be broadly clustered as; formal linguistic discourse analysis, empirical discourse analysis and critical discourse analysis. Critical discourse analysis (CDA) will be the central approach to discourse analysis in this study. Interestingly, the assumption of CDA is that, discourse is not merely a description of ideologies, it has a close association, influence on action and resulting social phenomena or differences, exploitation, domination in social and political practices (Avgerou and Bonina 2019 p.75; Fairclough 2005 p.915; van Dijk 1998 p.1) This implies that in this study, text and spoken communication will be analysed to determine how the notion of spatial transformation have been put forward to redress the legacy of apartheid planning in the City of Polokwane. In another perspective, this analytical approach helps to understand how discourse is also perpetuating domination, and inequalities inherent in the City of Polokwane, small and intermediate cities by extension like any other cities in South Africa.

Methodologically, there are three levels at which discourse is analysed in CDA namely; text, discourse practice and social practice (Avgerou and Bonina 2019 p.75; Blommaert and Buclaen 2000 p.448-449), as presented in table 2.3.

Table 2.3: Critical discourse analysis levels

Discourse analysis level	Description
Text	Textual elements (Avgerou and Bonina 2019 p.75), features Blommaert and Buclaen (2000 p.448), which represents social and physical aspects of the world (Fairclough 2005 p. 925). This implies discourse of different forms exists from a variety of sources on the reality of spatial transformation in the City of Polokwane.
Discourse/discursive practice	Producing, interpreting texts, and taking action (Avgerou and Bonina 2019 p.75; Blommaert and Buclaen 2000 p.448). Thus, analysing spatial transformation discourse practice in this study helps understand how the discourse is continuously reproduced, interpreted and necessary action is being taken to give effect to the desired objects of the discourse.

Social practice	The situational, institutional, and/or societal context (Avgerou and Bonina 2019 p.75), and ideological effects (Blommaert and Buclaen 2000 p.449). This implies that there is need to understand through discourse analysis, the reality and social institutions that drive spatial transformation in the City of Polokwane and by extension small and intermediate cities in South Africa.
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Source: Author, 2020

Table 2.3 shows that critical discourse analysis in this study involves the analysis of text elements because they represent social reality of spatial transformation. This reality is a result of social institutional practices, which also influence discourse practices to produce and reproduce text on spatial transformation in the City of Polokwane.

Conceptually in CDA when analysing text, discourse practice and social practice, the main issues that are addressed are; emergence, hegemony, recontextualization and operationalization (Avgerou and Bonica 2019 p.75; Fairclough 2005 p.932). Emergence- is approached from the principle that new discourses emerge through 'reweaving' relations between existing discourses. Thus, the production and reproduction of discourse on spatial transformation is a result of noticed failures and successes of existing discourse resulting in internal reweaving and recontextualization of discourse from external social institutions beyond the specificity of South Africa. Hegemony – focuses on determining the effect of an emerging social phenomena discourse practice in influencing social institutional practices and strategies. In line with this perspective, hegemony helps to analyse text, and unravel discourses, which helps to explain certain strategies adopted by social institution to effect the desired spatial transformation in the City of Polokwane. Operationalization: focuses on the resultant effect of discourse social institutions and reality, analysis is beyond text, to the gathering of empirical evidence showing actual changes in space of consideration. Thus, operationalization assisted the researcher to generate empirical evidence on spatial transformation in the City of Polokwane. This approach shows that empirical evidence is critical towards understanding the effects or progress of legislative policy discourses in attainment of the desired spatial transformation. Although, this operationalization perspective does not prescribe ways of gathering the empirical evidence required, this study identified and applied socio-spatial indicators to map spatial transformation in the City of Polokwane.

To add on Miller *et al.*, (2010 p.245), posit that CDA is characterized by the following elements, i) analysis of the role of discourse, language in political power dynamics in perpetuating inequality and social problems. That is in the context of this study discourse analysis assisted in illuminating the perpetuated (in)justices in the City of Polokwane; ii) in-built critical stance; researcher engaging in CDA must acknowledge, and accept all critical discourse. Hence, in undertaking CDA, the researcher was not biased but analysed discourse with a critical lens.

iii) contextuality; encompasses the three levels discussed in table 2.3. iv) intertextuality; this allows linkages of multiple discourses. This entails that to understand spatial transformation, one single form of discourse is not adequate, sufficient enough, meaning to get a holistic picture multiple discourse, texts linked are required to support the research.

2.6.8 Complexity theory

There is the need to adopt the complexity theory in understanding spatial transformation and its impacts employing the key variables of the theory namely; emergence, agents, criticality and self-organization (Alberti *et al.*, 2018 p.45; McAdams n.d. p.5).

Agents; they make decisions that have an effect on land use and resource allocation; the agents are identified as follows; academic institutions, non-profit organizations, government, real estate developers/private developers, businesses, and household members (Alberti *et al.*, 2018 p.47). This implies that decisions and actions made by the agents drive spatial transformation. Therefore it is significant to understand the agents driving spatial transformation in the City of Polokwane.

Emergence; interaction between agents, and economic markets through social networks result in emergent (Alberti *et al.*, 2018 p.47), that is observable in relation to spatial transformations over time. The emergent manifests in the form of physical-urban growth, socio-spatial segregation, injustices, behavioural- travel patterns, economic changes – property values, environmental patterns- pollution among others. Therefore, this theory provides a lens to look at spatial transformation and get to ask what are the drivers and implications of such spatial changes taking place.

Self-organization; increasing complexity in cities is because they evolve largely through interaction of internal systems and agents. This ability to self-organize increases cities complexity challenging the normal planning paradigm, there are always socioecological phenomenon that drift from the desired goals (Alberti *et al.*, 2018 pp.48-49). This perspective provides a lens of understanding why spatial segregation is still inherent in South African cities despite over 25years of progressive planning tools in post-apartheid era. Thus despite having the various tools to guide spatial transformation, self-organizing systems in the city are resulting in complex socioecological phenomenon deviating from desired spatiality, manifesting in spatial segregation among others. Thus self-organization in cities result in instability and chaos (Alberti *et al.*, 2018 p.49), messy, wicked planning problems (Nel 2019 p.26). To add on, spatial transformation is one such wicked problem being faced in the complexity of cities.

Criticality: cities as self-organizing systems at different scales over time, they reach a critical state that propagates change such as regime shift (Alberti *et al.*, 2018 p.49). Ability of cities to self-organize critically increases the vulnerability of cities to various problems. Alberti 2016 cited in Alberti *et al.*, (2018 p.53) reiterates that, spatial transformation in this complex systems of cities weakens the cities stability and resilience.

Complexity theory helps in understanding that cities are complex systems comprising of different agents which interact resulting in emergent of spatial transformations. However, the interaction between agents and the noticeable emergent makes cities evolve. The process of evolving towards the desired development patterns, is also challenged by the self-organizing ability of cities challenging the traditional approaches to planning. This self-organising ability result in emergent of spatialities that critically impact on the stability and resilience of cities. The implications of these subsets of complex systems of cities entails the need for new perspectives and approaches to understanding and planning than the traditional rational comprehensive planning model stipulated for development of spatial development frameworks (SDF's) and integrated development plans (IDP's). Nel (2019 p.33) suggest that, municipalities need to accept the complex nature of cities and their aspects and adopt new approaches to understanding space, time in order to practice adaptive collaborative and co-evolution planning.

Space should be conceptualized as relational, it is linked to various components of the complex systems of cities, it is not limited to given boundary and that interactions between agents happen at different scales and this has different implications on the complex system of cities (Nel 2019 p.33). Relational time provides a view point that planners need to understand that cities as complex systems are dynamic, they adapt and change at different timescales. Other components of the cities' complex system change quickly, traffic flow; while others change slowly such as the built-up environment. It is critical that planners should also know that most misalignment of plans with time, focusing on political terms of office, assuming all plans can be linked to this short-term time frame. Thus, failing to consider relational time frames affects the way cities develop or attain the desired form of spatial transformation.

Furthermore, planners need to keep on evolving and adapting as cities change with time. This implies that for planners to attain the desired spatial transformation, they should take a flexible approach, 'swarm planning' to policy making and planning of cities. This implies planners have to create an enabling environment to allow citizens to build on their own and spatially transform their own spaces. This perspective helps to attain the desired cities in that the government has limited resources and cannot build for everyone, hence enabling the environment will allow agents to build on their own. In addition, there is need for mutual learning between the agents

of change which are part of the complex system of cities. This entails adaptive collaborative planning, that promotes shared learning between the stakeholders.

2.6.9 Theory of change (ToC)

Change refers to that which the various agents seek to attain. For instance, various agents seek to spatially transform unjust apartheid legacies towards just spaces in South African cities. On the other hand, theory is regarded as an idea, the various post-apartheid progressive policy frameworks and associated normative principles which seek to guide, provide a pathway, the means to attaining the desired spatial transformation. Literature shows varied definitions of theory of change (ToC). Paina *et al.*, (2017 p.31) views ToC from the management tool perspective as, “an outcome based approach which applies critical thinking to the design, implementation, and evaluation of initiatives and programs intended to support change in their context”. According to Rogers (2014 p.1) ToC “explains how activities are understood to produce a series of results that contribute to achieving the final intended impacts.” Central to these definitions is that ToC is a technique that can be employed for critical retrospection, to evaluate the progress of spatial transformation initiatives in post-apartheid South Africa. This theory as presented in figure 2.7, provides for an analysis of how the planned intervention have effected change in an area of focus, the pathways guiding desired change in particular frameworks, maps created to direct desired spatial transformation. This indicates that the basis for ToC is to identify or design a framework (representation of space) to be used as a baseline or terms of reference for implementation and evaluation of change initiatives. This is crucial for the purpose of narrating the extent to which expected changes have happened.

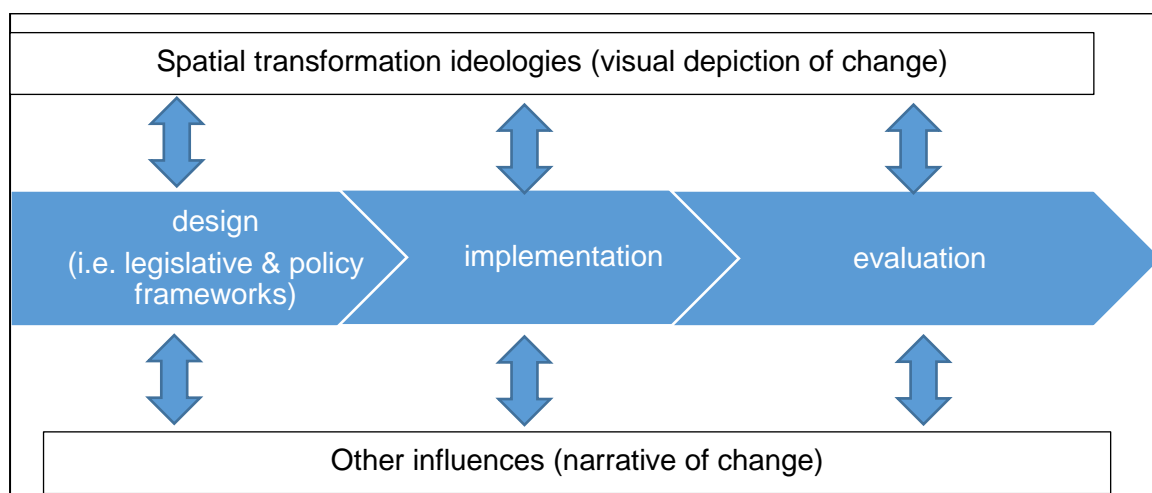


Figure 2.7: Theory of change (ToC)

Source: Author, 2020

Furthermore, Paina *et al.*, (2017 p.31) argues that ToC is conceptually composed of two main components namely visual depiction and a narrative account. Visual depiction, implies identifying key indicators to map and reflect on the desired pathways of intended changes. In relation to this study, linked to this visual depiction component on theory of change, a set spatial development framework maps depicting desired spatial change are presented in the chapter that discusses the policy directions for spatial transformation in the City of Polokwane. To add on, the study further identified spatial indicators that helped to track the outcomes, progress of spatial transformation which are broadly categorized in the following integrated framework; demographic distribution, urban structure and urban texture. Furthermore, these spatial indicators are essential, they provide information on performance, measuring the extent to which the intended objectives are being met. Various progressive policy frameworks have been put in place in post-apartheid era to direct spatial transformation in South Africa. Therefore, empirical evidence on spatial transformation will aid evaluation of the performance, progress of attaining the desired spatial restructuring in the City of Polokwane.

The narrative of change, describes the implementation context of the change initiatives, what is the problem at hand that needs to be addressed, the agents or drivers of such changes and by extension implications of such changes. Similarly, on narrative of change the study set out research objectives that seek to determine the agents and other drivers of spatial changes and by extension the implications associated with the spatial transformations in the City of Polokwane as discussed in detail in the respective chapters addressing these objectives.

2.7 Critical spatial transformation theoretical framework

The critical urban transformation theoretical framework informing this study is framed on the basis of the discussion on theoretical undertone of spatial transformation as set out in this chapter. Spatial transformation is multifaceted, complex setting the tone that there is no single approach, theory, framework, that can help unravel spatial transformation dynamics. This entails that it is necessary to build, an informed grounded theoretical framework to guide the process of inquiry on the reality, spatiality a manifestation of spatial transformation. On the basis of this perspective, the study developed a critical spatial transformation conceptual framework to guide the exploration of urban changes restricting in the case study setting. This framework is presented in figure 2.8.

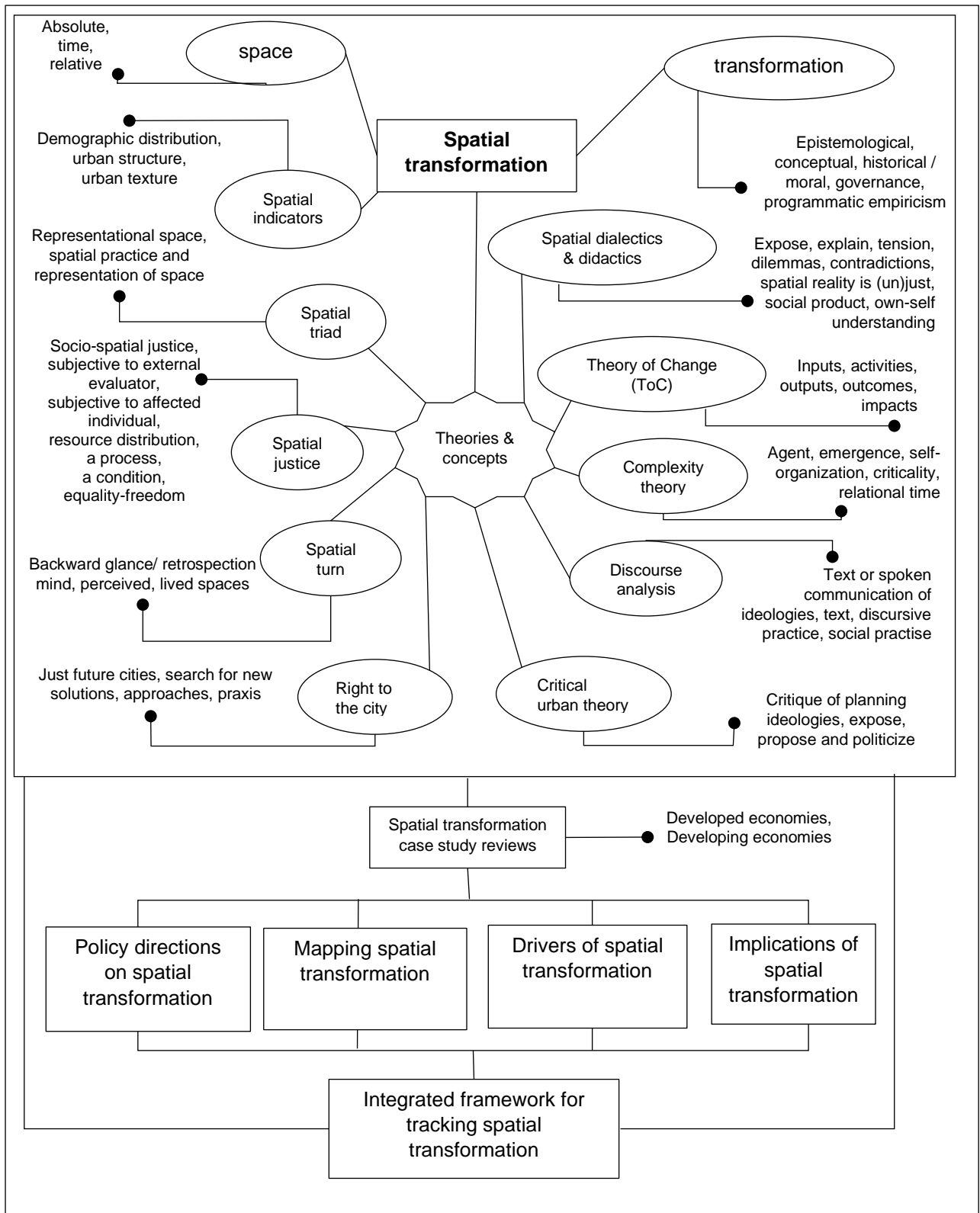


Figure 2.8: Critical spatial transformation conceptual framework

Source: Author, 2020

The critical spatial transformation conceptual framework guiding this study is presented in figure 2.8. It shows that to understand the reality of spatial transformation there is need to

disaggregate and understand the notion of the key terms spatial-space and transformation. Conceptually, the framework shows that to understand spatial transformation in a holistic manner the following indicators must be adopted; demographic distribution, urban structure, and urban texture. This implies a correlation between demographic changes in a city and the underlying urban structure and texture. Thus, rapid urbanization experiences correlates with spatial structural and texture changes in cities. In addition to this the ideology of the emergent spatiality can be unravelled using the complementarity of multiple theoretical perspectives. On the basis of this perspective the following key theories were selected to frame the exploration of spatial transformation dynamics namely; spatial justice, spatial turn, critical urban theory, spatial dialectics and didactics, complexity theory, critical discourse analysis, and the spatial triad. In addition to this, critical literature review of case studies on spatial transformation from developed and developing economies across the world is also essential. It sets the tone of understanding the methods, tools and techniques employed in previous studies in understanding the policy directions, spatial transformation indicators, drivers and implications of spatial transformation. The evidences from these discussions then assists in building an integrated framework for understanding spatial transformation.

2.8 Chapter summary

This chapter sets out to discuss the theoretical undertone of spatial transformation. It discussed the notion of space which was viewed as absolute, time, relative; transformation noted as having the following dimensions; epistemological, conceptual, programmatic empiricism and governance dimensions. Spatial transformation was conceptualized as follows; demographic distribution, urban structure and urban texture. To add on, this chapter also discussed key identified theories to guide exploring spatial transformation namely; spatial justice, right to the city, critical urban theory, spatial triad, spatial dialectics and didactics, spatial turn, discourse analysis, and complexity theory. Building on these different interrelated parts discussed, a critical spatial transformation conceptual framework was developed to guide the exploration of urban restructuring in the case study setting.

CHAPTER 3 SPATIAL TRANSFORMATION DISCOURSES: INTERNATIONAL EXPERIENCES AND PERSPECTIVES

3.1. Introduction

This chapter discusses international experiences and perspectives on spatial transformation discourses. It provides an overview of past studies, case studies demonstrating the different experiences of spatial transformation in selected cities from both developed and developing economies across the world. This chapter begins by an introduction, followed by background on shifting spatial transformation analysis discourse from classical ecological school of thought towards structuralist analysis. Literature review on spatial transformation case study experiences and perspectives is discussed in sections 3.3.1 for developed economies and 3.3.2 for developing economies. This is followed by section 3.4, which discusses the emergent and emerging lessons from case study reviews on spatial transformation discourses in line with the research objectives. Figure 3.1 provides the organizational structure of this chapter.

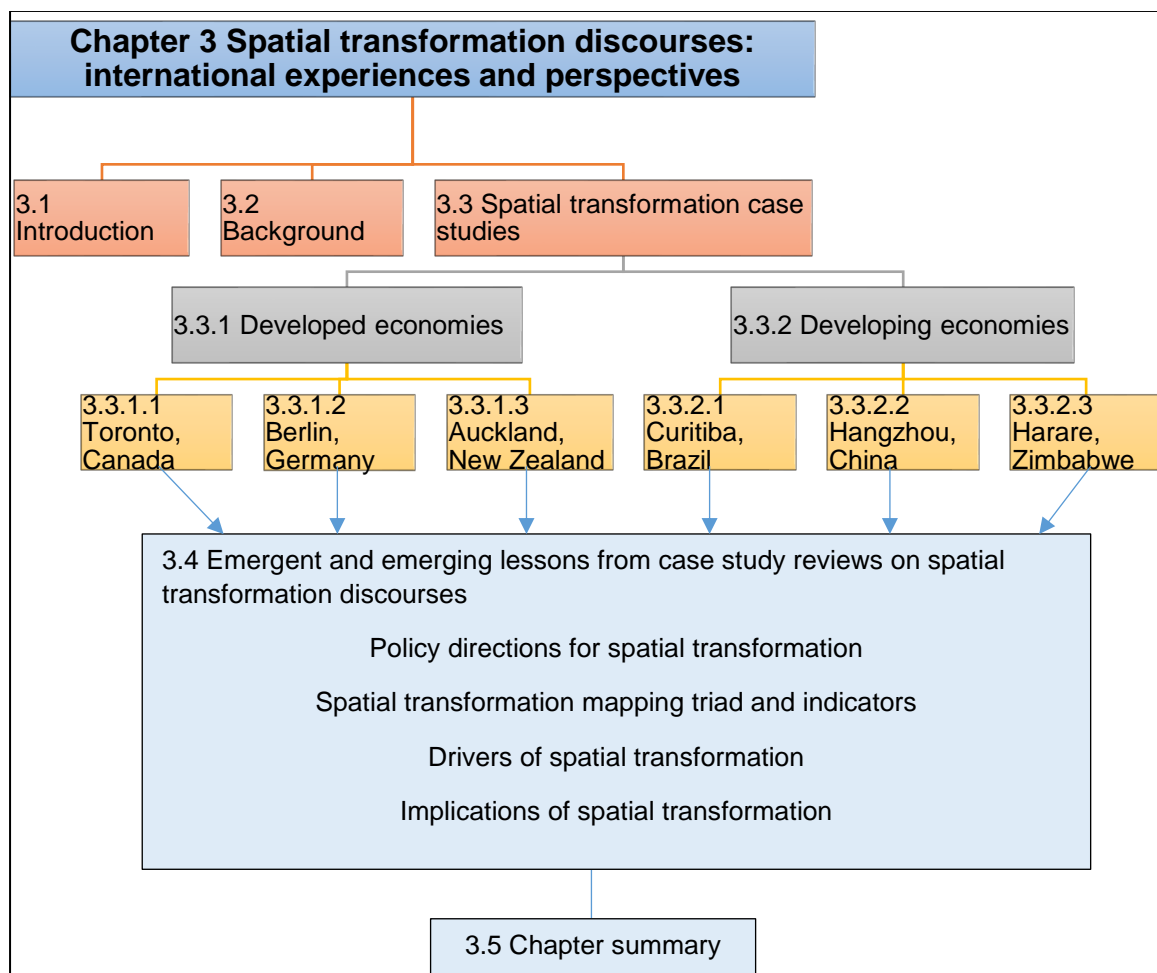


Figure 3.1: Chapter 3 Orientation

Source: Author, 2020

3.2. Background

Historically, spatial transformation analysis of cities was grounded in the 1920's classical school of thought centred on Chicago city which was shaped by classical ecological analogies of invasion, succession and domination (Thorns 2002 p.7; Muhammed and Onuche 2017 p.168). In reality the development trajectories of contemporary cities follows a different, complex evolutionary path, process, which renders classical theories inadequate and limited to explain the drivers and implications of spatial transformation in cities. Bruyns (2018 p.53); Muhammed and Onuche (2017 p.168); Thorns (2002 p.8) reiterates that the dominant neoclassical theories, are criticized as ideological and deficient in explaining the complex drivers of spatial transformation. Hence, the shift from classical school of thought on quasi-biological metaphor analysis to structuralist analysis of the complex web of urban systems on economic, political and power processes driving spatial transformation (Thorns 2002 p.8). The processes and drivers of spatial transformation are complex as alluded by the complexity theory, and their level of significance differs between cities (Turok, 2014, p. 81; Landman, 2006, p.2). Understanding the processes and forces driving spatial transformation is vital for making informed decisions on the formulation of possible strategies and tools towards redressing apartheid legacy, development trajectories and impacts associated with rapid urbanization (Coetzee *et al.*, 2014 p. 1; Mubiwa and Annegarn 2013, p. 4; Wray *et al.*, 2013 p. 6; Lauf, *et al.*, 2011, p. 71; Sadiki and Ramutsindela, 2002, p. 57). Furthermore, Coetzee *et al.*, (2014, p. 8), state that policy makers and planners cannot afford to ignore the complex spatial, economic and social dynamics that influence the spatial transformation of the cities. Harrison and Todes (2015, p.153) point out that implications associated with spatial transformation are "multiple, contested and complex". According to Yu *et al.*, (2011 p.600) spatial transformation has profound implications on both the natural environment (land, air, water) and humans. Floater *et al.*, (2014, p.7) argue that spatial transformation leads to various social, economic and environmental challenges.

3.3. Spatial transformation case studies

This section discusses case studies on spatial transformation, to demonstrate how different cities around the world have approached spatial transformation to attain their objectives in relation to their own stages of development, development trajectories, context and dynamics. The case studies were strategically selected using the UN (2019b p.169-170) classification to identify cities belonging to developed, developing economies and by extension Brazil, Russia, India, China and South Africa (BRICS) group of countries. The selected cities are presented in Figure 3.2.

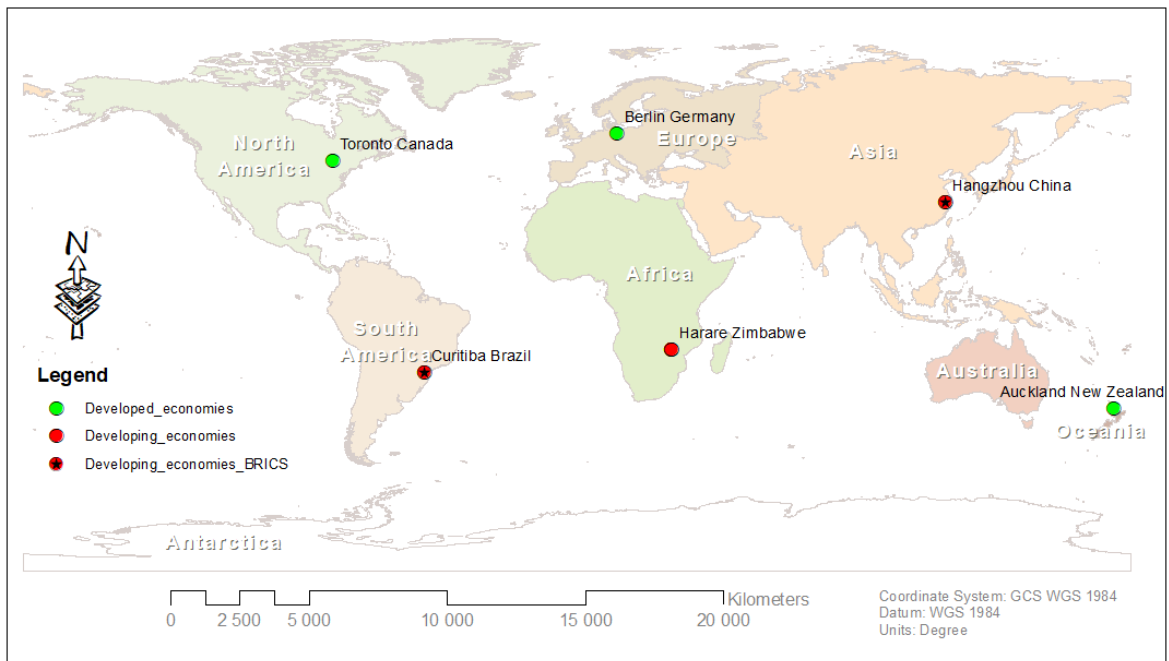


Figure 3.2: Spatial transformation case study countries

Source: Author, 2020

Figure 3.2 shows that in addition to the cities belonging to the broad groupings of developed and developing economies, the strategic selection was also extended to provide a wide coverage of the various continents. The cities from the developed economies include Toronto Canada in North America, Berlin Germany in Europe and Auckland New Zealand in Australia/Oceania. In relation to developing economies the cities selected are, Harare Zimbabwe in Africa, Curitiba Brazil, and Hangzhou, China. The last two case cities are developing economies and by extension are also part of the Brazil, Russia, India, China and South Africa (BRICS) group of transitioning economies to becoming developed economies.

3.3.1. Developed economies

This section discusses spatial transformation dynamics in the following cities in developed economies, Toronto Canada, Berlin Germany and Auckland New Zealand.

3.3.1.1. Toronto Canada

Toronto is alluded for its spatial transformation initiatives of clearing slums after post-world war II. It became recognized around the world as “the city that works” Brushett (2011 p.4). Various agents of change, stakeholders, slum dwellers, media, planners, social housing reformists, private developers, the bureaucrats of state evocatively unleashed a powerful transformative force in Toronto Canada to redress the Post-World War II squalid living conditions that existed, (Brushett 2011 p.1). This implies rapid population increase in the city had caused housing shortages and in attempting to redress the housing challenges of the

poor high-rise public housing and urban renewal, spatial transformation programmes were initiated to “wipe out the blots on the face” of the city.

Toronto experienced rapid urbanization, people migrated to fill the wartime industries, attributed to relaxed immigration policies which led to central city overcrowding. This in turn forced movement of people from the inner city promoting suburbanization which contributed to massive spatial transformation of Toronto (Brushett 2001 p.24). Figure 3.3 shows spatial transformation of built-up areas in Toronto.

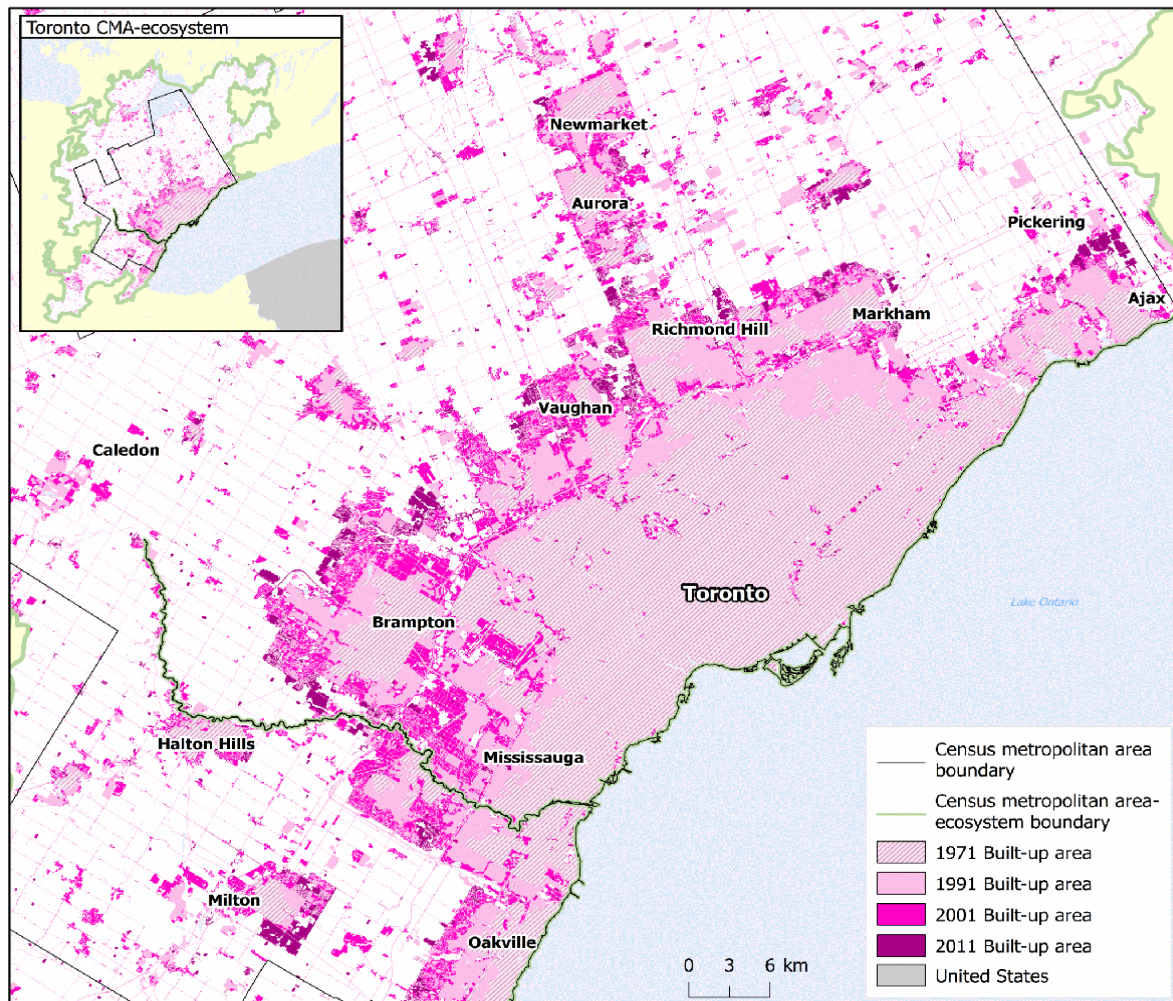


Figure 3.3: Spatial transformation in Toronto

Source: Stats Canada 2016 p.270

Figure 3.3 shows contiguous spatial transformations for the years 1971 to 2011. Wheeler (2003 p.328), reiterates that Toronto enforces its planning policies to ensure that infrastructure is not extended, “for more than one concession block at a time”. This ensures that the city remains compact minimizing urban sprawl, spatial splintering of the city.

Employing the conceptual spatial transformation mapping triad in Chapter two on demographic distribution, city structural changes and city texture changes the following spatial

transformations were noted in Toronto Canada; *Demographic distribution*; Toronto population increased significantly by 107% to 5 583 064 in 2011 from 1971 population of 2 699 927,(Stats Canada 2016 p.269); 2.1million in 1961 (Bourne *et al.*, 2003 p. 253). *City structural changes*; Built up areas of Toronto were approximately, 2184km², it increased by 1 189km² between 1971 and 2011 and it was considered the largest built-up, by extension the largest built up area increase, compared to other metros in the country. Arable land decreased by 1 063km² between 2011 and 1971 (Stats Canada 2016 p.6). *City texture changes*;- Similarly, Toronto had the highest population density in Canada 2011 of 3, 368person/km², clearly indicates compact development. The population density increased by 411 persons/km² between 2011 and 2001. To add on, the high rise buildings of five-storey and above contributed to 30% of the 2011 built-up area compared to a proportion of 22% of the total built-up areas before 1971. Dwelling density was 1255 dwellings/km² in 2011. It increased by 200dwellings/km² between 2001 and 2011 (Stats Canada 2016 p.6). This increased density in Toronto is attributed to the development of townhouses and condominium tower buildings around the city (Ibrahim 2017 p.7; Stats Canada 2016 p.14).

Toronto spatial transformations are influenced by rapid urbanization, personal preferences, land values as well as planning policy directions such as zoning and land use plans. Particularly, home owners have personal choices, others prefer single detached houses at the outskirts which are cheaper than city centre values. On the other hand some prefer condominiums or townhouses within the city core which are cheaper compared to detached houses located in city core (Stats Canada 2016 p.18). In another perspective, the spatial transformation of Toronto was influenced by intensive structural changes from built-up development activities between 1971-2011 which contributed to 64% of the built-up areas compared to the built-up areas pre-1971 (Stats Canada 2016 p.31). To add on dwellings construction, is also another factor that contributed to spatial transformation in Toronto, pre1971 there were 712 235 dwellings compared to 1 277 460 dwellings that were built between 1971 and 2011 a staggering growth rate of 179% (Stats Canada 2016 p.33).

Increasing spatial transformation in the city is also attributed to their planning policies, in particular The Official Plan of Toronto channelled development in certain nodes and suburbs to attain the broader city's vision of "complete community" where people can live and work, a mixed use development (Ibrahim 2017 p.16).

Furthermore, spatial transformation was intensified in Toronto between 1970s – 1980 by gentrification and intensification which changed the character of various neighbourhoods such as The Water Front (Bourne *et al.*, 2003 p. 263; Grant 2002 p.75). The drivers of spatial transformation in line with Wheeler (2003 p.330), can be broadly categorized as; institutional,

geographical, physical, technological, economic and social factors. However, the level of influence of these factors differ from one area to the other.

The emergent and changes of land use activities have many social, economic, health and environmental implications (Ibrahim 2017 p.8; Stats Canada 2016 p.13). Land cover change of natural and arable land for urban development contributed to loss of Toronto's ecological infrastructure mostly in the periphery (Stats Canada 2016 p.43). Particularly, urban expansion in Toronto is causing loss of natural land cover-wetlands, forests, grasslands, and croplands; and agricultural land (Stats Canada 2016 p.8). Densification; although it reduces sprawling, promoting compact cities, however it is resulting in loss of vacant, open and green spaces in the city. This amounted to loss of 448km² of (semi)natural land and a further arable land loss of 961km² (Stats Canada 2016 p.269). Similarly, Walton (2003) cited in Bourne *et al.*, (2003 p.261) reiterates that between 1986 and 2001, farmland of approximately 117 000ha was lost to built-up activities. Furthermore, Ibrahim (2017 p.14) states that there is lack of greenspaces and community spaces, yet the intensive spatial transformation in the urban core is also mounting more pressure on the existing few amenities and parks.

Toronto's rapid urbanization and massive built-up areas, also affected the housing type diversity, values and availability of houses, social cohesion, criminality, transit, lack of amenities (Ibrahim 2017 p.8; Stats Canada 2016 p.14). In relation to transit, spatial transformation has implications on mode of travel and commuting times (Stats Canada 2016 p.14). Furthermore, Ibrahim (2017 p.12) states that the rapid population growth of Toronto resulted in negative implications of traffic congestion, and that in North America the city has longest commuting times. On the other hand the city's transit capacity has been failing to handle the rapidly increasing population and traffic in the city. To add on, Ibrahim (2017 p.8) states that large scale spatial transformation occurring in the down-town of Toronto such as gentrification have ripple effects on social well-being of the residents particularly those who are poor. The poor people can no longer afford to reside in these areas because of increased property values through gentrification and are being forced out of the areas closer to opportunities.

Other implications are that the rapidly increasing population is causing traffic congestion, and shortage of parking spaces in the city (Stats Canada 2016 p.14). The construction of high-rise buildings is negatively impacting Toronto, by causing, loss of heritage value assets, loss of privacy because of tall buildings, ultimately resulting in loss of affordable rental housing (Stats Canada 2016 p.14). To add on, Ibrahim (2017 p.11) points out that extensive developments particularly down town have triggered property values to go up and low income earners are

spending nearly 50% of their salary on housing. Furthermore, this has further increased “socio-spatial inequality and polarisation.” (Walks 2001 p.436; Brushett 2001 p.18).

3.3.1.2 Berlin Germany

Berlin is characterized by turbulent spatial transformation history, attributed to conflicting political systems (Arandelovic and Bogunovich 2014 p.1; Gornig and Häussermann 2002 p. 332). The 20th century characterises various transformations that Berlin underwent from governance, to physical-spatial transformations. Of critical importance are the spatial transformations in the 1918 revolution, 1933 reign of Nazis into power, 1945 onwards post war divisions in the city, the 1961 Wall erection to divide the city, the life thereof in the divided city, and followed by the fall of the wall 1990s reunification of the city (Arandelovic and Bogunovich 2014 p.2). During the period of the Cold War, the city was politically divided for more than 40years. In addition, the city was further physically divided into western and eastern Berlin for over 30years. This evolutionary path characterized by these different events had an impact on the nature, dynamics of spatial transformation in Berlin. Interestingly, it is argued that the boundary of Berlin is not a result of the spatial transformation of the cities landscape through sprawling, peri-urban expansion and the organic way of city growth. Rather it was demarcated around 1920s when the surrounding small towns, agricultural areas, water bodies, forests were strategically selected and included as part of the broader city of Berlin (Arandelovic and Bogunovich 2014 p.2).

The dynamics of spatial transformation of the city in relation to demographic distribution are that; In 1710 the population was approximately 56 000, it increased to 265 000 in 1834, in 1871 it rose to 826 000, the population continued to rapidly grow to 2 040 100 by 1905. The establishment of the Greater Berlin changed the population structure to become approximately more than 4million people (Arandelovic and Bogunovich 2014 p.2). To add on, during Hilter reign in power, the Jews were about 170 000 around 1933 and after World War II the population significantly decreased to approximately 5 000 (Arandelovic and Bogunovich 2014 p.4). These demographic changes have a profound effect on spatial transformation, because the higher the population more housing will be developed causing expansion of the city. In addition, to structural transformation of the city the following spatial transformations were noted; During the 12th century a network of dense linear villages along a road characterized by green spaces at the centre emerged. These villages spatially transformed into Berlin and Collin, two separate huge settlements. These two separate settlements spatially transformed into a unified single settlement around 1709 (Arandelovic and Bogunovich 2014 p.2).

City growth and expansion around 1737 contributed to structural spatial transformation through development of gateways of the city infused with public spaces (Arandelovic and

Bogunovich 2014 p.2). The government's annexation of surrounding areas, suburbs, industrial sites spatially transformed the structure of Berlin. The agglomeration of these various spaces made Berlin to be a bigger city in Europe. This had implications for planning because the large city complicates the already complex urban systems. To add on, the 1918 establishment of Weimer Republic contributed to the amalgamation of various settlements around to form the Greater Berlin. The spatial transformation that resulted from this integration and merging of; 8 cities; 59 towns; 27 regions of agriculture making Berlin Europe's biggest city during 1920s (Arandelovic and Bogunovich 2014 p.3).

Post-World War II, transformation of the government into two separate entities led to structural spatial transformation of the city into East and West areas for a period of 40years. This led to the construction of the Berlin Wall reinforcing the structural division of the city into two separate parts (Arandelovic and Bogunovich 2014 p.5). Furthermore, the structure of Berlin was also spatially transformed, by the fall of the Berlin Wall around 1990s, the west and east sides were re-unified again to form a single city. The destructed open space at the city centre was concentrated with redevelopment projects, and construction of office spaces (Arandelovic and Bogunovich 2014 p.12). To add on Micheal *et al.*, (2011 p.110) pointed out that the reunification of Berlin after collapse of the wall sparked extensive spatial transformation because of the developments on peri-urban, suburbanization on the urban fringe of the city. The other notable, city structure spatial transformation in Berlin was the merging of former 23 districts into 12 districts in 2000 (Arandelovic and Bogunovich 2014 p.18). In another perspective, the "megalomaniac planning of the new capital city" significantly changed the structure of Berlin (Arandelovic and Bogunovich 2014 p.4; Bernt *et al.*, 2013 p.12). In an attempt to put Berlin on the picture with other cities with developed economies contributed to massive construction of houses to improve the lives of the citizens.

Berlin also witnessed spatial transformation of the urban texture over the years. In the 1700s there was an emergence of architectural spatial transformations in Berlin giving it its unique urban texture. Grid patterns were also developed around this period. Berlin architecture and culture made it famous when it became a European metropolis during 1740s to 1786s under the rule of Frederick II (Arandelovic and Bogunovich 2014 p.2). In another perspective, urban texture spatial changes noted in Berlin include changes from large industrial blocks to construction of large districts of residential areas for the industrial workers, the Hobrecht's Plan. This had a significant impact on spatial transformation of the city given the population of approximately more than 4million that needed housing (Arandelovic and Bogunovich 2014 p.4).

Furthermore, construction of dense housing units to meet the rapid population increase during the industrial revolution era influenced spatial transformation of the city (Arandelovic and Bogunovich 2014 p.4). The urban texture of the city was disturbed by the world war II leading to destruction of a third of housing in Berlin. Furthermore, the city centre evidenced a dwelling destruction of approximately 54% (Cobbers 2011 cited in Arandelovic and Bogunovich 2014 p.5). Other spatial transformations of urban texture in eastern Berlin include, development of grandiose plazas and wide boulevards, including a television tower which was considered the highest structure (Arandelovic and Bogunovich 2014 p.9). To add on, spatial transformations that also took place include construction of the facilities that were no longer accessible to either citizens as a form of compensation (Arandelovic and Bogunovich 2014 p.10).

Different agents had an influence of the nature of spatial transformation dynamics that took place, particularly in 1890s there was a rejection of further annexation of wealthier suburbs to form part of the greater city (Arandelovic and Bogunovich 2014 p.4). Similarly, just like any other city Berlin also experienced rapid urbanization due to industrial growth which also contributed to spatial transformation in Berlin. The central government and planning directions alluded the policy direction from the Hobrecht's plan had a significant influence in driving spatial transformation in Berlin (Arandelovic and Bogunovich 2014 p.4).

Real estate firms, private sector also harnessed this opportunity and began to buy land and develop dense housing units (Arandelovic and Bogunovich 2014 p.4). Massive spatial transformations were also evidenced driven by Hitler regime and the under the planning guidance of Albert Speer as Hitler's main architect. To add on, the "megalomaniac planning of the new capital city" Arandelovic and Bogunovich (2014 p.4) had a profound effect on spatial transformation in Berlin. In another perspective, the notion of megalomaniac city was attributed to the 'gold rush mentality', envisioning Berlin competing with big league cities of the world such as Paris, London, New York. Leading to massive urban renewal, redevelopment projects contributing to development of new residential units of more than 100 000 in the peri-urban areas (Bernt *et al.*, 2013 p.14) Spatial transformation in eastern Berlin was also driven by planning directions which focused on rebuilding industrial areas and compensation to the injustices from the division wall was the main driver for spatial transformation in either side of Berlin (Arandelovic and Bogunovich 2014 p.9). In another perspective, spatial transformation in Berlin was also driven by the central government vote to make it the capital of Germany (Arandelovic and Bogunovich 2014 p.11). Figure 3.4 shows empirical evidence on the structural changes of Berlin built-up areas.

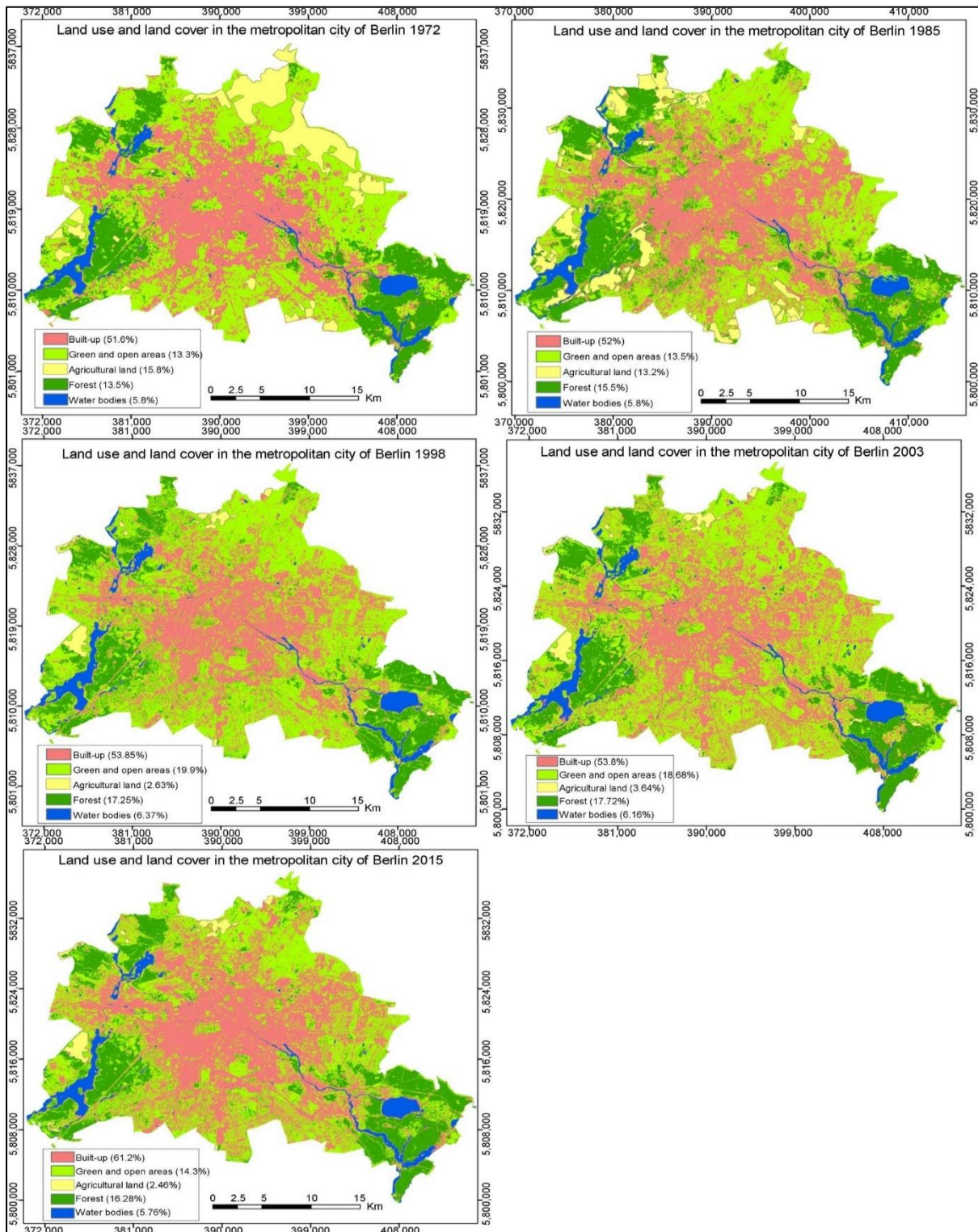


Figure 3.4: Structural spatial transformation of the Built-up areas in Berlin 1972-2015

Source: Mohamed 2017 p.360

Structural spatial transformation presented in Figure 3.4 shows that in 2015 the built-up area for Berlin increased to 61.2% (54 498ha) of the overall coverage area for the city from 51.6% (45 957ha) that was recorded in 1972. This lack of massive growth of the built up area is

attributed to the turbulent evolutionary process of Berlin, from World War II destructions, political contestations, division of the city and its reunification. Furthermore, the green spaces increased from 13.3% (11 846ha) in 1972 to 14.3% (12 734ha) in 2015; the agricultural land was lost from 14 072ha (15.8%) in 1972 to 2 191ha (2.46%). Interestingly, the forests coverage grew from 13.5% (12 024ha) in 1972 to 16.28% (14 497ha).

The implications of the structural spatial transformation led to political separation and spatial segregation, cultural division into two parts leading to lack of social cohesion between people belonging to one nation (Arandelovic and Bogunovich 2014 p.6). To add on, Gornig and Häussermann (2002 p. 331), states that governance systems and structural spatial transformations of Berlin's division for 40years had serious implications of being isolated from internal development, which also made the city to lose "its dominant position". Furthermore, the restructuring of Berlin after fall of the wall resulted in negative implications on other locations of the city which were closer to the wall, because people decided to relocate to other areas on the outskirts, (Bernt *et al.*, 2013 p.14). This implies the settlements and developments closer to the wall that divided Berlin suffered from dereliction as developments were being spatially targeted in other areas far away from this conflicted area.

3.3.1.3 Auckland New Zealand

The spatial configuration of Auckland, New Zealand was shaped by urban sprawl for several decades, mostly dominated family homes that were detached and having yards linked by a strong network of motorways and arterial roads. This made it one of the cities in the world that is highly dependent on cars, with limited users commuting by rail and bus. This is a result of the 1950's-80s automobile oriented transport spatial transformation policies (Salmon 2015 p.17; Early *et al.*, 2015 p.223). However there have been increasing calls for spatial transformation in Auckland for the previous "3 or 4 decades" Gu *et al.*, (2019 p.374) and ultimately, the mid-1990s witnessed a change in development ideologies. The Auckland Regional Council (ARC), began initiatives to drive spatial restructuring of the city through management of urban growth and development such as compact cities, urban limits, densification, intensification, concentration and corridor developments along existing public transport routes (Salmon 2015 p.17; Early *et al.*, 2015 p.223). However this was met with resistance by other agents of change namely; central government, North Shore City and residents. Similarly, in 1990s South African spatial transformation initiatives and practices were also met with resistance by various agents of change a movement famously known as not in my back yard (NIMBY).

According to Salmon (2015 p.18), the government of New Zealand legislated for the establishment of an integrated Auckland Council an abandonment of fragmented governance

systems, and concentrated powers in the Mayor's offices to facilitate "top-down decision-making and policy implementation." This implies promoting unitary governance systems to reduce tension, dilemmas and conflicts between multiple government sector departments and decentralization of powers from the central government. The vision of the new Mayor was similar to that of the previous Auckland Regional Council (ARC) and similar development ideologies. This development is similar to South Africa, the post-apartheid progressive policy frameworks retains the very same development trajectories which still perpetuates spatial injustices, marginalization of the poor. The legislation also mandated for the development of a spatial transformation strategic plan dubbed 'Auckland Plan' a discourse in itself, aimed at directing the management of urban growth and development. The plan promoted development of compact city, 75% of dwelling to be within existing urban limit, edge by the year 2040, grow-up not out. On the contrary, the strategy to grow up (vertically) was criticized by the public and Auckland council. This favoured their own quality compact city of less up and more outward (sprawling) developments of 160 000 (40%) dwellings. To add on, the strategic plan was also met with varying political support, the central government had a differing view to the plan. This clearly evidences the propositions of spatial dialectics and didactics theory that cities are characterized by contradictions of the desired spatial transformation, there is always dilemma between the agents of change and that it's a tension ridden process. Despite intensive public participation processes in developing, adoption and implementation of a strategic plan, the very same stakeholders resist implementation of the plans they put forward, a contradiction of 'what we want with really what we want'.

The Auckland strategic plan, was also focussed on spatial targeting of infrastructure development such as transport, particularly public transport as a catalytic programme for spatial transformation. The transport infrastructure developments included Britomart transport centre, commuter rail network electrification, western line double tracking, motorways. To add on another key transport programme is the development of Central Rail Link which gained central government support after being resisted several times (Salmon 2015 p.19; Early *et al.*, 2015 p.227). Another key implementation pillar is the 2013 Unitary Plan an augmenting strategic discourse to Auckland Plan. The spatial transformation ideologies, concepts and tools put forward include residential up-zoning, intensification, densification. Despite this plan being purported to be promoting compact city development, the reality is that it further promoted outward growth by increasing dwellings to be developed outside the urban limit, edge from the aforementioned 160 000 (40%) by the Auckland Plan to 270 000 (67.5%) dwellings (Salmon 2015 p.21; Early *et al.*, 2015 p.224).

Auckland city is also experiencing housing shortages, its population exceeded housing supply, ownership of homes declined. This housing crises is attributed to Auckland rapid urbanization

further exacerbated by price escalation of both houses and residential developable land (Terruhn 2020 p.134; Salmon 2015 p.2). Terruhn (2020 p.137) adds that the last 10 years evidenced 90% increase in house prices and a further 15-20% increase in rents in the last 5 years. In particular, (Cole 2017 p.3) substantiates that spatial transformation through gentrification in Auckland i.e. Glen Innes suburb 'hailed the greatest spatial transformation project of New Zealand', Hobsonville point resulted in negative implications on land values, to approximately \$1 million, from an average of \$400 000 around 2011. This clearly indicates that spatial transformation in relation to population increase has negative implications on housing supply and affordability. Collins (2010 p.940) states that international students influx in Auckland are also worsening housing demand "studentification" in the city. Thus, rapid urbanization is a concern around the world especially for developing countries that are not prepared to harness the opportunities and constraints associated with such population influx. To cater for the increasing housing demand, the Unitary Plan proposed liberalization of housing development rules to allow brownfield and greenfield housing development.

On the contrary, the government preferred addressing housing crises through ad hoc interim measures through the Housing Accord. The accord aimed to develop more houses, fast track housing delivery process, easy market pressures in line with desired spatial transformation as alluded by the Auckland Plan. To add on, the spatial targeting in brownfield and greenfield was also proposed of designating Special Housing Areas where processes of development are shortened to speed housing delivery. The policy directions also indicated that the following limitations, two storey mixed housing in suburban zone and maximum height of three storey mixed housing in urban zone. This implies increasing densification in the inner city where there is access to opportunities, limiting commuting and reduced transportation costs than promoting suburban developments that increases the cost of infrastructure and service provision. The plan also provided for identification of greenfield to be included in the urban fringe, which are regarded as potential future development areas. A process that helps direct the spatial structure of the city as it spatially grows, unlike sprawling without control which has undesired implications on the city (Salmon 2015 p.21-26; Early *et al.*, 2015 p.227).

Cities are complex systems with various agents, their interaction forges new emergence, self-organization and criticality of the ways in which cities spatially transform over time. Similarly Salmon (2015 p.27) posit that complex system of Auckland city influenced spatial transformation of the city in many ways. In particular; cultural norms such as strong preference of detached houses with yards and use of private cars contributed to spatial splintering of the city over the years. This resonates with 2012-14 survey report which showed that trip travel by car as the most dominant (77%), (18%) pedestrian, (4%) public transport and less than 1% for cycling (Ministry of transport 2015 cited in Salmon 2015 p.27). Rapid urbanization, in

Auckland also resulted in increased density over the years, a positive spatial transformation, changes in old cultural norms towards dense areas affordable areas and younger population a reflection on differences between different age groups (Early 2015 p.231). Similarly, rapid influx of international students in Auckland caused spatial transformation of the city through studentification, from construction of new-building apartments or student complexes (Collins 2010 p.946). Figure 3.5 shows the precincts in the CBD experiencing spatial transformation through studentification and its relative location to the universities.

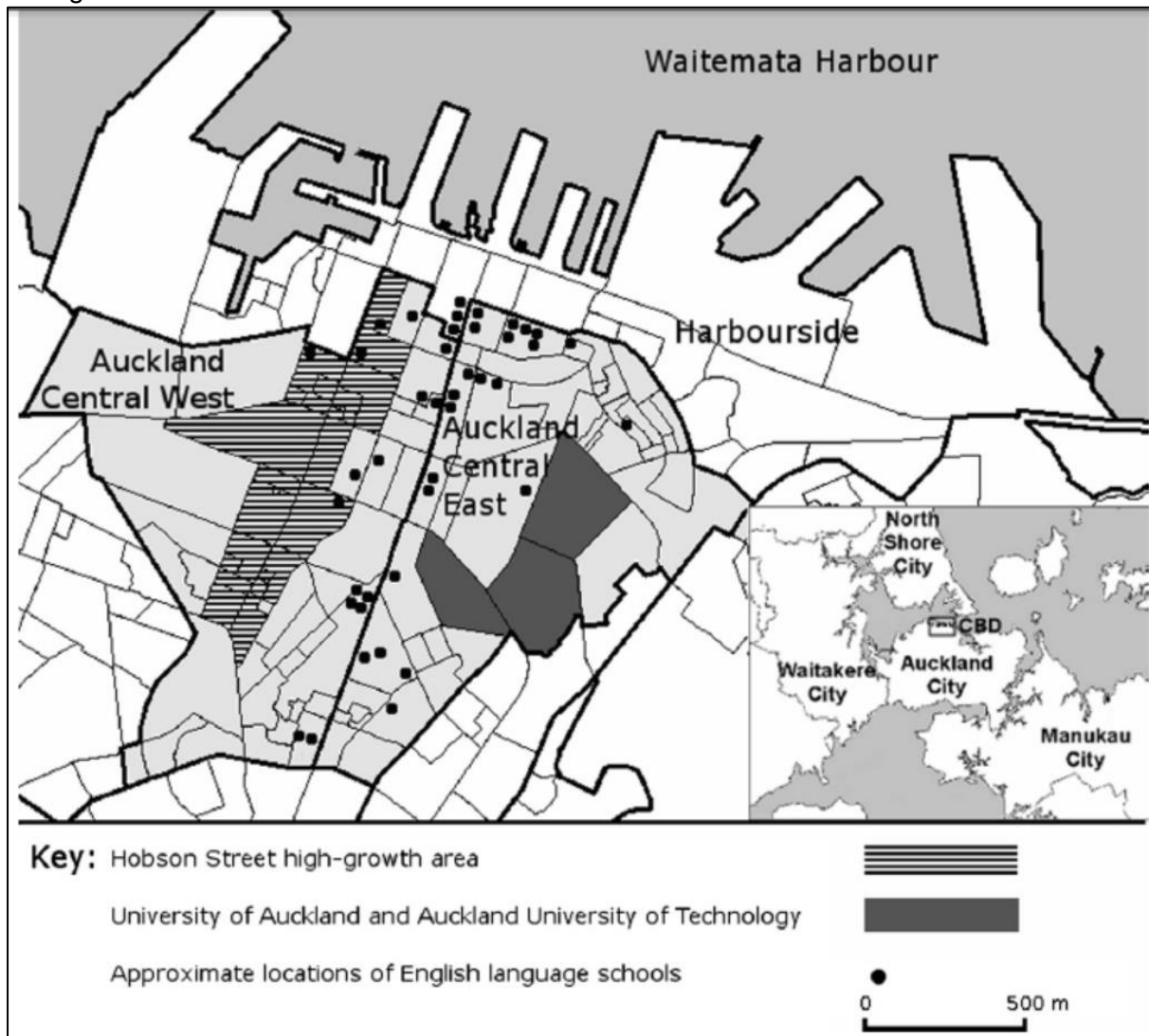


Figure 3.5 City texture: Studentification spatial transformation in Auckland CBD

Source: Collins 2010 p.943

Figure 3.5 shows that the area along Hobson street is experiencing spatial transformation through the development of student housing in the CBD. This shows that educational institutions play a significant role in influencing spatial transformation of their host cities. Furthermore, spatial transformation was also acknowledged as a threat to erosion of cultural character, urban texture and other high valued areas of the city. Hence their cultural norm was

to protect the erosion of such characters from degradation, which was also identified as being not adequately articulated by the Unitary Plan (Salmon 2015 p.28). Policy directions were also recognised as significantly influencing spatial transformation in Auckland. In particular, Auckland Unitary Plan provided for spatial targeting of Special Housing Areas, in brownfield and greenfield areas for housing development. To add on, Cole (2017 p.2) pointed out that the plan also proposed “inclusionary zoning” to facilitate inclusive development of affordable housing in Auckland. This policy also resulted in spatial transformation of the urban structure, the urban edge from the Metropolitan Urban Limit to the new Rural-Urban Boundary which extended the spatial coverage of the city. In another perspective, Salmon (2015 p.29) adds that local boards and residents had also a role to play in spatial transformation through pushing for planning restrictions in their areas. In addition, infrastructure development responsibilities are divided between multiple stakeholders, private developers, council controlled organizations, Auckland Council and the central government (Salmon 2015 p.33). This offers synergies, resilience, political will and shared infrastructure investments costs towards spatial transformation of the city. On the other hand, the Watercare Services a council controlled organization responsible for water infrastructure development pointed out that spatial transformation in the built up area of the city such as densification has negative implications on water provision (Salmon 2015 p.33). It suggested that proposed densification should be in phases so that they upgrade water infrastructure in stages unlike opening up the whole built up area for densification which strains the existing infrastructure and facilities. Similarly, on infrastructure investment, the New Zealand Transport Agency (NZTA) played a critical role in spatial transformation of Auckland (Salmon 2015 p.34). It is responsible for providing national highway road infrastructure, partly funding of public transport, development of local roads and also fund raising for infrastructure development. Salmon (2015 p.36); Early *et al.*, (2015 p.233); pointed out that spatial transformation in Auckland also resulted in negative externalities such as pollution, congestions, noise and greenhouse gas emissions. Furthermore, other implications of spatial transformation in Auckland that were identified include; accumulation by dispossession Cole (2017 p.7), increased value of land, constraints in financial markets, residential segregation (Salmon 2015 pp.39-51). Cole (2017 p.1) reiterates that the Unitary Plan further reinforces segregation through making Auckland, a liveable city for the following class of people; land owners, developers, and investors. This shows a spatial turn, retrospection is needed in order to understand how the planning discourse, tools are perpetuating and manifesting in injustices.

3.3.2 Developing economies

This section discusses spatial transformation dynamics in the following cities in developing economies, Curitiba Brazil, Hangzhou China, and Harare Zimbabwe.

3.3.2.1 Curitiba Brazil

Curitiba is heralded across the world as one of the best exemplar's of sustainable development (Rosário 2016 p.113; Duarte *et al.*, 2011 p.81); bus rapid transit cradle for the world (Lindau *et al.*, 2010a p.17). The city has over 50 years of enlightening urban planning in attaining various fronts, objectives, such as socio-economic, environmental and by extension spatial transformation. The revolution, radical intervention approaches that were adopted more than half a decade ago successfully resulted in spatial restructuring of Curitiba.

According to Rosário (2016 p.114; Duarte 2011 p.86) 1942 Agache Plan for Curitiba was a vision of radial city with a structure of concentric avenues that were wide, properly defined urban zones by function and largely reliant on automobiles, private cars. The implementation of the plan was faced with challenges of rapid urbanization in the 1960s when the population grew to an approximate of 400 000, (Rosário 2016 p.114). Ideally, this warranted a new approach to cope with the continued population growth estimated for the metropolitan area in 2018 to be 3 579 000 UN (2018 p.26); from the 1950's population of approximately 150 000 (Macrotrends 2020).

The agents of change that realised the need for a new approach with the anticipated population increase included local professionals and the city opened a bid for development of a new masterplan to guide spatial transformation amidst the rapid urbanization and deterioration of the city centre. The team that won the bid made a proposal that the city should establish the Institute of Research and Urban Planning of Curitiba (IPPUC- Instituto de Pesquisa e Planejamento Urbano de Curitiba) and it was created in 1965. This institute has been a strong pillar, driver for the successful spatial transformation of Curitiba, despite changes in the political climate over the years. Its critical role is to continuously monitor the city's spatial transformation process, adjust spatial transformation policies in changing economic, administrative and political climate (Rosário 2016 p.114).

The radical innovative approaches adopted to spatially transform Curitiba include, integrating land-use and public transportation, stimulating sustainable developments, decongestion of the CBD promoting pedestrianization, urban regeneration programmes, transforming of old quarries into public parks, teaching recycling at school as way of life, preservation of culturally significant buildings through the Transfer of Construction Potential, an incentive for transfer of development rights for retaining historic buildings from the 19th century (Rosário 2016 p.114).

The integrated land use and public transport of Curitiba emphasized growth on key structural axis, providing for the outward growth of the city ensuring high rise, dense developments promoting easy access to opportunities along the key corridors (Rabinovitch and Leitman 1996

p.48). The resultant Curitiba spatial transformations from the BRT are presented in Figure 3.6.

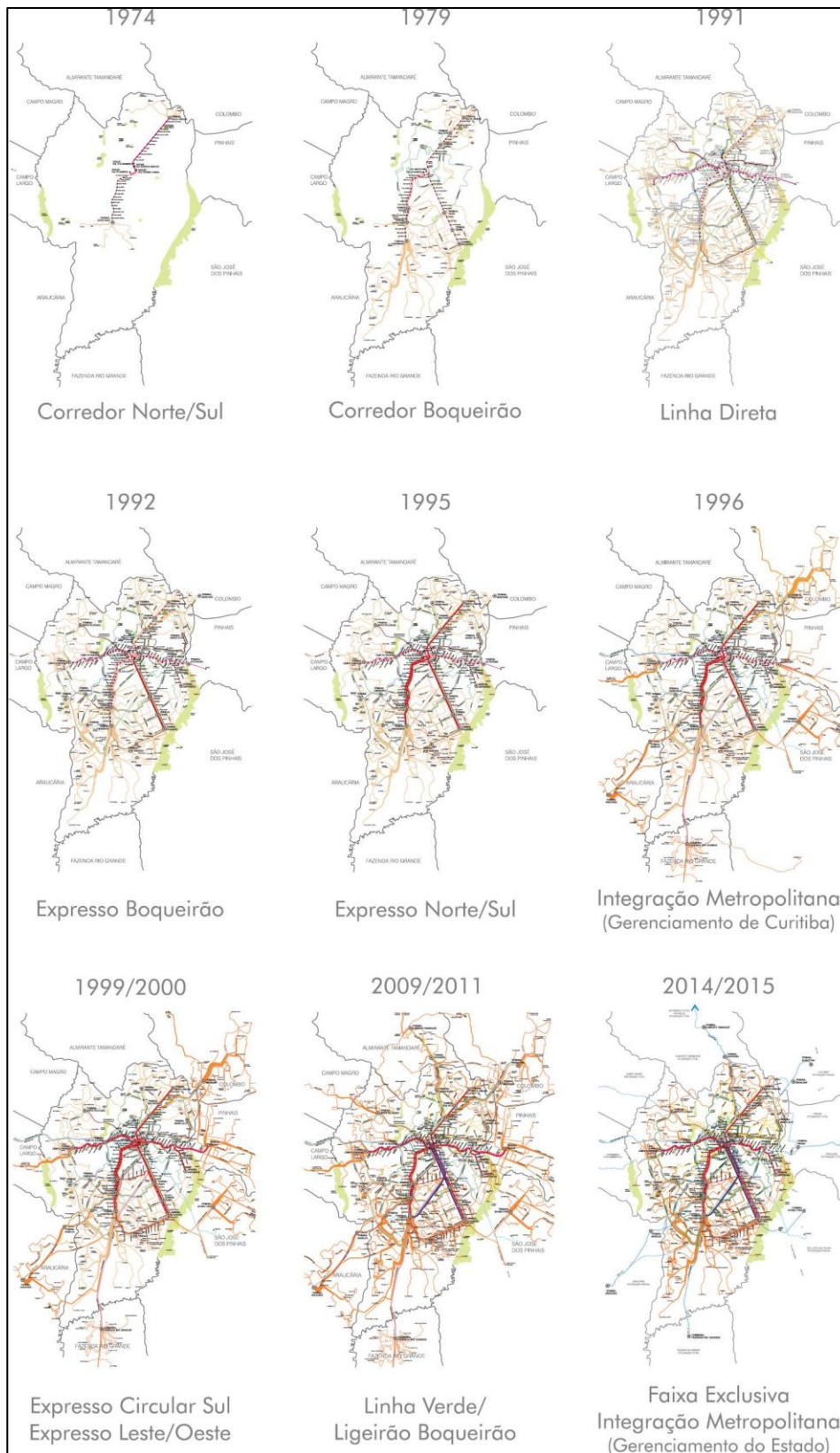


Figure 3.6 City structure: Transport network spatial transformation Curitiba 1974-2015

Source: URBS 2020

The incremental implementation and upgrading of bus rapid transit (BRT) integrated land use and public transport system as the city gradually grows is the key cornerstone of successful spatial transformation of Curitiba (Rosário 2016 p.115; Lindau 2010a p.17). The BRT system is supported by dedicated corridors of more than 83km, with above 350 stations and articulated buses with multiple doors to minimise boarding time (URBS 2020). The success of this system is further strengthened, by zoning legislations consolidating Curitiba’s radial five transportation corridors ‘structural axes’. In another perspective, the finer grained Curitiba city textural spatial transformations that are common along these corridor areas include, a linear transit oriented development (TOD) supported by a trinary road system on each of the key structural axes (Lindau *et al.*, 2010b p.276) as shown in plate 3.1.

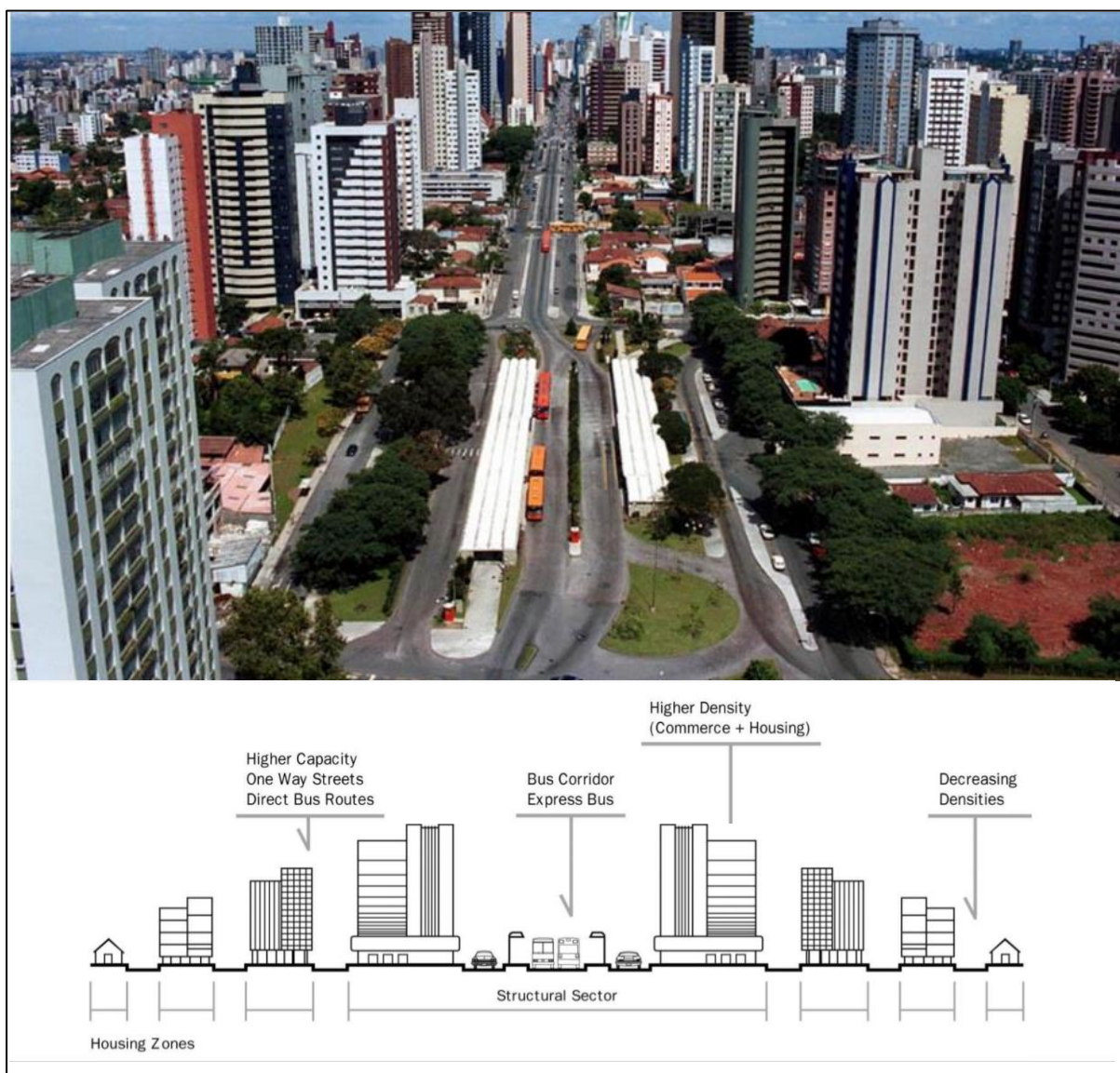


Plate 3.1 City texture: spatial transformation through TOD Curitiba

Source: URBS 2020

The linear TOD along the structural axis of Curitiba plays a critical role in spatially transforming the city texture. Plate 3.1 shows that, along the BRT structural axes corridors, a trinary system was developed, supported by 2 linear blocks of high intensity, high density, high-rise developments with mixed uses followed by gradually decreasing densities, lower building heights, as one moves away from the centre of the corridor. This concept successfully transformed the city texture as evidenced by URBUS photo image presented in plate 3.1. This implies integrated land use and public transport, TOD are crucial catalytic tools for spatial transformation of cities.

To add on, the success of the BRT is also influenced by externalities as agents of change, resulting in rapid spatial transformation of the city. This is noted in that, as cities are complex systems, this complexity is also linked to being part of the global village hosting the 2014 FIFA World Cup ensured the fast tracking of finances from the central government expediting infrastructure development in line with the spatial transformation plans of the city (de Oliveira Cavalcanti *et al.*, 2017 p.395; Rosário 2016 p.115). Part of the noticeable spatial transformation from this event were evidenced by airport improvements, avenues were widened, among others.

The continued growth of Curitiba as metropolitan city is considered having negative implications on the sustainability of one fare for any destination in the city. The outward expansion, longer travels trips and tripled number of users makes the one fare for all destinations to be unsustainable as the shorter trips can no longer adequately cover expenses for longer commuting distances, consequently tax payers money is now being used to bail out the system. The good quality life of Curitiba from its spatial transformation has also negative implications on the poor. Consequently, living costs have increased forcing low-income earners to live outside the city reinforcing spatial injustices, increased commuting hours (Rosário 2016 p.117). Zari (2018 p.170) reiterates that rapid urbanization in Curitiba has resulted in acute housing shortages, spatial segregation of the poor into informal settlements (favelas) just like any other cities in Brazil. To add on, this spatial targeting of development also results in lack of development in other areas of the city, and the increased population poses challenges of increased waste in the city (Rabinovitch and Leitman 1996 p.52)

Furthermore, BRT innovative responses to unprecedented rapid urbanization was not an easy road; various negative implications and barriers had to be resolved for the success of the system. According to Lindau *et al.*, (2010a p.23) some barriers that were met include: i) lack of planning capacity; this was resolved through participation of interested stakeholders, the creation of the IPPUC and URBS which are strong technical teams to manage, and monitor

the development needs of the BRT system in Curitiba, ii) opposition from transport industry leaders; the government made a coalition with the transport industry and also granted financial conditions that appeased the industry leaders, iii) limited funding access; forced adoption of sound financial management strategies, limiting costly road expansions, low cost design of bus stops, iv) resistance of paradigm shift; alternative modes of transport such as rail were rejected because they were too costly than upgrading the BRT system, v) structural corridor/axes lack of right of way; to counter this instead of developing new wider roads and existing roads were upgraded to trinary roads.

3.3.2.2 Hangzhou China

Qian (2012 p.431) epistemological dimension on approaching spatial transformation, reveals that even in China the understanding of cities is also skewed towards the major cities, and realities of intermediate or provincial cities is vague. Hence the spatial turn, and emerging analysis on restructuring of provincial cities is helping fill this knowledge gap particularly Hangzhou. China's incredible economic transformation over several past decades resulted in spatial transformation of the metropolises, particularly Zhejiang province capital Hangzhou, also known as China's ancient capital (Wei 2012 p. 396-8; Fan et al 2012 p.6).

The central government of China provided the overall frameworks and directions driving development and spatial transformation in the process of cities transition from socialist to post-socialist urban spaces amidst rapid urbanization. Whereas, the triple process reform of globalization, marketization and decentralization is also empowering local cities administrations as major agents, drivers of change focusing on local economic and spatial developments, guiding investments from private sector in line with national and local spatial transformation directions (Wei 2012 p.397).

Since 1980s, Hangzhou experienced significant spatial transformation in its attempt to find its position, survival strategies for, economic development, urban growth, against its competitor Shanghai and globalization at large (Wei 2012 p. 398; Qian 2012 p.432). In this pursuit several spatial transformation initiatives, programmes were rolled out, notably;

Hangzhou transformation into a world-class tourism city; various infrastructure development projects were undertaken to position itself as tourist destination by opening of museums; beautiful landscape developments; upgrading of historic sites, new sites were identified, and added to list of tourist and cultural sites, temples; hand craft industries and development of shopping centres (Oranje 2014 p.47; Wei 2012; 399). Some of the tourism related spatial transformation projects that were initiated include; Xixi Wetland 2005, 11.5km²; Hangzhou

Paradise 1999 1.3km²; Hangzhou Future World 1997 0.25km²; and Song Dynasty City 1996 0.4km² (Wei 2012 p.400).

Rescaling of administrative geography;- another spatial transformation approach adopted was rescaling of administrative authority in line with central policy directions; redetermination of jurisdictional boundaries to increase control over a bigger area. Qian (2012 p.432) points out that through rescaling around 2001, Hangzhou's land area grew to 3068km² from 683 km². Consequently leading to increased availability of land for further developments of suburbanization as part of the broader city's process of economic growth and spatial transformation (Wei 2012 p.401). Consequently this made land to be available for construction of new towns making it possible for spatial restructuring of the city through polycentric developments. To add on Zhang *et al.*, (2018 p.99) digitized municipal land survey maps and established that Hangzhou built-up land area spatially transformed to approximately 390km² in 2010 from 150km² in 2000.

Promotion of polycentric developments;- commonly most cities in China are dominantly characterized by a single core. Similarly Hangzhou pre-1990s main urban restructuring focus was on the inner city, interestingly around mid-1990's spatial transformation focus changed (Wei 2012 p.400; Qian 2012 p.432). It made a spatial turn from a monocentric compact city to polycentric development of multiple new towns and industries as activity nodes that are linked together, distributing opportunities across a wider geographical area opposed to concentration of opportunities at the city core (Wei 2012 p.400; Liu et al 2011 p.718).The new towns that were developed contributing to polycentricity and overall spatial transformation of Hangzhou include; Linping (2010 7.5km²); Dajiangdong (2009 500km²); Linjiang (2003 160.2 km²) and Qianjiang (2001 21km²) (Wei 2012 p.400; Qian 2012 p.443).

Hangzhou also adopted urban restructuring strategies such as urban development zones the spatial targeting of certain areas as special economic zones for high-tech, enterprise developments, to attract foreign investors (Zhang *et al.*, 2018 p.104; Wei 2012p.400; Qian 2012 p.432). Hangzhou Economic and Technological Development Zone (ETDZ) (1993 104.7km); Hangzhou High-Tech Zone 1990; 1997 Binjiang; Xiaoshan Economic and Technological Development Zone 1990 - Shibe: 9.2km, Qiaonan: 18.8km -Jiangdong: 105km; Zhijiang Tourism and Vocation Zone (1992, 9.88km) (Wei 2012 p.400).

Other spatial transformation development projects include establishment of education districts, to harness the active role of institutions of higher education in a knowledge economy as incubators of innovation, research and development (Wei 2012 p.400). The institutions districts developed over the years include; Binjiang Higher-Educational District 1.82km²;

Xiaoheshan Higher-Educational District 4.96km²; Zhejiang University-Zijingang Campus (2001, 2.06km²); Xiasha Higher-Educational District (2000, 10.91km²).

Development of a new CBD, the Qianjiang New Town to free up space and attract other businesses, tourism a similar approach to that of other cities in China, particularly Pudong district in Shanghai (Oranje 2014 p.48; Wei 2012 p.402). Furthermore, infrastructure developments were also undertaken facilitating structural spatial transformation of Hangzhou, which includes; Shanghai-Hangzhou High Speed Railway 2010; Hangzhou East Railway Station 2008; and Xiaoshan International Airport 2000 (Wei 2012 p.400).

In another perspective, Fan *et al.*, (2012 p.6); Liu *et al.*, (2011 p.708), pointed out other policy directions that influenced spatial restructuring includes the central state test piloting of land banking, land trusts and bonds to finance land required for development and spatial transformation of Hangzhou. To add on, Liu *et al.*, (2011 p.721), points out that spatial restructuring of Hangzhou, was also influenced by private sector role in urban development. Liu *et al.*, (2011 p.706) also points out that the other drivers of spatial transformation of Hangzhou include, easy accessibility, employment opportunities, establishment of industrial activities, road infrastructure, spatial planning policy directions, markets, the Qiantang River. These initiatives, developments discussed in relation to Hangzhou China contributed to spatial transformation over the years.

Figure 3.7 evidences how the structure of the built-up area of Hangzhou have spatially transformed between the years 1983-2008. Hangzhou spatially transformed from a monocentric built-up city centre around 1983 in light shed of grey around West Lake to a polycentric city sprawling over a larger area as of 2008. The city gradually grew in all directions splintering to the outskirts, as facilitated by the newly developed special economic zones. In particular, there is evidence of massive spatial transformation around the Xiashan ETDZ, Hangzhou ETDZ on the eastern side of Hangzhou, and further on southern side of the city.

Theoretically, using the lens of spatial turn, a retrospection of the processes of spatial transformation points to a myriad of challenges being experienced in Hangzhou, China. In particular, the growth and development trajectory is considered, unsustainable and the city in general not liveable for the urban poor (Wei 2012 p. 407). This manifests in injustices in the city, failing to provide adequate residential places, public spaces, and transportation. Furthermore, Hangzhou economic growth and rapid urbanization caused the boom of real estate business, resulting in sky rocketing of property prices particularly around the West Lake area, more than tripled in other suburban areas (Wei 2012 p.403; Liu *et al.*, 2011 p.718). In 2009, the prices of apartments had increase 10 times fold to US\$400/ft² in previous 10 years (Wei 2012 p.403). Similarly, this increased expenses on life is affecting the poor and lowly

paid working class. Increased rapid urbanization also affected the city by putting pressure on provision of services, the environment, agricultural land was lost, water bodies, lack of services, and social life, cohesion (Wei 2012 p.404).

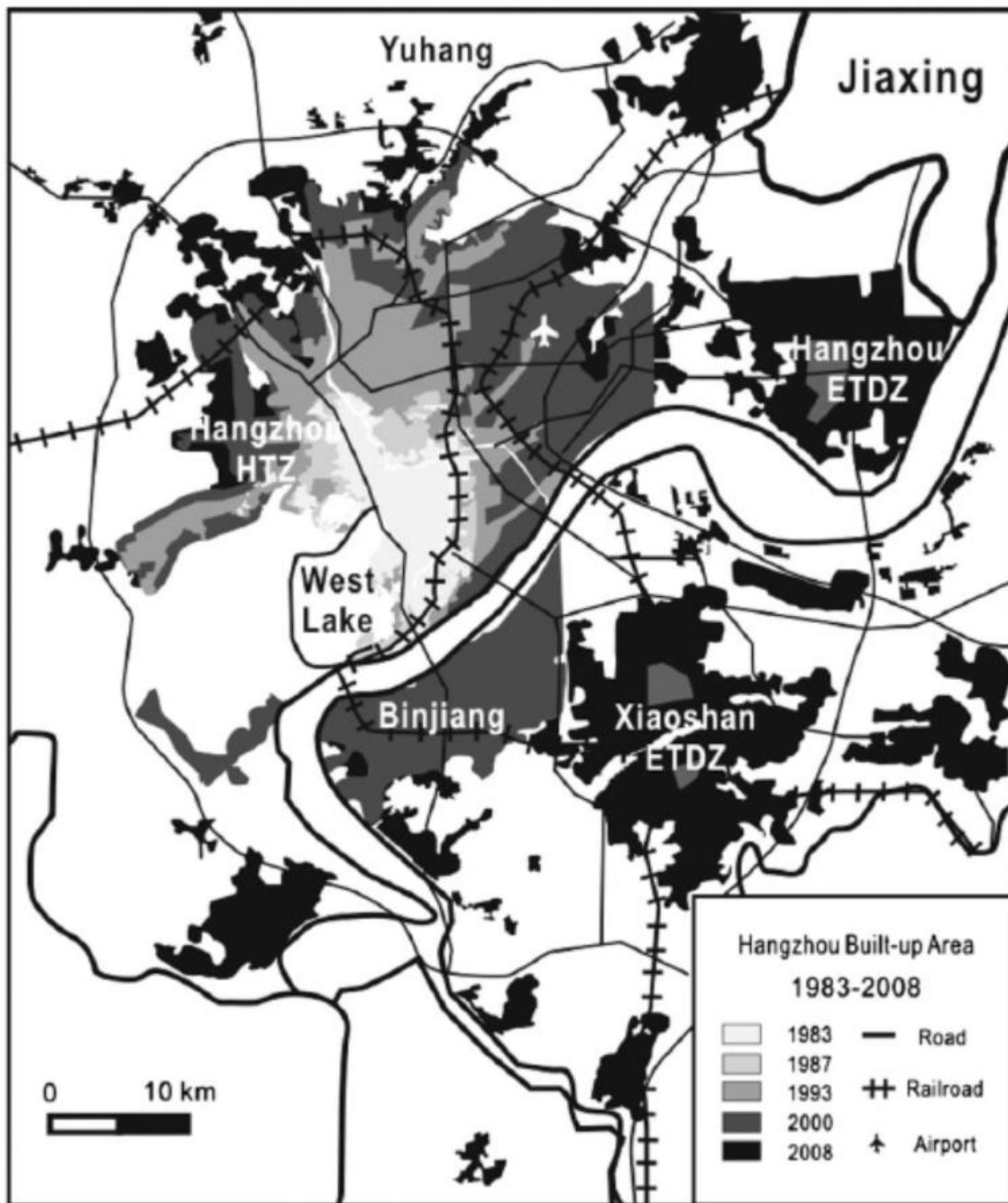


Figure 3.7: Spatial transformation of built-up areas Hangzhou 1983-2008

Source; Wei 2012 p.403

To add on, the competition for investment with other bigger strongly established city economies such as Shanghai is becoming costly, wasteful of financial resources that can be redirected to improve quality of lives of the poor and addressing growing environmental related problems (Wei 2012 p.404). Urbanization and spatial transformation also exerted pressure on

the growth of the CBD, a new CBD had to be developed resulting in construction of the Qianjiang New Town. Spatial transformation in Hangzhou also resulted in negative implications as some of the historical and cultural sites were destroyed. Wei (2012 p.400) reiterates that along the internationally known Grand Canal, only a few historical sites still exist, other historical neighbourhood buildings were demolished for development. To add on, there are no more historical, cultural buildings on the newly built Song Dynasty city as it was redeveloped on a farmland from scratch (Wei 2012 p.400).

3.3.2.3 Harare Zimbabwe

In line with, Muronda (2008 p.36) spatial transformation dynamics in Harare can be described in 3 epochs namely; 1st epoch 1890-1946, 2nd epoch 1946 to 1980, and the 3rd epoch 1980-post-independent to present time.

1st epoch 1890 to 1946

The 1st epoch 1890-1946 witnessed slow rate of spatial transformation in Harare. In 1890 about 8 150Ha (81.5km²) of land was reserved by the pioneer column 'British migrants' for urban development, separated from farmlands that surrounded the area (Muronda 2008 p.37). The structure of the area was characterized by various open spaces, isolated infrastructure, few residential buildings, grocery stores, a main street (Mudimu 1989 cited in Muronda 2008 p.37). The demographic distribution in relation to race was largely composed of whites (90%), mostly immigrants from Britain. The area began to experience urbanization attributed to increasing migrants over the years, from around the world United Kingdom, India, Portugal (Muronda 2008 p.37). This increasing population led to spatial transformation of the city through outward expansion. It is argued that the lack of availability of expected quantities of mineral reserves in then Salisbury (now Harare) turned the pioneer columns to agriculture making the town's economy to be dominantly agrarian (Muronda 2008 p.36). Furthermore, other minimal spatial transformation took place because of the development of railway infrastructure around 1888 by British South Africa Company (BSAC). In 1935 a city status was granted to Salisbury, although the population was below 20 000 (Muronda 2008 p.38).

2nd epoch 1946 – 1980

The period after 1946 saw spatial transformation resulting in the disappearance of open spaces, reduced isolation and concentrated infrastructure development in the city centre. Furthermore, economic functions started to diversify from the dominance of agrarian activities. The infrastructure developments that drove spatial transformation include, construction of government buildings, more roads, the first international airport was built in around 1951 increasing mobility and accessibility.

Around 1960s the manufacturing sector grew, attracting in migration of semi-skilled labour required in the manufacturing sector. Demographically, this resulted in spatial transformation of the racial composition of the overall city because of increased black migrants coming for employment opportunities. In response to the increasing migrant workers, and colonial ideologies of racial segregation, segregated townships were established contributing to further spatial transformation and expansion of the city (Kamusoko *et al.*, 2013 p.324). The high density black townships that were created include site and service scheme Dzivarasekwa, Kambuzuma, Marimba Park, Highfield and Mbare; low density suburbs created for the white colonial community include Marlborough, Mt Pleasant, Mabelreign, Hatefield and Borrowdale and the townships created for the mixed race include Cranborne, Arcdia, Breaside just to mention a few (Munzwa and Wellington 2010, p.133; Muronda 2008 p.38). To add on, in 1970s Chitungwiza city with a population of approximately 15 000 emerged out of the growth of St Mary's and Seke townships. These townships were established by the colonial government, locating Africans approximately 25km far away from Harare CBD and specially designated for churches and missionary services (Kamusoko *et al.* 2013 p.324). Furthermore, spatial transformation of Harare was also increased by the establishment of an informal settlement, Epworth by war refugees attributed to 1970's liberation war struggles (Kamusoko *et al.*, 2013 p.324).

3rd epoch Post-independence

During this post-independence epoch, the notion of spatial transformation was to reorganise the society, improve the economy in line with the ideologies, objectives, political interests of the ruling party (Muchadenyika and Williams 2017 p.34). Interestingly, around 1980s, spatial transformation had made an urban conurbation to be evident characterized by a clearly defined CBD. In this era, spatial transformation is also noticeable on the urban texture, particularly more high rise buildings, and increased urban density. Demographically, the city transformed into a multi-racial society. Furthermore, spatial transformation through sprawling was also evidenced in this era. The higher income social class moved to the outskirts of the city developing new suburbs escaping various issues that emerged from rapid urbanization of the city such as congestion.

Soon after the 1980's Zimbabwe's independence migration controls were abolished and the city experienced rapid urbanization due to influx of rural migrants (Marondedze and Schutt 2018 p.3). Rapid urbanization in post-independence contributed to extensive spatial transformation of areas around Epworth because people who could not secure accommodation in the city were relocated to this unplanned informal settlement (Kamusoko *et al.* 2013 p.324). Consequently, this rapid urbanization and sprawling of the city in post-

independence caused the redetermination of the cities boundary over the years (Munzwa and Wellington 2010 p.138).

In another perspective, the spatial transformation of Harare in the 3rd epoch, post-independence is further substantiated by the work done by Marondedze and Schutt (2018 p.8) as shown in Figure 3.8.

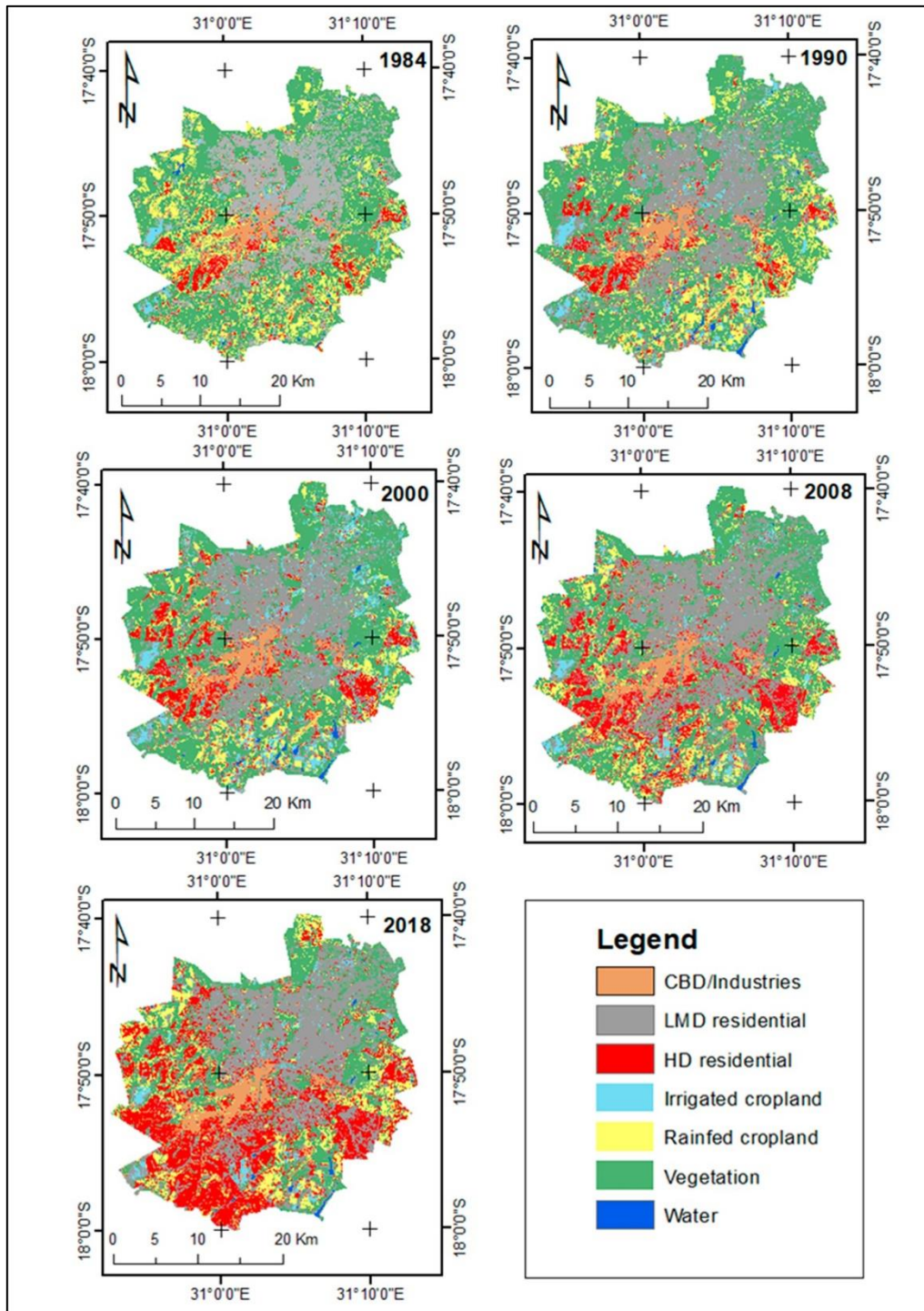


Figure 3.8: Spatial transformation in Harare

Source: Marondedze and Schutt (2018 p.8)

Remote sensing and geographic information systems (GIS) was employed to indicate spatial transformation of land uses in Harare between 1984 and 2018. The net land use area spatial transformations presented in Figure 3.8 are that; the CBD and industrial area slightly increased to 7.17% in 2018 from 3.7% in 1984; high-density residential suburbs (HD) grew considerably to 24.50% in 2018 from the land area coverage of 5.81% in 1984. Another noticeable decrease in land area is the spatial transformation of vegetation land from 50.35% in 1984 to a land cover of 25.08% in 2018. Similarly, another loss was recorded in rainfed crop land 15.85% in 1984 to 10.47% in 2018 and water bodies decreased from 3.60% in 1984 to 0.31% in 2018 (Marondedze and Schutt 2018 p.9). Adding to this, Marondedze and Schutt (2018 p.11) argues that the drivers of these spatial transformations include; availability of road infrastructure, gentleness of slopes, and informal settlements growth.

These substantial spatial transformation in low density areas are best explained by the various post-independence spatial transformation programs that were initiated by the central government; The 1990s Economic Structural Adjustment Programme (ESAP); facilitated spatial transformation because non-residential activities were permitted in the residential areas. These informal city evolution activities of self-organization from interaction of agents of change had started long before 1990 which include, development of offices and shops; medical centres and institutions; general maintenance and warehouses; home industries as indigenisation and economic empowerment, inline with the statutory instrument 216 of 1994 (Muchadenyika and Williams 2017 p.35). To add on, Fast Track Land Reform Programme (FTLRP) 2000s, was political programme which had far reaching spatial transformation implications. This programme disregarded planning systems leading to development of unplanned human settlements, including peri-urban areas causing spatial splintering of the city. Over this had negative implications because of lack of infrastructure developments, services, water, electricity among others (Muchadenyika and Williams 2017 p.34).

Furthermore, Post-2000 is also known of the ruling political party interfering in planning promoting illegal occupation land, leading to considerable spatial transformation in the city, (Muchadenyika and Williams 2017 p. 34). Other peri-urban developments that increased the rate of spatial transformation were also a result of the parallel planning by central government ministry mandate of delivering services and planning and development without involving local municipalities. The planned open and recreational spaces in the residential areas were further converted to other built-up uses, causing spatial transformation in terms of change of use in the Regional Town and Country Planning Act (RTCPA) of Zimbabwe (Muchadenyika and Williams 2017 p. 35). Housing cooperatives established on political basis of the ruling party in disguised agenda of housing provision also disregarded planning systems. These cooperatives also engaged in allocation of land, designing layouts and approving house

developments leading to rapid spatial transformation in urban areas (Muchadenyika and Williams 2017 p. 35).

Consequently, rapid urbanization in the city resulted in various implications, the city exceeded its carrying capacity (Muronda 2008 p.39). This implies overloading of basic infrastructure and services, transport services became stressed, and maintenance challenges arose. The economy became stagnant, started going down, the number of unemployment increased, there is huge disparity between the rich and the poor, informal settlements mushroomed all over the city, causing environmental degradation. In particular, the population influx in Epworth an unplanned and informal settlement, implied increased number of people without access to basic services, sanitation, clean water, and no community facilities (Kamusoko *et al.*, 2013 p.324). To add on, Marondedze and Schutt (2018 p.11) indicates that spatial transformation of Harare through the built-up area expansion resulted in loss of water bodies, cropland and vegetation. This challenge of reduced water bodies is strongly affecting Harare because most households have not received tap water over the years. On the other hand, political interference in spatial transformation planning impacted negatively on the planning practice impinging on the responsibility of planning resulting a myriad of social issues because of lack of proper planning. Wetlands are also being lost because of political interference in land allocation leading to an unsustainable growth path (Muchadenyika and Williams 2017 p. 37). Furthermore, Munzwa and Wellington (2010 p.139) pointed out that the implications of spatial transformations include urban poverty; increased crime rate, informal business and shortage of housing, ruralisation of the city core, shortage of electricity, and illegal land subdivision.

3.4 Emergent and emerging lessons from case study reviews on spatial transformation discourses

Case study reviews on spatial transformation dynamics, corroborates that the classical urban land use models of 1920's grounded on Chicago City are inadequate, limited in explaining the emergent spatiality's in contemporary cities. The emergent lessons from literature review on spatial transformation case studies guided by informed grounded theory and content analysis in relation to study objectives can be summarised as follows;

3.4.1 Policy directions for spatial transformation

It is evident from the case studies literature review that policy directions provide a pathway for spatial transformation rather than the classical norm of organic growth, invasion and succession. In particular, the Official Plan of Toronto channelled development in certain nodes and suburbs, 'Auckland Plan' and the 2013 Unitary Plan promoted spatial targeting (Early *et al.*, 2015 p.224). To add on, policy directions in Curitiba resulted in development of the most successful bus rapid transit (BRT) system a cradle for the world (Lindau *et al.*, 2010a p.17).

Furthermore, Rosário (2016 p.114); Duarte (2011 p.86) pointed out that the 1942 Agache Plan for Curitiba was a vision of radial city. Interestingly the spatial structure of Curitiba resembles a radial city with structural axis radiating outwards from the city centre. In addition to the policy direction of promoting linear TOD along the structural axis of Curitiba played a critical role in restructuring the city. Similarly policy directions in Hangzhou pre-1990s changed urban restructuring focus on the inner city, monocentric developments towards polycentric developments by spatial targeting which promoted industry growth, establishment of new towns, and education institutions, (Wei 2012 p.400; Qian 2012 p.432; Liu et al 2011 p.718; Rabinovitch and Leitman 1996 p.52). To add on, Fan *et al.*, (2012 p.6); Liu *et al.*, (2011 p.708), pointed out that other policy directions that influenced spatial restructuring includes the piloting of land banking, trusts and bonds to finance land required for development and spatial transformation of Hangzhou. Furthermore, Zimbabwe’s policy directions of 1990s Economic Structural Adjustment Programme (ESAP), Fast Track Land Reform Programme (FTLRP) 2000s, had far reaching implications on spatial transformation. The policy directions disregarded planning restrictions imposed on the use of land facilitating incompatibility of land use such as permitting non-residential activities within residential areas. The FTLRP, policy directions promoted land inversion, development of unplanned human settlements, causing spatial splintering of the city.

3.4.2 Spatial transformation indicators

The emerging lesson on spatial transformation indicators from literature review on the case studies conforms to the conceptualized aspects to track and understand spatial transformation namely; demographic distributions, urban structure and urban texture. Methodologically, the identified examples from case study reviews demonstrate approaches that can be adopted to map and provide empirical evidence on spatial transformation in cities. Table 3.1 provides examples of spatial transformation indicators identified in the case study reviews.

Table 3.1: Spatial transformation indicators

Aspects of spatial transformation mapping triad	Spatial transformation indicators	Lefebvre’s Triad-‘Spatial practice’-Maps of spatial transformations
Demographic distributions	Population changes, (Arandelovic and Bogunovich 2014 p.2; Maronedze and Schutt 2018 p.3);	-
City structure	Built-up area growth (Arandelovic and Bogunovich 2014 p.2); Mohamed 2017 p.360; Wei 2012 p.403 boundary changes, Arandelovic	Figure 3.3 built-up areas Toronto, Figure 3.4 built-up areas Berlin,

	and Bogunovich 2014 p.4; Bernt <i>et al.</i> , 2013 p.12; Cole (2017 p.2); Qian (2012 p.432), transport network,	Figure 3.6 transport network Curitiba Figure 3.8 built-up areas Hangzhou Figure 3.9 built-up areas Harare
City texture	Density-population, dwellings, (Arandelovic and Bogunovich 2014 p.4; Early <i>et al.</i> , 2015 p.231; building heights Collins 2010 p.946, architectural changes (Arandelovic and Bogunovich 2014 p.2; city blocks (Arandelovic and Bogunovich 2014 p.4)	Figure 3.5 Studentification Auckland CBD Plate 3.6 TOD Curitiba

Source: Author, 2020

Table 3.1 shows that from the case study reviews, spatial transformation indicators identified conforms to the broad categories of demographic distributions, city structure and city texture. In particular, the city structure spatial indicators identified are changes in built-up areas, city boundary changes, and transport networks. To add on, using the lens of Lefebvre's spatial triad, 'spatial practice' maps have been identified to represent the reality of spatial transformation. In particular table 3.1 listed that the maps presented in literature shows spatial transformation in built-up areas; and transport network changes. These evidences from case study reviews entails that the conceptual approach of spatial transformation indicators can be adopted in this study to generate empirical evidence on spatial transformation in small and intermediate cities, by extension City of Polokwane.

3.4.3 Drivers of spatial transformation

The emergent trajectories of spatial transformation are driven, created and recreated by the interactions between the different agents, the governance systems, discourses embedded in the complex parts of cities' economic, cultural, social, and political system as a whole. This entails that there is no single pathway to spatial transformation in cities as purported by the classical land use theories for organic growth, invasion and succession. The complex nature of cities, different development contexts, and trajectories plays a major role in setting the tone for urban restructuring in line with the ideologies of the political leadership (Li & Li, 2009 cited in Wei 2012 p.397). Thus, different factors and drivers influence spatial transformation, however their level of significance and influence differs across different scales of cities and time (Turok, 2014, p. 81). Table 3.2 provides a summary of the drivers identified from the case studies.

Table 3.2: Drivers of spatial transformation

Drivers	Factors (if <i>x</i> then <i>y</i>) where <i>x</i> is factor and <i>y</i> is spatial transformation	Source
Governance/ political	State control	Ibrahim 2017 p.16; Arandelovic and Bogunovich 2014 p.2; Salmon (2015 p.18); Wei 2012 p.397
	Spheres of government/institutional design, boundary determination	Arandelovic and Bogunovich 2014 p.4; Qian (2012 p.432)
	Allocation of resources	Salmon 2015 p.33
	Administrative level	Wei 2012 p.397
	Fiscal expenditure	de Oliveira Cavalcanti <i>et al.</i> , 2017 p.395; Rosário 2016 p.115
	Design and implementation of policies	Arandelovic and Bogunovich 2014 p.4; Early <i>et al.</i> ,2015;
	Ideology of political organizations, private sector	Liu <i>et al.</i> , (2011 p.721), Kamusoko <i>et al.</i> , 2013 p.324
Spatial characteristics/ biophysical factors	Physical characteristics of the area	Wheeler (2003 p.330)
Social and cultural norms	Migration, demographic changes; Urbanization	Stats Canada 2016 p.8; Early, <i>et al.</i> , 2015; Wheeler (2003 p.330); Arandelovic and Bogunovich 2014 p.4; Rosário 2016 p.114; Zari (2018 p.170); Wei 2012 p.404; Muronda 2008 p.37
	Preferences (living areas, driving)	Stats Canada 2016 p.8; Salmon (2015 p.27)
	Income and employment	Liu <i>et al.</i> , (2011 p.706),
	Community organization, housing cooperatives	Muchadenyika and Williams 2017 p. 35
	Housing development	Arandelovic and Bogunovich 2014 p.4; Bernt <i>et al.</i> , 2013 p.14;
Economic drivers	Employment opportunities	Zhang <i>et al.</i> , 2018 p.104; Wei 2012p.400; Qian 2012 p.432 ; Liu <i>et al.</i> , (2011 p.706),
	Technology	Wheeler (2003 p.330)
	Market forces (increased real estate prices), property markets.	Stats Canada 2016 p.8 ; Early <i>et al.</i> ,2015; Liu <i>et al.</i> , (2011 p.706),
	Suburbanization	Micheal <i>et al.</i> , (2011 p.110);
	Attractive city life	Rosário 2016 p.117).
	Change in economic function of city	Wei 2012 p. 396-8; Fan et al 2012 p.6
	Private sector investment,	Arandelovic and Bogunovich 2014 p.4
	Infrastructure development	Stats Canada 2016 p.16; Arandelovic and Bogunovich 2014 p.5; Salmon 2015 p.19; Early <i>et al.</i> , 2015 p.227; Oranje 2014 p.47; Wei 2012; 399; Liu <i>et al.</i> , (2011 p.706),
	Industrial development	Arandelovic and Bogunovich 2014 p.4; Zhang <i>et al.</i> , 2018 p.104; Wei 2012p.400; Qian 2012 p.432; Liu <i>et al.</i> , (2011 p.706),
	Education and health facilities	Wei 2012 p.400
Gentrification, Urban renewal;	Bourne <i>et al.</i> , 2003 p.263; Grant 2002 p.75). ; Ibrahim (2017 p.8) ; Arandelovic and Bogunovich 2014 p.12 ; Cole 2017 p.3	

Source: Author, 2020

Table 3.2 shows that the identified drivers can be broadly categorised as governance and political, spatial characteristics/biophysical, social and cultural norms, and economic drivers. This provides the researcher with a lens to understand spatial transformation in the case setting.

3.4.4 Implications of spatial transformation

In line with right to the city, critical urban theory, theory of change there is need to evaluate the outcomes of change initiatives, desired city future an outcome of interaction between change agents. Table 3.3 outlines the identified implications from case study reviews.

Table 3.3: Implications of spatial transformation

Implications	Factors	Sources
Environmental	Air pollution, Environmental degradation, Forest reduction, Waste sink reduction	Ibrahim 2017 p.8; Stats Canada 2016 p.13; Salmon (2015 p.36); Early <i>et al.</i> , (2015 p.233); Rabinovitch and Leitman 1996 p.52; Maronedze and Schutt (2018 p.11)
Economic	Traffic congestion	Ibrahim 2017 p.12; Stats Canada 2016 p.14; Salmon (2015 p.36); Early <i>et al.</i> , (2015 p.233);
	Long travel hours	Ibrahim 2017 p.8; Stats Canada 2016 p.14; Rosário 2016 p.117).
	High transport costs/ and provision of public transport	Rosário 2016 p.115
	Infrastructure backlogs, pressure on existing infrastructure	Wei 2012 p.404; Munzwa and Wellington (2010 p.139)
	Urban renewal	Gu and Shen 2003;
	Decline of city centre	Munzwa and Wellington (2010 p.139)
	Shortage of parking	Stats Canada 2016 p.14
Social	Social inequality/polarization	Cole 2017 p.3; Ibrahim (2017 p.8); Walks 2001 p.436; Brushett 2001 p.18);
	Studentification	Collins 2010 p.946;
	Loss of cultural character	Salmon 2015 p.28; Collins 2010 p.946; Wei (2012 p.400
	Lack of safety	Munzwa and Wellington (2010 p.139)
	Inadequate basic services	Wei 2012 p.404; Muchadenyika and Williams 2017 p.35)
	Informal settlements development, informality	Kamusoko et al 2013 p.324).; Munzwa and Wellington (2010 p.139)
	Loss of open spaces	Stats Canada 2016 p.8; Ibrahim (2017 p.14); Wei 2012 p 407
	Poverty	Ibrahim (2017 p.8); Munzwa and Wellington (2010 p.139)
	Loss of affordable housing, exorbitant property prices	Cole 2017 p.3; Ibrahim (2017 p.11); Stats Canada 2016 p.14; (Terruhn 2020 p.134; Salmon 2015 p.2
	Housing backlogs	Terruhn 2020 p.134; Zari (2018 p.170)Ibrahim 2017 p.8; Stats Canada 2016 p.14.; Salmon 2015 p.2;
Poor territorial cohesion	Ibrahim 2017 p.8; Stats Canada 2016 p.14	
Governance/ policy	decentralization	Salmon (2015 p.18)
	Development conflicts/ structural class conflicts	Arandelovic and Bogunovich 2014 p.6); Lindau <i>et al.</i> , (2010a p.23)
Spatial planning, monitoring, evaluation	Limited funding, wasteful expenditure	Wei 2012 p.404 ; Lindau <i>et al.</i> , (2010a p.23) ;
	Lack of capacity	Lindau <i>et al.</i> , (2010a p.23)
	Urban sprawl/ spatial splintering	(Bernt <i>et al.</i> , 2013 p.14).; Early <i>et al.</i> , 2015 p.223 ; Salmon (2015 p.27) ; Wei 2012 p.403 ; Munzwa and Wellington 2010 p.138
	Polycentric developments	Wei 2012 p.401
	Loss of agricultural land	Stats Canada 2016 p.8; Bourne <i>et al.</i> , (2003 p.261)
	Spatial segregation	Cole (2017 p.01); Salmon (2015 p.36); Early <i>et al.</i> , (2015 p.233); Arandelovic and Bogunovich 2014 p.6);
	Illegal subdivisions, land invasion	Munzwa and Wellington (2010 p.139)
	Uneven developments	Walks 2001 p.436; Brushett 2001 p.18).

Source: Author, 2020

The implications of spatial transformation identified from case study reviews can be broadly categorized as environmental, economic, social governance/political, and spatial planning, monitoring and evaluation as indicated in table 3.3. For example the environmental implications discussed in literature review include environmental degradation, forest destruction, loss of wetlands just to mention a few. This frames a better understanding on aspects to be further investigated on implications of spatial transformation in cities.

3.5 Chapter summary

This chapter discussed the evolution and development of spatial transformation discourses. The background on spatial transformation analysis was provided setting the tone that contemporary cities follows a complex evolutionary path. This is evidenced by spatial transformation case study reviews from cities from both the developed and developing economies around the world. The reviewed spatial transformation case study cities are developed economies; Toronto Canada, Berlin Germany, Auckland New Zealand, and developing economies; Curitiba Brazil, Hangzhou China and Harare Zimbabwe. The emergent lessons from the spatial transformation case study reviews were also discussed in line with the research objectives. The lessons were framed based on policy directions, spatial indicators, drivers and implications of spatial transformation. This provided a lens of understanding the methods, and tools that can be adopted to investigate spatial transformation dynamics in cities.

CHAPTER 4 RESEARCH METHODOLOGY

4.1 Introduction

This chapter describes the methodology that guided this research study on exploring spatial transformation dynamics in the City of Polokwane (1996-2016). The details on the orientation of adopted research methodology is presented in figure 4.1.

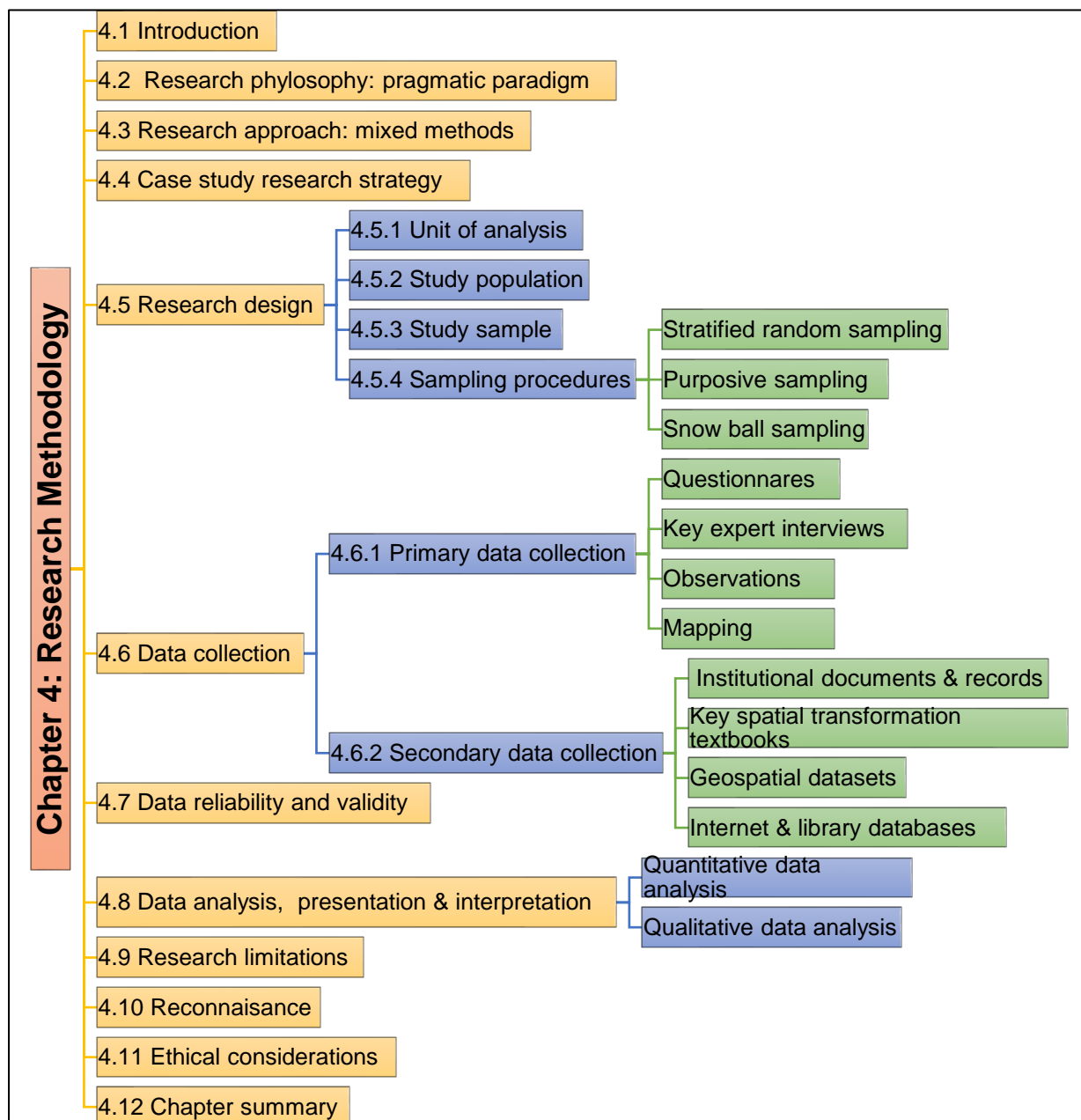


Figure 4.1: Chapter 4 Orientation

Source: Author, 2020

Section 1 introduces this chapter, followed by section 2 which discusses the pragmatic paradigm, adopted as the overarching philosophical framework, while section 3 discusses the mixed methods research approach which guided this study. Section 4 discusses the case

study research strategy highlighting its relevance in this study. This is followed by section 5 which highlights the research design, whilst section 6 expands on the adopted data collection tools. Section 7 explains adopted measures on data reliability and validity, leading to section 8 which clarifies methods of data analysis, presentation and interpretation. Section 9 clarifies research limitations encountered, section 10 highlights study reconnaissance, section 11 reflects on ethical considerations and lastly, section 12 provides a summary of this chapter.

4.2 Research philosophy: pragmatic paradigm

This research enquiry on understanding the realities of spatial transformation in the City of Polokwane is underpinned by the pragmatic research paradigm. The researcher followed Creswell and Clark (2018 p.52); Leavy (2017 p.13); Creswell (2008 p.10); Mackenzie and Knipe, (2006 p.196), suggestion that in the lens of pragmatic paradigm, the critical issue in a research inquiry is the research problem being investigated and it is important that all possible research approaches, strategies and methods that work be employed to uncover the truths about the issue being studied. This denotes that, the researcher was empowered to employ mixed methods research approach, adopt several strategies to augment data collection methods and analysis to unravel spatial transformation dynamics in the City of Polokwane

4.3 Research approach: Mixed methods

The premise of pragmatic paradigm Creswell and CLark (2018 p.55); Creswell (2008 p.10); Mackenzie and Knipe, (2006 p.196), underpinned the adoption of mixed methods approach in this study to understand the reality of spatial transformation in the City of Polokwane. This allowed the researcher to triangulate theories, paradigms, strategies, qualitative and quantitative data and analysis methods as summarised in table 4.1.

Table 4.1: Application of pragmatic paradigm and mixed methods

Ontology- reality of spatial transformation as understood based on the following key research questions (<i>epistemology</i>)	Theoretical perspective/ Paradigm	Methods (mixed)	Data collection tools (examples)	Outcome/contribution to knowledge
What are the policy directions for spatial transformation in the City of Polokwane?	Interpretivist/ Constructivist	Qualitative methods Visual data analysis	Document analysis, Interviews, Visual data analysis	Policy directions on spatial transformation in the City of Polokwane
What are the spatial transformations that occurred in the City of Polokwane?	Interpretivist/ Constructivist	Qualitative methods dominate triangulated with quantitative methods	Document reviews Visual data analysis Matrixes, Links, Polygon/ Area/ Point data/nodal analysis, reconnaissance survey, mapping, Interviews,	Maps of spatial transformation in the City of Polokwane

			Observations, ground truthing,	
What are the drivers of spatial transformation in the City of Polokwane?	Transformative	Qualitative methods with quantitative and mixed methods.	Questionnaires, expert interviews, reconnaissance survey, content analysis, EFA	Drivers of spatial transformation in the City of Polokwane.
What are the implications of spatial transformation in the City of Polokwane?	Transformative	Qualitative methods with quantitative and mixed methods.	Questionnaires, expert interviews, Brainstorming technique, content analysis, EFA	Implications of spatial transformation in the City of Polokwane.
Which framework can be used for tracking spatial transformation in small and intermediate cities in South Africa?	Positivist/ Post-positivist	Quantitative,/ qualitative. quantitative methods tend to be predominant	Interviews, content analysis, Document reviews, SWOT analysis, Gap analysis	Integrated framework for tracking spatial transformation.

Source: Author, 2020

Spatial transformation is a complex and multi-dimensional aspect, that cannot be unpacked by being loyal to either qualitative or quantitative research approach. This warranted the researcher to adopt a mixed methods research approach in this study. Table 4.1 summarises the application of mixed methods approach underpinned by pragmatic paradigm, in selecting multiple methods and data collection tools to realize the outcomes of this study in line with suggestions by Creswell and Clark 2018 p.55); Patel (2015); Creswell, (2009, p.11); Mackenzie and Knipe, (2006 p.196); Rehman and Alharthi (2006 p.51). For instance, to achieve the second objective of this study on mapping spatial transformation in the City of Polokwane, the interpretivist/constructivist paradigm, augmented by qualitative and quantitative methods and data collection tools was adopted.

4.4 Case study research strategy

The case study strategy was relevant in this study because human activities, as entrenched in the real world can only be understood or studied in their context as highlighted in respective studies by Idowu (2016 p.184); Yin (2003 p.13); Gillham (2000 p.1). In this way the City of Polokwane was a perfect case study, for answering the research aim, objectives and questions making use of various techniques and data types as highlighted in works by Woodside (2010 p.6); Gillham (2000 p.1). This adopted strategy was modelled around the argument by Yin (2003, p.6) that a case study strategy is ideal to answer questions posed by this study on “what”, “how” or “why” aspects related to spatial transformation in the City of Polokwane. In the application of this strategy the study also employed the cornerstones highlighted by Mills *et al.*, (2010 p.69) which encompasses; i) selecting the case study objects,

ii) ensuring entrance to the case site; iii) outlining the theoretical frame as a foundation of the study; and iv) data gathering, processing, and analysing.

4.5 Research design

Inline with ideas of Kothari (2004); Creswell (2009 p.11), this section provides the conceptual structure within which this research was conducted and it also elaborates on the blueprint, a roadmap that was followed for data collection, measurement, and analysis. In this view, exploratory research design roadmap was adopted in this study to gain more insight and understanding on spatial transformation dynamics in the City of Polokwane as presented in figure 4.2.

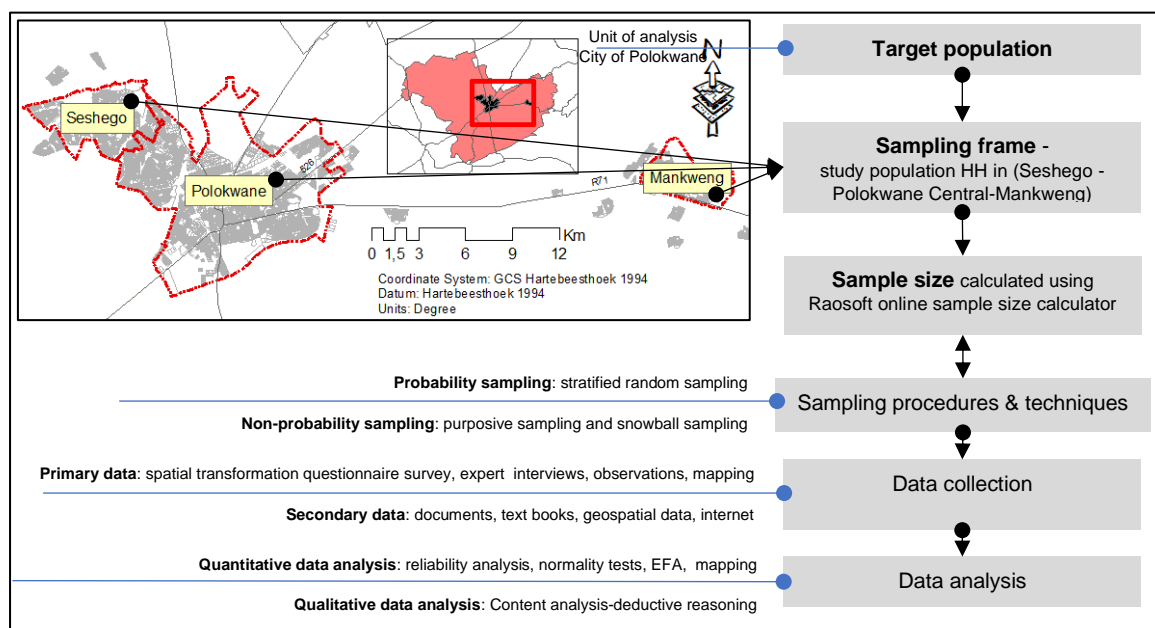


Figure 4.2: Exploratory research design roadmap

Source: Author, 2020

Figure 4.2 outlines logic, coherence and integration of various components that built the roadmap followed in this study to effectively address the research objectives set out to understand spatial transformation in the City of Polokwane. These components include, study population, sample size, sampling procedures, data collection and analysis.

4.5.1 Unit of analysis

Unit of analysis for this study is understood as highlighted in respective studies by Trochim, (2020); Saunders *et al.*, (2009 p.147); Grünbaum, (2007 p.83); Long (2011 p.1). It is defined as what the case study is focusing on such as, geographical unit i.e. country, city, organization, group, school, individual just to mention a few. In line with this perspective, and in relation to the study aim, the unit of analysis for this study is City of Polokwane.

4.5.2 Study population

Study population refers to all items within the field of enquiry (Kothari 2004, p.55). The field of enquiry or unit of analysis for this study is City of Polokwane. However, it is too large hence three areas were strategically selected that represent the apartheid city structure of Polokwane. Therefore, the strategically selected areas are Polokwane CBD, Seshego township and Mankweng rural township, which resemble the spatial structure of apartheid engineered planning in the City of Polokwane provides the accessible population or study population.

This implies that overall study population will be made of total households of these strategically selected areas as presented in table 4.2. The selected target population aids in providing insights on the drivers and implications of spatial transformation in the City of Polokwane.

Table 4.2: Study population

		Total population
Households	Polokwane Central	43 846
	Seshego Township	24 736
	Mankweng Township	10 303
Total Population		78 885

Source: Author, from Stats SA (2011)

Table 4.2 shows that the total population for the study is 78 885. This population comprises of households from the strategically selected areas, Polokwane Central, Seshego and Mankweng rural township.

4.5.3 Study Sample

The desired sample size for this study is 588 (0,75% of total population). It was calculated from the overall study population of 78 885 using Raosoft sample size calculator accessed from <http://www.raosoft.com/samplesize.html>. This sample size of 588 was derived with a margin error of 5%, confidence level of 98.5% and a response distribution of 50% as presented in appendix A. This sample size is sufficient because, Yong and Pearce (2013 p.80) also recommends that a good sample size should be above 300 for meaningful advanced statistical analysis. This entails that the selected sample size contributed to generation of sufficient data warranting the use of Exploratory Factor Analysis (EFA) in understanding the dynamics of spatial transformation in the City of Polokwane.

4.5.4 Sampling procedures

Sampling procedure refers to the technique, method used systematically, to select the data source items or study subjects from the sample (Sharma 2017 p.749; Kothari 2004.p.57). This study adopted a complimentary approach mixing both probability and non-probability sampling

techniques in selecting the sample study subjects. A probability sampling technique employed is stratified random sampling method and the non-probability sampling techniques selected are purposive sampling and snow ball sampling.

4.5.4.1 Stratified random sampling method

Stratified random sampling is a probability sampling technique, in which the researcher divides the population into different sub-groups (strata), and randomly selects the final study subjects proportional to each strata (Sharma 2017 p.750). Three strata were identified in this study namely, households in Polokwane Central; Seshego and Mankweng rural township. Thus, the representative sample for each strata will be proportional to the total population size of that category as shown in table 4.3.

Table 4.3: Sample distribution

		Total	Proportional Sample	%total
Household	Polokwane Central	43 846	327	56%
	Seshego	24 736	184	31%
	Mankweng township	10 303	77	13%
Total population		78 885	588	100%

proportional area sample size = area population/total study population x 588

Source: Author, 2019

Table 4.3, shows the proportional sample from each category. For instance, Mankweng rural township has a household population of 10303 and the total household population of the study is 78 885. Therefore, the proportional sample size is 77 (13%) out of the total sample size of 588.

4.5.4.2 Purposive sampling

Purposive sampling is a non-probability sampling technique that is also referred to as, subjective, selective or judgemental sampling, denoting a group of sampling techniques that are reliant on the researchers judgement on selecting the subjects of study (Sharma 2017 p.751). The examples of techniques that are employed include; total population sampling, maximum variation sampling, typical case sampling, homogenous sampling and expert sampling. In view of this, this study adopted key expert sampling. The experts were selected because of the underlying assumption that they are experts in planning field, and are well versed with knowledge on spatial transformation dynamics and by extension have knowledge about spatial restructuring in the City of Polokwane.

Thus, key experts were mostly selected from key stakeholders in the study area which include the following; City of Polokwane municipal officials, Limpopo Department of Cooperative

Governance Human Settlements and Traditional Affairs (CoGHSTA), Department of Rural Development and Land Reform (DRDLR), National Department of Public Works, Housing Development Agency (HDA), Practicing planners.

4.5.4.3 Snow ball sampling

Snow ball sampling is also a non-probability sampling technique. It refers to chain referral sampling or chain sampling wherein initially selected subjects of study links the researcher to other acquaintances as possible subjects of study (Sharma 2017 p. 752; Atkinson and Flint 2011, p.1). Similarly, through snow bow technique (see appendix B), the researcher was linked to various key experts from CSIR Built-environment in Pretoria, Germey Abrahams consultants, GCRO in Johannesburg and also engaged with other invited key experts through a series of academic workshops that were organized during the course of the project. To add on, the purposively selected key experts also assisted in linking the researcher with a network of other key experts i.e. a key expert from National Department of Public Works referred the researcher to other key experts from the private sector to deepen the understanding of spatial transformation in the City of Polokwane.

4.6 Data collection

This section is a discussion on primary and secondary data collection methods, tools employed in this study to deepen the understanding on spatial transformation in the City of Polokwane.

4.6.1 Primary data collection

Primary data collection tools that were employed to collect qualitative and quantitative data needed to understand the dynamics of spatial transformation in the City of Polokwane, include; spatial transformation survey questionnaire, key expert interviews, observations and mapping.

4.6.1.1 Spatial transformation survey questionnaire

The right to the city theory as espoused by Lefebvre articulates that citizens have the right “to make known their ideas on the space” (Marcuse 2012, p. 24). Therefore, a spatial transformation survey questionnaire was developed to allow the citizens to make known their perspectives in line with the research objectives on spatial transformation, the drivers and implications of such spatial transformations in the City of Polokwane. The spatial transformation survey questionnaire was designed using both open-ended and close ended questions as shown in figure 4.1. The close-ended questions were largely characterized by a 5 point Likert-scale. The responses to the spatial transformation questions were provided on scale of 1-strongly disagree to 5-strongly agree as shown in box 4.1.

13. Whom do you think is causing these spatial changes in your area?
.....
.....

Section C: Implications of spatial transformation

Please use the following scale to indicate your most appropriate response to answer question 12

1=strongly disagree	2=disagree	3=neutral	4=agree	5=strongly agree
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14. To what extent do you strongly agree or strongly disagree that spatial changes in your area has caused the following impacts?

Implications					
1.Loss of wetlands	1	2	3	4	5

Box 4.1: Questionnaire- open-ended and closed-ended Likert-scale design

Source: Author, 2020

Box 4.1 shows how the spatial transformation survey questionnaire was designed to collect both qualitative and quantitative data. In relation to the objective on implications of spatial transformation in the City of Polokwane, respondents were asked to answer the question, To what extent do you strongly agree or strongly disagree that spatial changes in your area has caused the following impacts? 1. Loss of wetlands. The responses were provided on a 5 point Likert-scale 1 = strongly disagree to 5= strongly agree. The full spatial transformation survey questionnaire is attached in appendix C.

The administration of this questionnaire was aided with three research assistants that have research knowledge, also graduates in the field of urban and regional planning and also converse well in Sepedi which is the dominant local language of Polokwane. This assisted in the translation of the questionnaires to the local community in their vernacular language as they were written in English. The administered spatial transformation survey questionnaire in the City of Polokwane yielded 507 questionnaires. The detailed breakdown in table 4.4 shows the proportional number of questionnaires that were distributed per strata and the number of the returned questionnaires.

Table 4.4: Questionnaire distribution

	Selected Localities	Population	Proportional Sample	%total	NQD	NQR
Household	Polokwane Central	43 846	327	56%	327	293
	Seshego	24 736	184	31%	184	151
	Mankweng township	10 303	77	13%	77	63
Total population		78 885	588	100%	588	507

NQD : number of questionnaires distributed, NQR: number of questionnaires returned

Source: Author, 2019

In line with the stratified random sampling, table 4.4 shows the questionnaires distributed and returned from the identified strata. For example the number of questionnaires distributed (NQD) in Polokwane Central were 327 to formal and informal households in Polokwane CBD will be a total of 328 questionnaires (61%) out of the study sample size of 588.

4.6.1.2 Key expert interviews

Key expert interviews were employed to collect qualitative primary data in this study. Key experts were purposefully selected because the underlying assumption is that they are well informed, and knowledgeable about spatial transformation dynamics in the City of Polokwane. Therefore, triangulation of key expert interview, qualitative data with quantitative data from the questionnaires surveys deepens the understanding of spatial restructuring in the City of Polokwane. To ensure consistency in gathering information, semi-structured interview guide (see appendix D) and aided with interview recording was employed to solicit views of key experts guided by key themes that emanated from the research objectives. Employing this tool offered the researcher an opportunity to probe more questions, seeking new insights and perspectives to get in-depth understanding on spatial transformation dialectics and didactics in the City of Polokwane. The key experts interviewed are from the following key stakeholders; Gemey Abrahams Consultants, CoGHSTA, CSIR, DRDLR, Gauteng City Region Observatory (GCRO), Housing Development Agency (HDA) Polokwane, National Department of Public Works Polokwane, Polokwane Local Municipality, and private sector town planners.

4.6.1.3 Observations

The researcher also collected qualitative primary data through field observations. Observation was also used for ground truthing of identified, mapped spatial transformations from the spatial indicators in the City of Polokwane. The researcher was able to notice the land use spatial transformations on the ground validating the mapped outcomes from the spatial indicators. In addition to taking photos, observations were also aided with video recording of the tour of Polokwane CBD, using a cell-phone camera via AutoBoy BlackBox mobile software on an android device. A snippet from a video taken in the field is presented in plate 4.1.

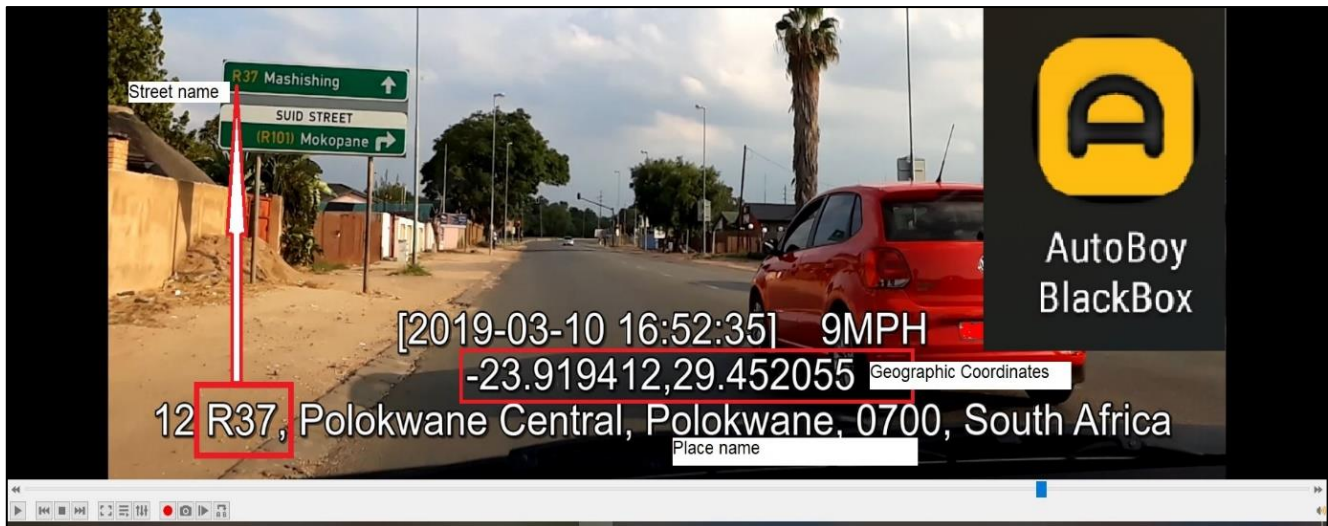


Plate 4.1: Field observation video recording using AutoBoy BlackBox app

Source: Author, 2019

The researcher employed technical advancement of AutoBoy BlackBox, a dashboard camera mobile software to record videos around the study area during field observations. This software records videos of approximately 5minutes each and automatically saves it to the mobile phone. The advantages associated with technical sophistications of this software is that it also captures the geographic coordinates, road names and the details of the place being video recorded which makes the information captured valid and reliable in understanding spatial transformation dynamics in the City as presented in plate 4.1. This data collection technique was very valuable in this study, because by the end of March 2020, South African national lockdown restrictive measures were put in place limiting movement of people due to the pandemic Corona Virus Disease 2019 (COVID-19). Thus, the researcher had the videos to play over and decipher making critical reflections on dynamics of spatial transformation with convenience, safety and comfort at home during nation wide lockdown.

4.6.1.4 Mapping

The study also adopted mapping as a primary data collection tool. The researcher printed cadastral maps for Polokwane CBD, Mankweng and jotted notes identifying key areas of interest and noting information essential for answering the broader research objectives and questions. For instance, the researcher used these printed maps to pinpoint specific areas where illegal parking and dilapidated buildings were observed as presented in figure 9.5. To augment these maps, the researcher also adopted digital field mapping for ease of use in ArcMap, using a free android compatible mobile software application SW Maps as shown in plate 4.2.

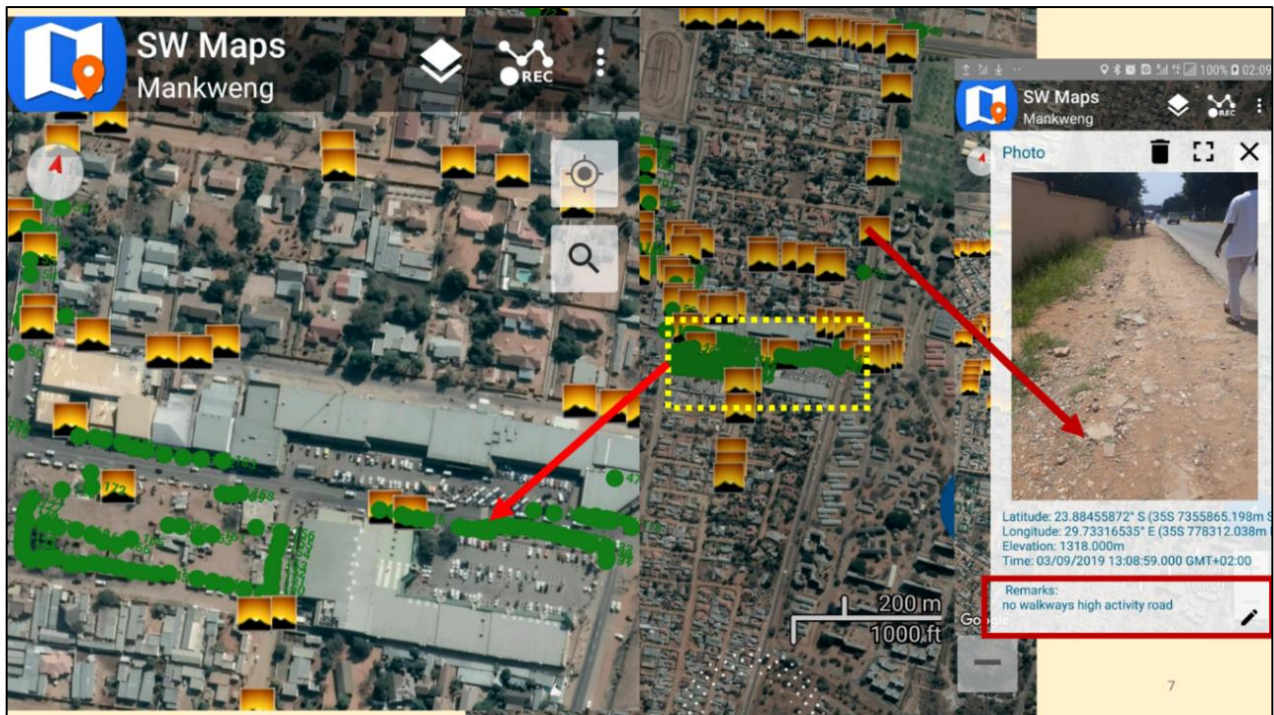


Plate 4.2: Geospatial mapping, primary data collection with SW Maps

Source: Author, 2019

Plate 4.2 is a screen-short illustrating a mobile-phone interface of SW Maps showing digitally captured and stored spatial primary data that was gathered during field observations. This mobile mapping technological application and its inbuilt functions were essential in this study because it offered the researcher various capabilities which include; capturing of photographs embedded with specific geographic coordinates, writing of remarks which assisted in providing thick descriptions on implications of spatial transformation central to the research objectives of this study (refer to Plate 9.1). In another perspective, this mobile application offered the capability of capturing point data, i.e. green dots in plate 4.2 showing the specific areas where informal activities were observed in Mankweng area. In addition to the convenience of storing the information on the application, it also allowed the researcher to export the captured and stored spatial information in ESRI-shapefile (.shp) format for ease of use in ArcMap.

4.6.2 Secondary data collection

This section discusses the collection of secondary data that was needed to augment the understanding of spatial transformation dynamics in the City of Polokwane. Secondary data that is reliable, valid and adequate was used to deepen the understanding on spatial transformation policy directions, aids in mapping spatial transformation, drivers and implications of spatial transformation in the City of Polokwane.

4.6.2.1 Institutional documents and records

The researcher accessed various government documents from City of Polokwane municipal officials, collected through a Universal Serial Bus (USB) flash drive. The documents were mostly legislative and policy frameworks- Polokwane SDF 2010; Framework Plan SDA1,2,3, Mankweng, Sebayeng; Precinct plans: Polokwane CBD, Seshego, Polokwane municipal policies- Medical node, Densification, Gated communities, Subdivision and densification of agricultural land in Polokwane local Municipality; By-laws: planning, outdoor advertisement; Town planning and township ordinance 15 of 1986, Town planning schemes; Redbook on Human settlements planning and design, Annual reports, Integrated Development Plans (IDP), SMART CITY Vision 2030 Economic growth and Development plan. These documents were essential in this study, in particular they provided access to legislative and policy discourses that were relevant in unravelling the directions for spatial transformation in Polokwane as analysed in chapter 6. In addition to this, the researcher also accessed secondary data records such as census data with assistance of Anneline Bezuidenhout from Statistics South Africa (refer to appendix E on logistics). The researcher was given two Compact Discs (CDs) containing StatsSA SuperCross software for 1996-2011 census data and 2016 community survey (CS) respectively. This census information was essential in this study, it was employed to augment findings deepening the understanding on spatial transformation dynamics in Polokwane as presented in table 7.2.

4.6.2.2 Key spatial transformation textbooks

The researcher also accessed repositories of textbooks in search of secondary data sources to crystallize the research methodology, towards attaining the broader research objectives (refer to tables 2.2, 3.1-3.3 and appendix c: spatial transformation questionnaire). Key textbooks that were used include - Harrison *et al.*, (2014) Changing Space, changing city: Johannesburg after apartheid; Early *et al.*, (2015) Drivers of urban changes; Marais and Nel (2019) Space and planning in secondary cities: reflections from South Africa – just to mention a few. These key text books among other key literature reviewed provided authentic data that assisted the researcher in understanding research methods to map spatial changes, drivers and implications of spatial transformation in cities. In particular, Early *et al.*, (2015) text book played a central role in framing literature review discussion on spatial transformation of Auckland New Zealand which is one of the case study cities from developed economies in chapter 3. This text engaged the researcher on the policy directions, various agents, actors driving urban restructuring, contestations, and implications of spatial transformation.

4.6.2.3 Geospatial data sets

The researcher also accessed secondary geospatial data from City of Polokwane municipal GIS section. The shapefile information included; cadastral information, street names, township boundaries, zoning, BRT system, informal activities, previous SDFs 2010 among other areas.

4.6.2.3 Internet and library datasets

The internet was used to access various secondary data sets that were employed in this study to understand spatial transformation dynamics in the City of Polokwane. In particular, mesozone geospatial data that was employed to generate most maps in chapter 7, depicting spatial transformations in the City of Polokwane from 1996 to 2016 was accessed from the internet. To attain this the researcher extracted geospatial shapefiles linked to quantitative and qualitative data as summarised in table 4.5. The mesozone geospatial data were accessed from the internet on the web page for Spatial Temporal Evidence Planning South Africa (STEPSA)-CSIR <http://stepsa.org/data/2018%20CSIR%20Typology%20v2.rar>.

Table 4.5: Geospatial shape file data for mapping spatial transformation

	Datasets	Description
1	Base Mesozone Dataset	It shows updated mesozones for the entire country that incorporates 2011 municipal boundaries revisions done by the South African Municipal Demarcation Board, (Mans <i>et al.</i> , 2015)
2	Total Population Distribution	1996 (EAs), 2001 (SPs) and 2011 (SPs) population distribution realigned to the mesozones using dasymetric mapping process, to create comparable time series aligned data (Mans <i>et al.</i> , 2015).
3	Combined Main Economic Sectors	It indicates economic production per sector per mesozones for ease of spatial comparison of the mesozone(s) over time (Mans <i>et al.</i> , 2015).
4	Total Employment	It indicates “employment per sector (excluding construction), expressed as the number of potential job opportunities at the place where people will work” for spatial comparison of the mesozone(s) over time (Mans <i>et al.</i> , 2015).

Source Author, 2017

In other words, the geospatial data mesozones polygons used for mapping spatial transformation are linked to an attribute table containing information on each polygon. This information include population distribution, age, employment and unemployment, households, labour force, education, poor, gross added values and standard industry classifications. In addition, the internet was very resourceful in accessing other secondary geospatial datasets employed in this study to the research objectives on understanding spatial transformation in Polokwane i.e. Dwelling Layer (SPOT Building Count SBC) (figure 7.23), Global Human Settlements Layer (GHSL) (figure 7.14), road transport network shapefiles (figure 7.15).

Furthermore, the internet was used to access secondary data to deepen the understanding on spatial transformation in the City of Polokwane from various library databases and websites. The journal articles accessed include: scholarly works by Kotze and Donaldson (1998); Donaldson (2001); de Villiers and Kalema (2005); Cloete and Massey (2017) among others. This greatly assisted in inductive reasoning shaping the research idea and methods to attain the research objectives. To add on, the internet also assisted in getting additional documents critical in deepening the understanding on spatial transformation dynamics in Polokwane i.e. Polokwane General Valuation Roll (table 9.10) among other documents.

4.7 Data reliability and validity

Measurement scale analysis was performed through reliability tests and validity analysis, as highlighted in studies by Cronbach, (1951); Al-Shehri (2012); Hair et al. (2014); Nadi et al (2012:103). Cronbach's alpha was employed in determining reliability of the 5-point Likert-scale spatial transformation survey questionnaire for City of Polokwane. It was first employed on a pilot survey of 37 questionnaires that were returned out of a total 54 that were distributed. The results are presented in table 4.6.

Table 4.6: Pilot test, Cronbach's Alpha Reliability Results: City of Polokwane variable constructs

Targeted Research objectives (latent variable)	Variable construct	Number of items	Cronbach alpha	Overall Cronbach alpha of all variable constructs	Overall comment based on (based on Hair et al.'s, (2014) four degrees of reliability scale)
To determine the <u>drivers of spatial transformation</u> in the City of Polokwane	Governance/political drivers of spatial transformation (GP.Drivers.ST)	12	0.752	0.824	High Reliability
	Spatial characteristics/biophysical factors drivers of spatial transformation (SCBF.Drivers.ST.)	8	0.613		
	Social and Cultural Norms drivers of spatial transformation (S&CN.Drivers.ST)	10	0.636		
	Economic drivers of spatial transformation (Eco. Drivers.ST.)	12	0.603		
To assess the <u>implications of spatial transformation</u> in the City of Polokwane	Environmental implications of spatial transformation (Env.Implications.ST)	8	0.754	0.847	High Reliability
	Economic implications of spatial transformation (Eco.Implications.ST)	8	0.612		
	Governance/Policy implications of spatial transformation (GP.Implications.ST)	5	0.641		
	Spatial planning, monitoring & evaluation implications of spatial transformation (SPME.Implications.ST)	7	0.690		

Source: Author, 2018

The reliability results from the pilot study in table 4.6 showed that the research questionnaire survey was highly reliable with an overall Cronbach's alpha (α) value of 0.824 for questionnaire

items on drivers of spatial transformation and 0.847 for questionnaire items on implications of spatial transformation. In addition to this reliability test, the research instruments were also framed, confirmed and validated by the summary of drivers and implications of spatial transformation case study reviews indicated respectively in tables 3.2 and 3.3 from chapter three.

Furthermore, the questionnaire survey instrument was also assessed at the 2nd project workshop in Durban 2018, by the PhD cohort team together with Wits-Univen-DUT supervisory team which were part of the bigger project on Resilience and Spatial Justice in South Africa's Built Environment: Generating Interdisciplinary Transformative Knowledge under the NRF Collaborative Postgraduate Training Programme (2017-2019). Furthermore, content validation was done with the assistance of research experts from The Gauteng City-Region Observatory (GCRO) and the Department of Urban and Regional Planning at University of Venda. This assisted in refining the instrument after determining ambiguities that were embedded in the questionnaire, structure of sentences, and adequacy of items towards attaining the broader objectives of the study of understanding spatial transformation in the City of Polokwane. Thus, the final questionnaire was further tested for reliability before proceeding with any advanced statistical analysis as presented in table 4.7.

Table 4.7: Final questionnaire items reliability analysis: study constructs on drivers and implications of spatial transformation

Targeted Research objectives (latent variable)	Variable construct	Number of items	Cronbach alpha	Overall Cronbach alpha of all variable constructs	Overall comment based on (based on Hair et al.'s, (2014) four degrees of reliability scale)
To determine the <u>drivers of spatial transformation</u> in the City of Polokwane	Governance/political drivers of spatial transformation (GP.Drivers.ST)	17	0.788	0.881	High Reliability
	Spatial characteristics/biophysical factors drivers of spatial transformation (SCBF.Drivers.ST.)	9	0.765		
	Social and Cultural Norms drivers of spatial transformation (S&CN.Drivers.ST)	13	0.836		
	Economic drivers of spatial transformation (Eco. Drivers.ST.)	13	0.832		
To assess the <u>implications of spatial transformation</u> in the City of Polokwane	Environmental implications of spatial transformation (Env.Implications.ST)	11	0.831	0.901	Excellent Reliability
	Economic implications of spatial transformation (Eco.Implications.ST)	14	0.824		
	Social implications of spatial transformation (Soc.Implications.ST)	12	0.811		
	Governance/Policy implications of spatial transformation (GP.Implications.ST)	10	0.811		
	Spatial planning, monitoring & evaluation implications of spatial transformation (SPME.Implications.ST)	9	0.772		

Source: Author, 2019

Table 4.7 presents reliability test results for the final questionnaire survey instruments. A comparison between table 4.6 and 4.7 shows that the questionnaire items were increased

compared to the initial questionnaire and also overall Cronbach alpha values improved i.e. Cronbach's alpha for items on implications of spatial transformation increased from α , 0.847 (high reliability) to α , 0.901 (excellent reliability). This indicates that the more meaningful items are on a questionnaire measurement instrument the more reliable the instrument becomes.

4.8 Data analysis

This section discusses quantitative and qualitative methods of data analysis that were triangulated in this study to attain the research objectives. Quantitative data analysis was the dominant method of analysis to attain objectives iii and iv, and qualitative data analysis was also the dominant method to attain objectives i and v in this study.

4.8.1 Quantitative data analysis

Quantitative data collected using the spatial transformation questionnaire survey was captured and stored using Statistical Packages for Social Sciences (SPSS) version 23. Before commencing any reliability tests, and advanced statistics, the captured data was first cleaned by running descriptive statistics in SPSS, checking on measures of dispersion. The dispersion measures that were looked at are minimum, maximum and mean values for each question. The errors that were identified during data cleaning phase are indicated in table 4.8.

Table 4.8: Data cleaning

Question	Scale	Min	Max	Correction
Place of stay.	-	-	4	3
Period of stay	62	-	-	6
8. Are you originally from City of Polokwane?	-	-	4	3
12.6. Drivers.ST-GP6.Government spending on construction of roads	-	-	23	2
Drivers.ST-GP15.Political organizations giving people land to build	-	-	45	4
Drivers.ST-SCBF7.Availability of natural resources and drainage patterns	-	-	52	5
Drivers.ST-S&CN1.People moved from rural areas to Polokwane city	-	0	-	1

Source: Author, 2019

The errors presented in table 4.8 were corrected as indicated and descriptive statistics were run again to cross check the corrections. This was also followed by basic preliminary tests i.e. normality tests using skewness and kurtosis as highlighted by Gorrie *et al.*, (2019), which are part of requirements for undertaking exploratory factor analysis (EFA).

Normality tests were performed in this study to determine if data for this study follows a normal distribution. This was done through measures of skewness and Kurtosis. According to Lee (2008:63), "Skewness characterizes the degree of asymmetry of a distribution around its mean. Kurtosis characterises the relative peakedness or flatness of a distribution compared to the normal distribution". Park (2008) cited in Lee (2008) states that normality can be

checked in two ways; numerically or graphically. The graphical or visual method is criticised for being unreliable, and it fails to guarantee normal distribution (Ghasemi and Zahediasl 2012). Therefore, this study adopted the numerical method which summarises the descriptive statistics of the variables such as standard deviation, skewness and kurtosis.

Ghasemi and Zahediasl (2012) points out that there are various numerical methods for testing normality. The commonly used numerical methods are Kolmogorov-Smirnov (K-S) and Shapiro-Wilk test which uses significance statistic (p-value) to determine normality distribution. However such approach is criticised because it works for smaller sample sizes of 50 or less for Shapiro-Wilk test and that K-S test has low power. Ghasemi and Zahediasl (2012 p.489); Field (2009 p.139) recommends an alternative approach to assess normal distribution of data when sample sizes are large (200 and above). This approach considers data to be normally distributed when the standard errors are small (± 2.58) and the significance test statistic (p-value) of kurtosis and skewness should not be employed. Interestingly, Lee (2008) points out that, “as a rule of thumb, if the skewness is within the range of ± 2 and kurtosis is within the range of ± 3 , the data is assumed to be normal”. Thus, the study employed the numerical approach by Lee (2008) and the results are presented in table 4.9.

Table 4.9: Normality test results for study constructs

Descriptive Statistics: Normality tests						
Objective	Study constructs measuring research objectives	Std. Deviation	Skewness		Kurtosis	
		Statistic	Statistic	Std. Error	Statistic	Std. Error
3.To determine the <u>drivers of spatial transformation</u> in the City of Polokwane	Drivers.ST-GP	1,06	-0,48	0,11	-0,24	0,22
	Drivers.ST-SCBF	1,07	-0,63	0,11	-0,06	0,22
	Drivers.ST-S&CN	1,10	-0,57	0,11	-0,26	0,22
	Drivers.ST-Eco	1,06	-0,50	0,11	-0,21	0,22
4.To assess the <u>implications of spatial transformation</u> in the City of Polokwane	Implications.ST-Env.	1,04	-0,46	0,11	-0,29	0,22
	Implications.ST-Eco	1,10	-0,48	0,11	-0,38	0,23
	Implications.ST-Soc.	1,08	-0,50	0,12	-0,32	0,23
	Implications.ST-GP	1,07	-0,52	0,12	-0,23	0,23
	Implications.ST-SPME	1,12	-0,44	0,12	-0,49	0,23

Source: Author 2019

The normality test results in table 4.9, indicate that the numerical values for our data are within the acceptable range recommended by Field (2009) of ± 2.58 , standard deviation and Lee (2008) of ± 2 for skewness and ± 3 for kurtosis. Therefore, the data is assumed to be normally distributed and is suitable for further statistical tests such as Exploratory Factor Analysis (EFA)¹.

¹ Subjects approach reading and dimension reduction of 5point Likert scale data differently, they are also assumed to be measured at an interval level.

EFA was the dominant method of quantitative data analysis that was employed in chapters 8 and 9 on drivers and implications of spatial transformation in Polokwane. The procedures that were followed by the researcher in conducting quantitative data analysis employing EFA are outlined in appendix F, and are inline with a study by Yong and Pearce (2013 pp.80-92). The extracted factors from employing EFA are presented using mathematical model 4.1 by Field (2009);

$$Y_i = b_1X_{1i} + b_2X_{2i} + \dots + b_nX_{ni} + \varepsilon_i$$

$$Factor_i = b_1Variable_{1i} + b_2Variable_{2i} + \dots + b_nVariable_{ni} + \varepsilon_i$$

4.1

Where Y_i is the unobserved latent factor extracted, b is the factor loading for the variable, X_1 is the variable.

The relevance of EFA in this study was that it allowed the researcher to attain parsimony by reducing large number of variables i.e. 17 questionnaire items (see appendix c) for Governance/political drivers of spatial transformation (GP.Drivers.ST), into a few latent variable factors as presented in table 8.3, while preserving and explaining as much information from the observed variables on spatial transformation dynamics in the City of Polokwane.

4.8.2 Qualitative data analysis

In this study content analysis was employed in line with discourse analysis theory, making inferences moving from systematic analysis of qualitative data to answer the broad research objectives that were set out. Thus, content analysis allowed the researcher to systematically sift large volumes of qualitative data without losing focus guided by the established analytical constructs as summarised by a process presented in figure 4.3.

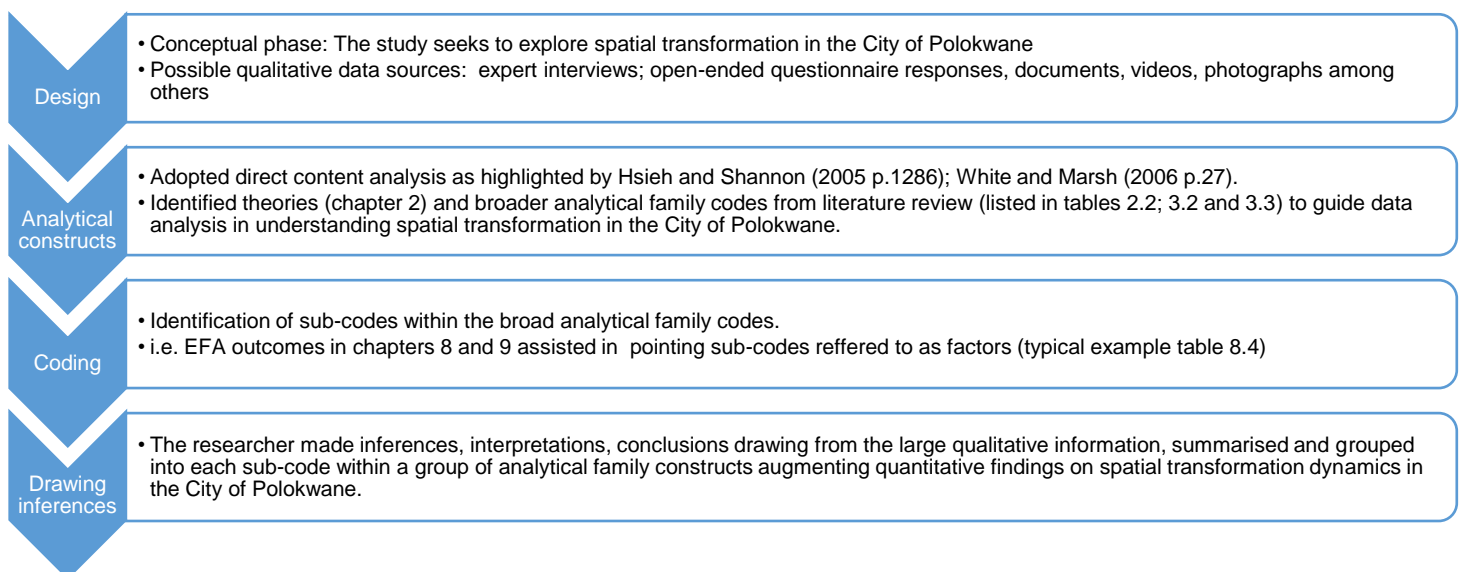


Figure 4.3: Content analysis procedure

Source: Author, 2020

Literature evidences varied approaches, a clear sign on lack of agreed universal approach to content analysis (Neuendorf 2019 p.215-216; Skalski, *et al.*, 2017 p.201-242; Prasad 2008 p.181; White and Mash 2006 p.30; Krippendorff 1989 p.406). However, the approach to content analysis adopted in this study was adapted from stages developed by Krippendorff's (1989 p.406). The steps followed as presented in figure 4.3 are; design, analytical constructs, coding and drawing inferences on spatial transformation dynamics in the City of Polokwane.

4.9 Research limitations

Research permission took long to be issued by the municipality. The researcher went to the responsible office for granting research permission and engaged with them face to face and the misunderstanding was clarified and the permission to conduct research was granted.

Inadequate data: The municipal geo-spatial database crashed and most of the historical data was lost. Despite this limitation, there is data available from 2014 onwards. Adding to this, the researcher also engaged with GEOTERRAIMAGE and was requested to fill forms on data use for academic purpose (appendix G), but the geospatial data was never released despite several follow up emails. To counter this limitation on access to geospatial data, the researcher took advantage of availability of historical images within municipal documents among others, and the use of ArcMap GIS software. ArcMap conversion tools were used to convert Portable Documents Format (PDF) into Tagged Image File Format (TIFF) and digitizing tools were then used, facilitating the easy reconstruction of the geo-spatial information required to understand spatial transformation in the City of Polokwane for this study. To add on to this, other geodatabases from external sources were also accessed to augment spatial transformation dynamics in the City of Polokwane. These external databases include Statistics South Africa Supercross, CSIR Mesozones, Quantec EasyData, and Eskom Spot Building Count (SBC).

To add on, the documents that were accessed from the municipality were in adequate to address the research objectives. The researcher supplemented these documents by accessing the municipal website and downloaded the necessary documents that were available and are required to answer the research questions and by extension research objectives.

Language barrier: The researcher does not speak Sepedi the dominant language in Polokwane. To resolve this limitation the researcher was assisted by three research assistants. Two of these research assistants are graduates of Bachelor of Urban and Regional Planning at the University of Venda. Thus in addition to proficiently conversing in Sepedi they had background understanding of research and planning related matters in relation to spatial transformation in the City of Polokwane.

Lack of safety: The researcher was robbed in Polokwane CBD during the process of data collection. In order to address this situation, the researcher decided to video record the tour around Polokwane CBD using a geocoded android software, AutoBoy BlackBox which captures the place name, street name, date, time and geographic coordinates whilst the video is being recorded. The recorded videos are of high quality resolutions making it easier to identify subjects being studied. Furthermore, the researcher decided to use SW Maps a free android mobile app to map out observed activities, and also take pictures and simultaneously allowing writing of notes about the photograph integrating all the information in the app for ease of use.

4.10 Reconnaissance

The researcher attended the first annual post-graduate training workshop hosted by Wits University, at West Campus in Johannesburg from 19-22 June 2017. At the colloquium the researcher went through an exploration of research methods, theoretical, conceptual and empirical literature on spatiality, equity and resilience to broaden the understanding of spatial transformation. The researcher also had informal meetings with City of Polokwane municipal officials in November 2017 and February 2018 to secure preliminary literature needed for the study.

4.11 Ethical considerations

The researcher followed the university research guidelines and ethical considering by getting research proposal approval from the department, School of Environmental Sciences Higher Degrees Committee and finally Univen Higher Degree Committee (UHDC) where research approval was granted (see appendix H). The research strategies, and case study approach outlines that the researcher needs to gain access to the field of study. In line with this and as an ethical consideration, the researcher applied to Polokwane Local Municipality requesting for permission to undertake research and was granted permission (see appendix I).

It is important for research involving human subjects to protect the rights and dignity of participants. To ensure that the research met the requirements of protecting human subjects, it was conscientiously scrutinized for ethical clearance by the Univen research ethics committee and an ethical clearance certificate was issued (see appendix J). The researcher also adhered to the research ethical standards on human subjects as stipulated in section 13.4 of the University of Venda's Research and Innovation Policy (2010 pp. 49-52). The researcher provided a consent form for participants to make an informed decision whether to participate or not (see appendix K). In addition, research participants were made aware about the following ethical standards, (i) the researcher association with the university, (ii) nature of research, purpose and usefulness, (iii) the procedures in which the subjects are asked to

participate which included recording of interviews (iv) confidentiality and protection of collected data through use of passwords (v) subjects are free to withdraw from participating at any time without giving any reasons, (vi) no benefits will be provided, participation is voluntary (vii) subjects that are underage will not be allowed to participate and (viii) consent to publish findings using anonymous names. Furthermore, the researcher also asked for permission to conduct research from City of Polokwane and permission was granted. The researcher presented the findings accurately and fairly without being biased.

The researcher also abided by the requirements of Eskom (appendix L) and those for NRF that funded research on: (i) acknowledging financial assistance on the title page of the thesis, and all publications to emanate from this research; (ii) declaring that the opinions expressed in the thesis are that of the researcher and not attributed to NRF and that a copy of the thesis need to be uploaded to University of Venda library online repository for ease of access by the public.

4.12 Chapter summary

This chapter unpacked the overarching pragmatic spatial transformation paradigm that framed the research methodology, mixed research methods, and case study research strategy adopted in this study. This chapter also highlighted the research design road map, methods of primary and secondary data collection employed in this study. This is followed by discussion on data reliability and validity, data analysis, presentation and analysis, research limitations, study reconnaissance, and ethical considerations observed in this study.

CHAPTER 5 ANALYSIS OF GEOSPATIAL MAPPING METHODOLOGY

5.1 Introduction

This chapter analyses the South Africa Spatial Data Infrastructure (SASDI) a source for geospatial data to inform the development of a mapping methodology crucial in attaining the second research objective of this study. The orientation of this chapter is presented in figure 5.1.

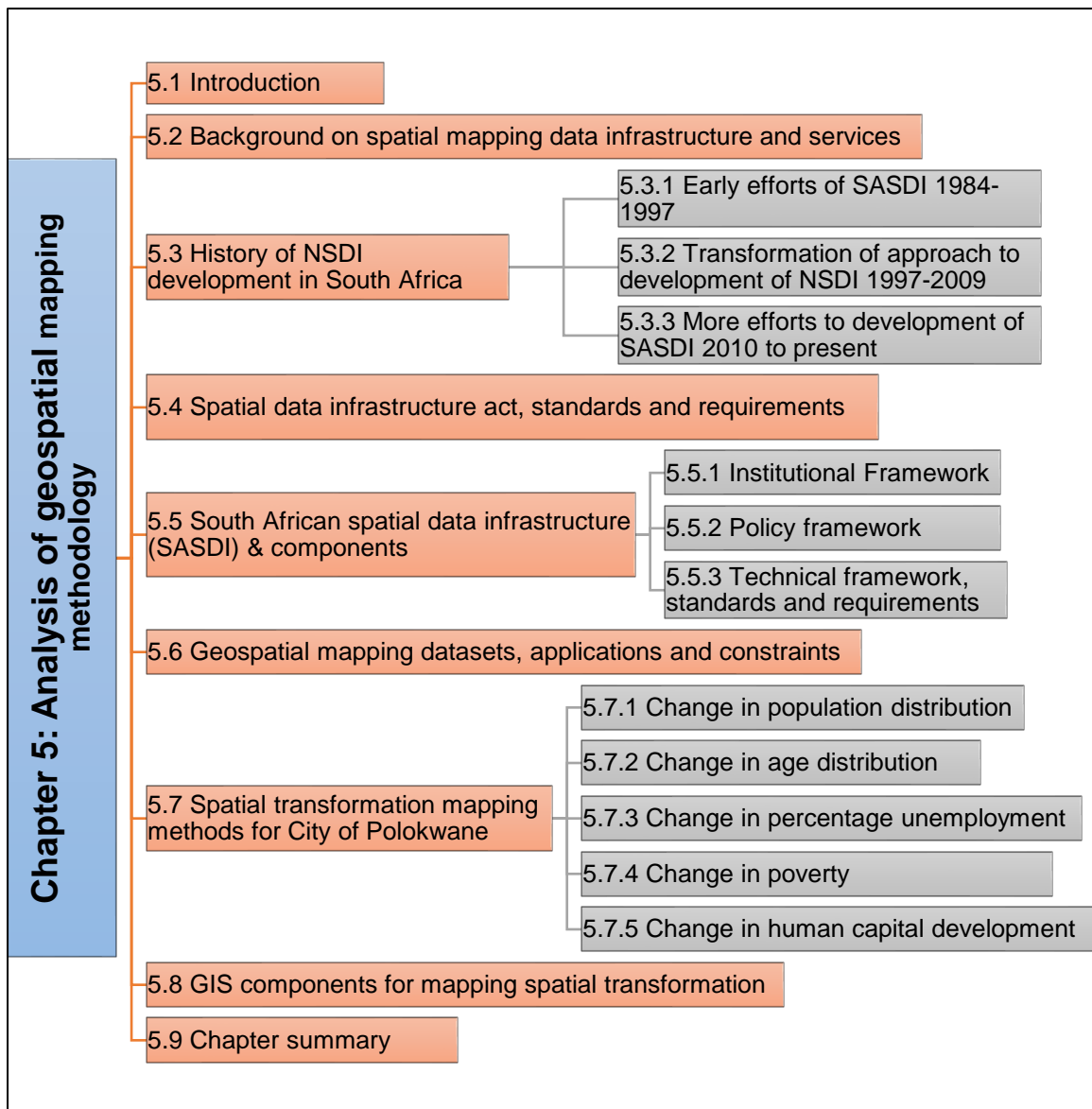


Figure 5.1: Chapter 5 Orientation

Source: Author, 2020

Figure 5.1 shows that this chapter comprises 9 sections. Section 1 provides chapter orientation, section 2 is a background discussion on spatial mapping data infrastructure and services. This is followed by section 3 providing the history on national spatial data infrastructure (NSDI) in South Africa. Section 4 unpacks spatial data infrastructure Act,

standards and requirements, while section 5 discusses South African spatial data infrastructure (SASDI) and its components. Section 6 focuses on existing geospatial mapping datasets, application and associated constraints in relation to mapping spatial transformation in this study. This led to section 7, which explains part of the methods employed working with attribute data linked to geospatial datasets selected to map out spatial changes in the City of Polokwane. Section 8, links GIS components to mapping spatial transformation in this study followed by section 9 summarising this chapter.

5.2 Background on spatial mapping data infrastructure and services

Globally there have been growing interests on development of spatial data infrastructure (SDI) to facilitate easy access of geospatial data required to track, map and generate empirical evidence on urban spatial transformations. Spatial data infrastructure (SDI) is also known as Geospatial Data Infrastructure (GDI) (United Nations Economic Commission for Africa (UNECA) *et al.*, 2003 p.7). Literature corroborates that there is no universally agreed definition for SDI (Siebritz and Fourie 2015 p.2; UNECA *et al.*, 2003. p10). It refers to an, “umbrella” that comprises of legislative policies, standards, and procedures in which institutions, organizations, agencies and their technologies cooperate together in production and management of geodata in an effort to foster improved efficiency in the use of geographic information systems (Lance 2003 p.36; Federal Geographic Data Committee (FGDC) 1996 cited in National Research Council (NRC) (2002 p.37). It is clear that this concept tries to bring together various uncoordinated stakeholders in a collaborative partnership, which have been enjoying their own independence in producing geographic data for their own interests. In doing so, Lance (2003 p.36) views SDI as a ‘hard sell’, a forceful, aggressive, advertisement, initiative, aimed at persuading, convince various stakeholders to jointly coordinate beyond their administrative and budget structures in making geographic data available to users.

In another perspective, the underlying assumption here is that geographic data is found in multiple formats, priced differently as developed by various custodians resulting in geodata that is inconsistent, conflicting, and incompatible with desired applications. The duplication of data sets also makes it difficult to accomplish any project outside the format and interest of the data custodians, which warrants the development of National Spatial Data Infrastructure (NSDI). UNECA *et al.*, (2003 p.1) corroborates this perspective stating that various government sectors, agencies, have a tendency of working in silos in relation to collection, processing, storage and sharing of geographic information making it inefficient, fragmented to access community information.

The NSDI is regarded as a consistent geographic data framework for the entire country (NRC 2002 p.37). Consistent geodata implies, geospatial data that is easy to access, compatible

with many applications, softwares and can be used multiple times, a panacea to the implications of uncoordinated development of geographic data needed to make informed socio-spatial decisions by the government. Mwangu (2017 p.2); Taylor 1997 cited in NRC (2002 p.38) pointed out that the SDI concept gained prominence three decades ago, and as a fairly recent, concept at infancy stage, the initiative's efforts, acceptance in developed economies was still far from complete, evidence to this is that it gained prominence in the USA around 1990s. Similarly, around 1990s the concept was, scanty, still at its infancy stage in developing economies, with only a few African countries having an NSDI namely Ghana, South Africa (NRC 2002 p.38) and more recently Rwanda (Mwangu 2017 p.3). This facilitates a learning curve on best and worst practices for countries still finding their ways in developing effective and efficient NSDIs.

Literature survey shows differing views on the components of an SDI for instance; geographic data, information communication technology systems (ICT), technical standards, policy and governance (GSDI cited in Siebritz and Fourie 2015 p.2); base spatial data, standards, metadata, policies and practices, and human and technical resources, (UNECA *et al.*, 2003 p.12); According to NRC (2002 p.38), "An SDI comprises standards, framework foundation data, framework thematic and other geographic data, metadata, clearinghouses, and partnerships". The content of what constitutes the NSDI vary with countries, the graphical summary of various components of an SDI are presented in figure 5.2.

Policies: data legislative policy framework provides the moral and principles facilitating ease of access to data. Without them in place various data custodians would refuse to share their data or information a common practice with most agencies in the private sector. The policies relevant to SDI cut across different aspects from right to access information, pricing, use-copyright of spatial data, and other matters (UNECA 2002 p.18).

Data standards: standards allow development of consistent geographic data (framework foundation, thematic and other data) for ease of use by interested stakeholders. They refer to, "specifications, and documented practices applied to spatial data formats, data compression and decompression formats, data transmission formats, metadata formats and computer interfaces" (NRC 2002 p.38). In support of having uniform standards there have been several parallel and joint initiatives and efforts internationally. For instance the International Standards Organization (ISO) and European Committee for Standardization had an agreement to ensuring joint international standards in 2000. Similarly, the US Geological Survey (USGS) and European Commission Joint Research Centre's joint initiative towards removing earth's observation data technical obstacles. This ensured ease of use of geographical data across the world (NRC 2002 p.38).

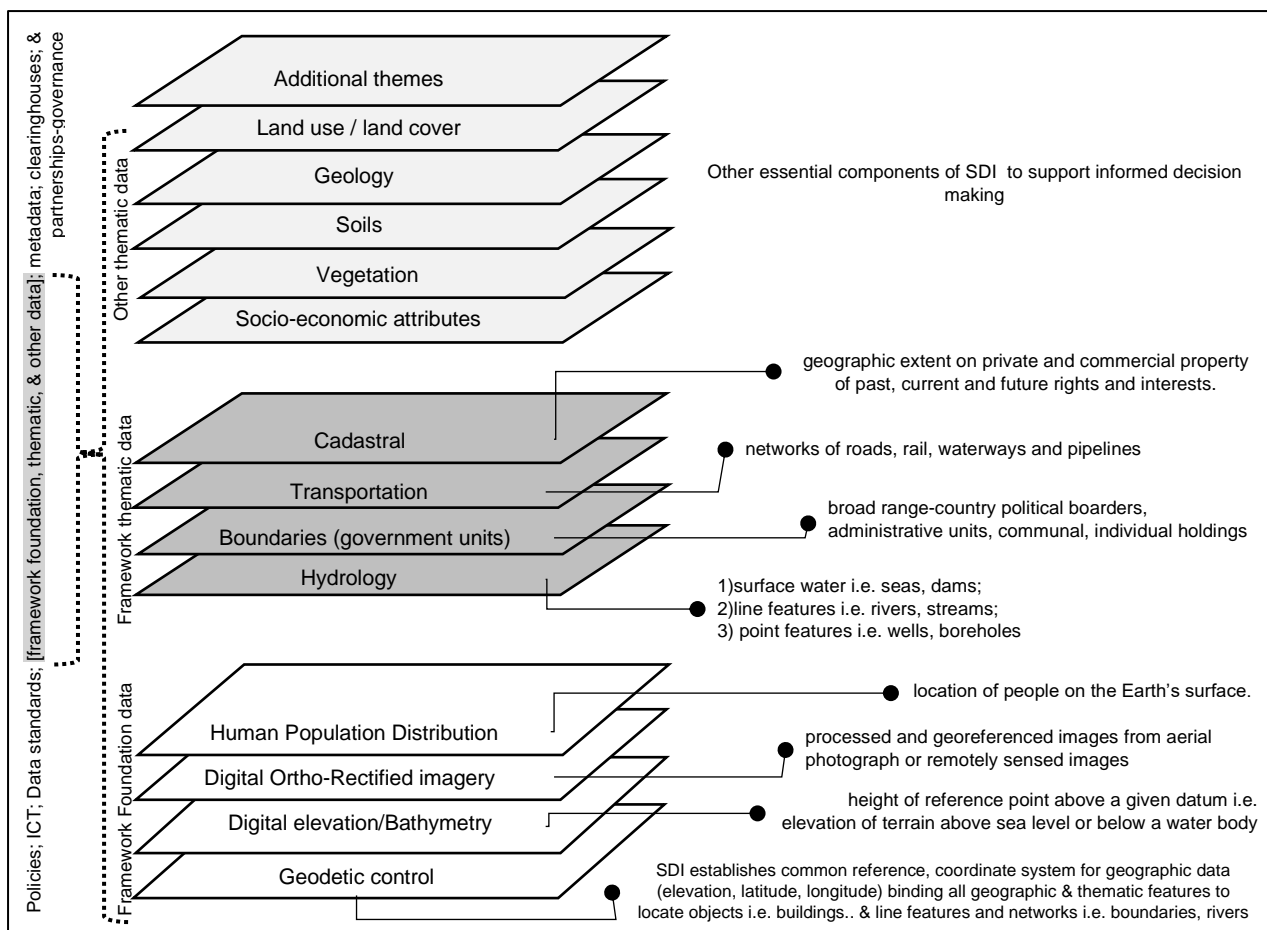


Figure 5.2: NSDI Components

Source: adopted and edited from NRC (2002 p.41)

Framework foundation data is key geospatial data, it is comprised of geodetic control; digital elevation and bathymetry; digital ortho-imagery; human population distribution (NRC 2002 p.48). This base framework data is identified as the geospatial datasets that are used for multiple application by various stakeholders. To add on, thematic geospatial datasets are also identified which are also significant for any other applications. These thematic datasets are identified as hydrology; boundaries; transportation; cadastral data (NRC 2002 p.48).

In order to identify the available geographic information, data custodians are required to provide metadata. Metadata is essential because it provides information that helps the user to understand the following questions about the data; how, when, why, where. This information about geographic data is captured in a standardized format for ease of use by other stakeholders (UNECA 2003 p.16; NRC 2002 p.49). The captured information, is uploaded to the established clearing houses, such as the metadata catalogue. These internet websites allows data custodians around the world to integrate metadata and geodata for easy searching, identification of data characteristics in relation to user requirements and sharing of the data over the internet (NRC 2002 p.49). Maintenance and continuous provision of

geographical data requires various agencies to come together to develop a functional spatial data infrastructure for any country. Therefore, there is need for partnerships, in leadership and governance of spatial data infrastructure, where in data custodian jointly partner together taking advantage of their strength, technical skills and expertise to develop an interoperable SDI for easy sharing of geographic data (UNECA 2003 p.19; NRC 2002 p.49).

5.3 History of NSDI development in South Africa

The discussion on NSDI, clearly evidences that SDI is an authoritative source of interoperable geospatial data required for mapping spatial transformation. In light of this perspective, this section discusses the development of NSDI for South Africa known as the South African Spatial Data Infrastructure (SASDI). This narrative helps one understand whether or not there is an interoperable SASDI facilitating users to access, download, and process the required geographical information using various GIS software applications employed in the endeavour of mapping spatial transformation.

5.3.1 Early efforts of SASDI 1984-1997

Efforts to develop an SDI, by the 'State Interdepartmental Coordinating Committee for the National Land Information System' (CCNLIS) in South Africa can be traced back to mid-1980s (Cooper *et al.*, 2014 p.68; Clarke 2011 p.33; Lance 2003 p.35), further attempts late 1990s Siebritz and Fourie (2015 p.3) however these attempts failed. The aim of the earlier initiative was making an inventory of geospatial datasets Cooper *et al.*, (2014 p.68) and necessitate intergovernmental sharing of geospatial information (Clarke 2011 p.33). The various departments used 'closed', disparate computer systems which inhibited sharing of information. This entails that the computer systems around 1984/5 that were used by the government departments were not integrated, or sophisticatedly advanced to meet these requirements of easy sharing of geospatial data. This meant the need for reprogramming to create a special interface that would facilitate the easy sharing of information. The departments on their own could not develop such an interface as they are not the owners of GIS software that was being promoted. In other words, GIS software developers were required to develop this interface to allow integrated sharing of geospatial information. Unfortunately, GIS software as a closed system, and owned by external, international agencies or group of companies they not seriously take heed of implementing this requirement. This requirement was considered to be 'ahead of its time', technology had not advanced to offer such capabilities, which are being enjoyed in recent years through recent advanced, revolutionary, disruptive technological innovations across different GIS software's.

Furthermore, the need to facilitate, drive the use of GIS and sharing of implementation experiences resulted in the establishment of 1985 Coordinating Committee for the NLIS,

comprised of inter-governmental departments. Foundation to this committee was public sector organizations voluntary contribution and participation. Despite showing interest and commitment to be active participants of the committee, the members did not attend the meetings consistently. In another perspective, a limiting factor to the success of this initiative was lack of knowledge on GIS, having a few experts in the country on this field. In an attempt to address this lack of capacity the project team that was working on the 'Standard Exchange of Digital Geo-referenced Information' (SEDGI), had to undergo GIS training and sensitization. In another perspective, there was limited digital geospatial information, much effort was then devoted to geospatial data digitization. This effort did not really think through of the end user of the geospatial information being generated. This gap was then filled by private sector, that emerged providing services for geospatial data conversion to reach various users.

5.3.2 Transformation of approach to development of NSDI 1997-2009

This phase was characterised by the need for change in approaches to effectively govern and manage the growing interest in public sector for access to geographic data and the use of GIS (Cooper *et al.*, 2014 p.70). The response to this need, was to assign these responsibilities to a well-resourced government department to effectively facilitate the development of the SASDI. This resulted in the transformation of the NLIS from an organizational component to become known as the National Spatial Information Framework (NSIF) as fully fledged directorate within then Dept. of Land Affairs (now Dept. of Agriculture, Land Reform and Rural Development), closer to most users and other government departments in Pretoria. This approach fast tracked and facilitated the establishment of a NSDI in South Africa (Cooper *et al.*, 2014 p.70).

Successfully in 1998 a database was built from the disparate datasets as a result of inter-departmental efforts. This clearly indicates that when different agencies, organizations partner together they attain much for the greater good of the public. The main purpose was to use the geospatial database in the planning and conducting of the 1999 provincial and national government elections. This showcased the capabilities of GIS, resulting in increased buy-in and interest from various stakeholders such as private sector data conversion services boost.

During these developments in this period, approval was granted for policy shift in geospatial information pricing model. The improved policy developments provided for access to geospatial information at no cost except supply costs to the user. Ultimately, this change in approach to free access to information increased the opportunities and adoption of GIS, even contributions of private sector value added sector.

To add on, the aim of NSIF was also to put in place technical and policy frameworks to create an environment that facilitates access and use of geospatial information for evidenced based

planning. This resulted in another significant shift towards SDI development approach from being a voluntary based approach, a legislative approach with the parliament of South Africa passing the SDI Act in 2003, followed by its enactment in 2004. This entails a hard sell, top-down approach, using established legal policy frameworks, attributed to lack of understanding and appreciation of the SDI by various stakeholders, government sectors, private sector and others Mwungu (2017 p.99). An evidence of being on the right path putting together the critical components of an SDI by establishment of legislative framework.

However, despite establishment of the Act in 2004, four years down the line there was no notable progress of implementation (Siebritz and Fourie 2015 p.3; Clarke 2011 p.34), only until mid-2010s that's when it notably come into effect (Cooper 2014 p.70). Sections 1-11, 13 and 19 to 22 of the SDI Act became operational in 2006, which is 2years after the Act was passed (Siebritz and Fourie 2015 p.3). This clearly indicates a sign of reluctance, lack of understanding of the significance of having an SDI to inform investment decisions in the country. Clarke (2011 p.34) adds that during this period, another drawback on the successful development of the NSDI, was poor maintenance, limited, inadequate functionality of the geo-portal catalogue. The inadequate functionality of the geo-portal, hindered coordinated collection of data and metadata paucity. The implication of this was establishment of multiple geo-portals by the various departments in an effort to share their data. This clearly showed lack of coordination resulting in geoportal duplication.

5.3.3 More efforts to development of SASDI 2010 to present

The notable developments of this period include the Directorate NSIF being handed back in 2010 to the national mapping organization (Siebritz and Fourie 2015 p.3; Clarke 2011 p.34; Vorster and Duesimi 2010 p.31). To add on, the leadership for the NSDI initiative, Committee for Spatial Information (CSI) was established in 2010 (Campbell 2017 p.1; Siebritz and Fourie 2015 p.3; Clarke 2011 p.34). The CSI embarked on audit of geo-portal, and the Spatial Metadata Discovery was one of the tools, which was found to be operating inadequately leading to it being dropped based on the audited outcomes.

The CSI continued to have regular meetings leading to the establishment of the sub-committees, a crucial structure required for the success of the NSDI. These sub-committees are "policy and legislation, data, systems, standards, communication, and education and training" (Clarke 2011 p.34). To add on, other developments of the NSDI in this period include, promulgation of sections 12,14-18 of the SDI Act after approximately 11years. This clearly indicates that less progress in development of the NSDI are also attributed to these delays in establishment of necessary structures, and the necessary appointments. In addition, another development was the Pricing of Spatial Information Products and Services which was ratified

2015 and also Base Dataset Custodianship (Campbell 2017 p.2; Siebritz and Fourie 2015 p.3). The spatial information products and services identified two broad categories namely; generally available products and services which are accessible for free and value-added products and services which are charged extra costs. This is a significant development in that most geospatial agencies charge exorbitant prices for their product which makes it difficult for most users to get access to such information they require for their projects. Thus, having an established SASDI offering certain products at no cost to the public improves information access, notably the right to access information.

In another perspective, Campbell (2017 p.1) pointed out the Director for NSIF, acknowledged that there is considerable progress that has been made in developing the SASDI, but there are gaps that need to be addressed. There are ten Base Dataset Custodianship that were identified which are responsible for registering, capturing and maintaining metadata for geospatial data held by their respective portfolios in line with the provisions of the Act. Only two custodians out of ten have been appointed (Campbell 2017 p.2). This has serious negative implications on access to geospatial information required for mapping spatial transformation as required for evidence based planning. This delayed appointment of data custodians implies that the researcher have to rely on geospatial data produced by other agencies for their own project related processes, making the data inadequate or limited in executing certain analytical functions of indicating spatial transformation. On that same note, geospatial data from other agencies is steeply priced because of their closed business system nature, attributed to lack of competition of the SASDI which would offer most of the geospatial data free of access.

In addition, to the ten Base Datasets Custodianship, also ten Base Dataset themes were identified. Similarly, only two Basic Dataset coordinators responsible for conservation and land cover areas had been appointed as of 2017 (Campbell 2017 p.2). Furthermore, another essential development in this period is the development of a data capture project register (DCPR), in order to help identify what various stakeholders are engaging in (Campbell 2017 p.2). This assists in capturing user's information and their related projects or activities when they report errors or propose any requirements.

In light of these developmental path discussed, South Africa is regarded as a leader in development of the SDI in the African continent,(Clarke 2011 p.33). This corroborates with Mwungu (2017 p.30) survey findings that, South Africa was the only country considered to be having a very good status and operational clearing house portal for SDI in Africa. This success status of the South Africa's Spatial Data Infrastructure (SASDI) is attributed to the continued, sustained financial support from the government, (Mwungu 2017 p.8; Lance 2003 p.36). It also

created policy frameworks, an enabling environment which is a driving force for the successfully attained milestones in facilitating access to geographic data.

5.4 Spatial data infrastructure Act, standards and requirements

This section discusses the Spatial Data Infrastructure Act 54 of 2003 for the Republic of South Africa. According to section 2, this Act is applicable to organs of state that hold geo-spatial information and those who use such information. Figure 5.3 provides a summary of the SDI Act of 2003.

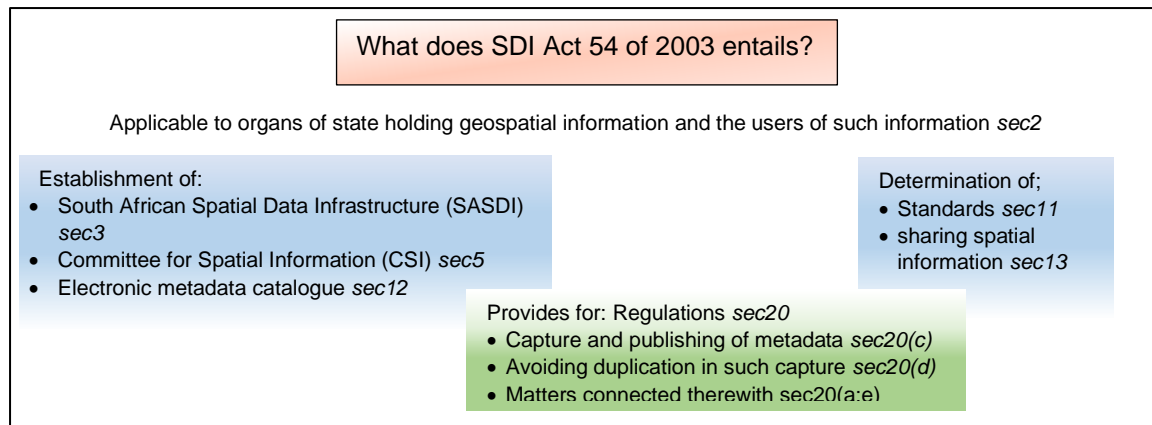


Figure 5.3: Spatial Data Infrastructure (SDI) Act No. 54 of 2003

Source: Author, 2020

Figure 5.3, shows the provisions put in place to address the challenges discussed in the section on the background development of South Africa's Spatial Data Infrastructure through the SDI Act of 2003. Section 2 of the Act, points out that this Act is applicable to organs of state that hold geo-spatial information and those who use such information. This created an enabling environment to ensure that various agencies responsible for geospatial data can collaboratively make it available to users. In particular, geospatial information is essential for tracking spatial transformation generating empirical evidence, required to assess the progress attained by the post-apartheid policy frameworks in relation to spatial restructuring of South African cities.

5.5 South African Spatial Data Infrastructure (SASDI) and components

In order to ensure that geospatial data is made easily available to various stakeholders, the Act articulates that an SDI should be established, dubbed the South African Spatial Data Infrastructure (SASDI). Section 3(1) of the Act, points out that establishment of SASDI is aimed at creating an enabling environment facilitating coordination, and cooperation between organs of state, other stakeholders, avoiding duplication in capturing, effective management and maintenance, integration, universal access, distribution, sharing and ensuring copyright protection of geo spatial information. This is prompted, by the increasing recognition of the

need to use, spatial outcomes, indicators to generate empirical evidence from geospatial data to support decision making in policy, socio-economic development, spatial planning and any other activities. Particularly, activities such as tracking spatial transformation are reliant on geospatial information, which implies the SASDI is a critical database that provides access to multiple geographical datasets required for tracking and mapping of urban restructuring.

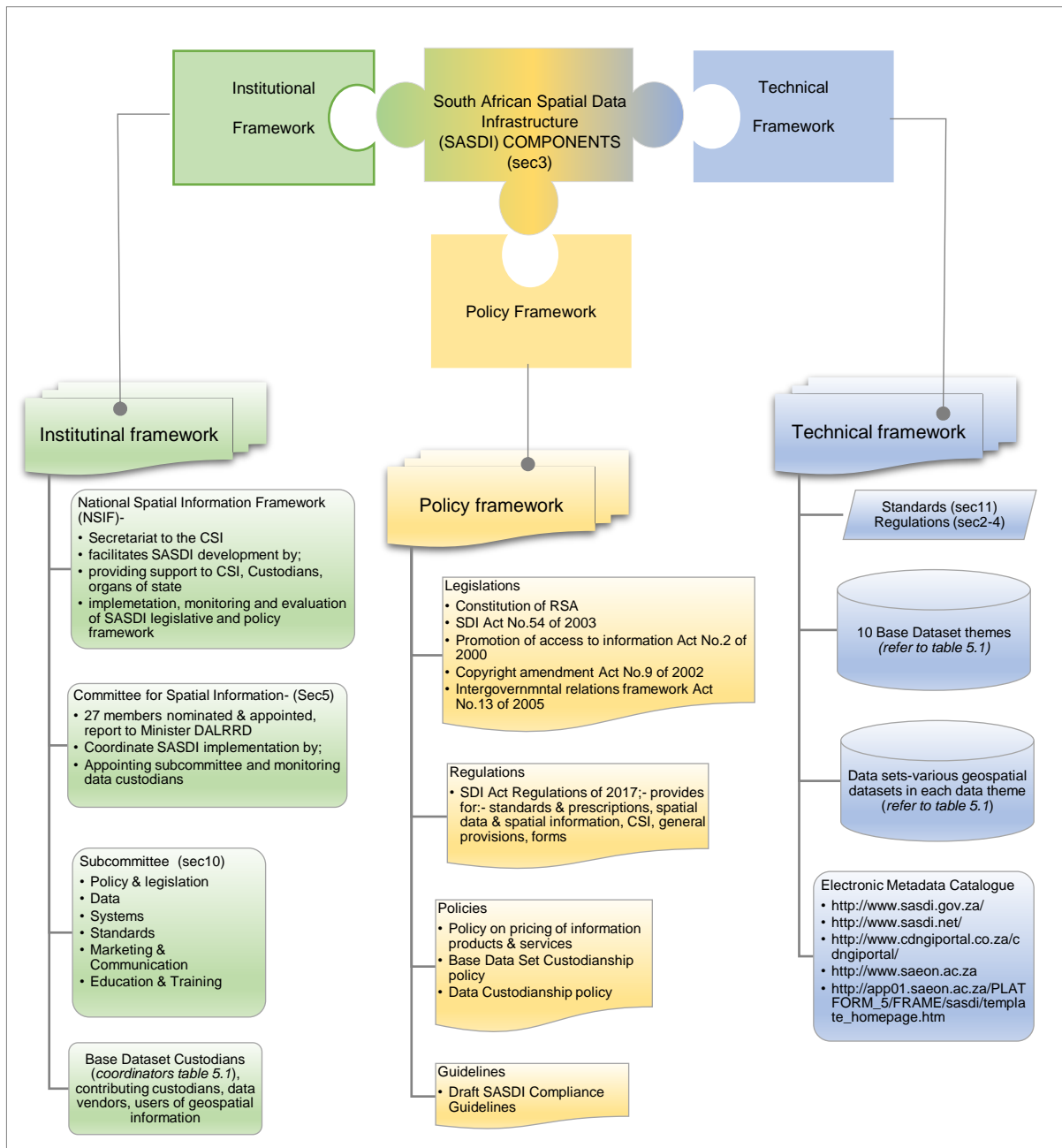


Figure 5.4: South African Spatial Data Infrastructure Components

Source: Author, 2020

The earlier discussion articulated that there are differing views on the components of an SDI. In relation to SASDI, the identified components are; institutional, technical, and policy frameworks (SDI Act 2003 3(1)). Figure 5.4 illustrates the key components of SASDI that are

assumed to be critical, in facilitating access to geospatial information required for tracking spatial transformation.

5.5.1 Institutional Framework

The institutional framework component, shows that the SASDI is facilitated by the National Spatial Information framework under the Directorate of NGI, giving all the necessary support to the CSI, organs of state and the custodians. This is important because DALRRD, where the NGI is situated is also responsible for gathering other geospatial information and are experienced in such matters. The 1st committee for CSI was established in 2010, this implies there was no progress of establishment of a fully functional SASDI and geospatial data can only be obtained from other organs of state and vendors who captured and produced such information for their own interests. To add on, a subcommittee was established by the CSI as part of its mandates, to assist in paving the road for the success of SASDI. The subcommittees are, policy and legislation, systems, data, education and training, standards, marketing and communication. These subcommittees create an enabling environment for a successful SASDI, for instance Data subcommittee is responsible for identifying data custodians, Base dataset themes, data sets, and managing and monitoring of data collection project register (DCPR) for integration in SASDI. In line with their responsibilities, data custodians were proposed in 2012, and in 2019 a 2nd list was published of the appointed data custodians. This slow process in appointment of key personnel required to facilitate the efficacy and efficiency in SASDI development is worry some. This implies it's still a long way before getting a functional SASDI, that would provide integrated access to geospatial information.

5.5.2 Policy framework

SDI Act No. 54 of 2003, indicates that the other key component of the SASDI is policy framework. On one hand, the objective of the policy framework is to create an enabling environment for effective and efficient geospatial data capturing, management for the development of an SDI. On the other hand policy framework seeks to ease access to geospatial datasets required by various stakeholders, in particular for mapping spatial transformation in this study. Thus, various policy frameworks can be identified, Constitution of RSA, SDI Act no. 53 of 2003, Promotion of access to information Act no. 2 of 2003. The key legislation is the SDI Act 54 of 2003, section 3 provides for the establishment of SASDI to promote integration of organs state in capturing and sharing spatial information, an attempt to address challenges alluded in the discussion on SDI development in SA. To add on, the SDI Act, is also under review process, and various policies, guidelines and regulations have been developed for the development of the SASDI. A general pattern emerging is the delay of critical aspects that promote the SASDI, in particular, the Act was established in 2003 yet the policies

were developed in 2013 following the establishment of CSI in 2003, and by extension regulations of the SDI Act 54 of 2003 were put in place in 2017 that is 14years later after the establishment of the Act. These delays are negatively impacting on the successful development and functioning of the SASDI. This implies data custodians, base set themes, data sets were not in place waiting for the establishment of relevant committees, and subcommittees which would then identify and appoint data custodians responsible for capturing, maintaining and sharing of geospatial information.

5.5.3 Technical framework, standards and requirements

The technical framework is overarching, comprising key aspects of framework datasets, technical standards and the technologies required to promote easy access to geospatial information. The framework datasets, is also known as the base dataset themes (Permanent Committee For Geospatial Data Infrastructure of the Americas (PC-IDEA) 2013 p.5). As part of the technical framework 10 Base Datasets themes, were identified through a series of consultations with key stakeholders and agreed as the common geospatial datasets that are mostly sought after and used for various applications that rely on empirical findings from geographical information. The Base Dataset themes that were identified also presented in table 5.1 are; 1.Administrative boundaries, 2.Imagery, 3.Roads, 4.Social statistics, 5.Land use, 6.Land cover, 7.Cadastre, 8.Hydrology, 9.Geodesy, and 10.Conservation areas. In essence, these are the base datasets required to be integrated through SASDI in order to bridge the gaps and challenges to access of geospatial information usually confirmed to the fragmented geographical data vendors. This is a welcomed development for South Africa, however such identified base mapping datasets are required to be assigned to a base dataset custodian. Table 5.1 presents a grave concern towards the successful development of SASDI, the 2013 approach was all encompassing, integrating a number of custodians that were proposed. However, the 2019 approach towards assigning the custodians is limiting, restrictive, exclusionary by not integrating other key contributory data custodians. Furthermore, lack of appointment of the various data custodians as presented in table 5.1 is a drawback on the development of a functional SASDI. This implies that as of now the SASDI is not yet functional in providing easy access to geospatial data as the data custodians are not yet appointed. Therefore, the implication in relation to this project is that the researcher had to find other alternative means, sources to acquire the required geospatial information for mapping spatial transformation.

Table 5.1: Base Dataset Coordinators, Themes, Datasets and Custodians

Base Dataset Coordinators	Base Dataset theme	Datasets	Proposed Custodian 2012	Custodian appointed 2019
Dept. Agriculture, Land Reform & Rural Development (DALRRD) – Office of the Chief Surveyor-General (OCSG)	1.Administrative boundaries	National Boundaries	Municipal Demarcation Board (MDB)	Not yet appointed
		Provincial Boundaries	MDB	Not yet appointed
		Coastlines	Datasets not included in 2012	Not yet appointed
		High water marks		Not yet appointed
		Low water mark		Not yet appointed
		Municipal Demarcation Board (MDB)	District Municipality	MDB
Dataset not included in 2019	Local Municipality	MDB	MDB	
MDB	Metropolitan Municipality	MDB	Dataset not included in 2019	
Dataset not included in 2019	Magisterial districts	Department of Justice	Dept Justice and Constitutional Development	
MDB	Voting districts	Independent Electoral Commission (IEC)	Dataset not included in 2019	
Dataset not included in 2019	Wards	MDB	MDB	
MDB	Traditional Boundaries	Provincial Department of Traditional Affairs	Dataset not included in 2019	
SANSA	Tribal Authorities	Department of Traditional Affairs	Dept. Traditional Affairs	
DALRRD CD:NGI	2.Imagery	Satellite Imagery	South African National Space Agency (SANSA)	Not yet appointed
		Aerial photography (0.35m-0.5m)	National Geo-spatial Information (NGI)	DALRRD-CD NGI
Department of Transport	3.Roads	National	NGI, South African, National Roads Agency Limited (SANRAL), National Roads Agency (NRA)	Not yet appointed
		Main, Secondary, other	NGI, Provincial Government, Local Authorities	Not yet appointed
		Streets	Provincial Government, Local Authorities	Not yet appointed
Not indicated	4.Social statistics	Place name	Statistics South Africa (Stats SA), NGI, Provincial Government, Local Authorities, South African Geographic Names Council (SAGNC)	Not yet appointed
		Enumeration areas	Stats SA	Not yet appointed
		Small areas		Not yet appointed
Not indicated		Dwelling frame	Stats SA, Eskom, Department of Water and Sanitation (DWS), Local Authorities	Not yet appointed
DALRRD CD:NGI	5.Land use	Land use	NGI, National department, Provincial Government, Local Authorities	Not yet appointed
	6.Land cover	Land cover		Not yet appointed
DALRRD-OCSG	7.Cadastre	Land parcel boundaries	Chief Surveyor General (CSG), Provincial Surveyors General, Department of Agriculture Forestry and Fisheries (DAFF), Local Authorities	Offices of the surveyor Generals
		Deeds register attributes	Deeds Office	Chief registrars of Deeds Registrar of Deeds
Department of Human Settlements, Water and Sanitation (DHSWS)	8.Hydrology	Water courses streams and rivers	DWS, NGI, Local Authorities, Catchment Management Agencies (CMA)	DHSWS
		Rivers spatial data	Dataset not included in 2012	DALRRD-CD NGI
		Drainage networks and catchment	DWS	DHSWS
		Water bodies (e.g. dams, lakes)	DWS, NGI, Local Authorities, CMA	Not yet appointed
		Water resources (boreholes, ground water)	Department of Water and Sanitation (DWS) Catchment Management Agencies (CMA)	Not yet appointed
		Wetlands	Datasets not included in 2012	Not yet approved
Water management areas	DHSWS			
Drainage regions	DHSWS			
DALRRD CD:NGI	9.Geodesy	Trigonometrical beacons	NGI,	DALRRD-CD NGI
		Town Survey Mark	Dataset not included in 2012	DALRRD CD:NGI
		Town Survey Mark Schemes	NGI, Local Authorities	DALRRD-CD NGI
		Benchmarks	NGI, Local Authorities	DALRRD-CD NGI
		TrigNet GNSS Base station network	NGI	DALRRD-CD NGI
		Geoid Model	NGI	Not included in 2019
Department of Environmental Affairs	10.Conservation areas	Conservation Areas and Protected Areas	Department of Environmental Affairs (DEA) Provincial Government, Local Authorities	Not yet appointed

Source: Author, 2020

Table 5.1 shows the 10 Base dataset themes, datasets for the themes, proposed and those appointed custodians by CSI in 2019.

Furthermore, as part of the technical framework, technologies are required to be put in place to ensure easy access to the identified key base datasets and any other data sets of geospatial information included in the SASDI. This implies, development of Electronic Metadata Catalogue which is an internet web service to facilitate remote, global search and identification of the geospatial data required by the users. According to PC-IDEA (2013 p.6), technologies for SDI entails the development of a network of physical servers that ensure an internet Web service, access to geospatial data through the Web services, and further allows easy integration with developed application that can pull geospatial data from this service. A typical example is the USGSS catalogue which allows other third party applications such as Quantum GIS- Semi-automatic classification plugin to directly download satellite images as defined by the user. In another perspective, Mabuza (2003 p.2319) argues, that the aim of developing SASDI is not intended to create a single centralized geospatial database, but rather to make a network of linked different databases, that are developed, managed and maintained by the different respective data custodians, agencies, vendors through the use of uniform protocols and standards. The underlying assumption is that a network of databases promotes integration of multiple sources of various geospatial data making it easy to identify and access geospatial information. In an attempt to facilitate the development of a functional SASDI, websites and internet service to capture metadata on the electronic metadata catalogue have been put in place.

The SASDI, website (<http://www.sasdi.gov.za>) is aimed at promoting easy access, use and sharing of geospatial information and providing an enabling environment for coordinated and cooperative efforts in providing access to geographical data. Siebritz and Fourie (2015 p.4) pointed out that the website was being developed as of 2015 and expected to integrate other necessary technical tools into this single website, without including the electronic metadata catalogue (EMC). Despite having the website, the lack of appointed base dataset custodians make it difficult to access required geospatial data for mapping spatial transformation from this website. To add on, an EMC is not integrated in the SASDI website as it is being hosted by South African Earth Observation Network (SAEON). This clearly indicates a fragmented system that makes it confusing and complicates the understanding of available and accessible geospatial information. This implies users have to continue relying on other various geospatial data vendors, agencies or government departments a process which is inefficient, and some data vendors do not offer free access to their spatial data sets.

In addition, data custodians, agencies and vendors are required to capture their metadata, data about data or simply information about their geospatial data for integration into the EMC. At one end, this is aimed at allowing users across the globe to search on the internet and be able to decide whether the available data meets their project requirements or not. On the other

end, allowing a feedback process from users to data queries, identifying areas that need to be addressed by the data custodians. Various standards have been put in place by the international community also followed by South African Bureau of Standards on geographical information. Metadata is essential for identifying available spatial data. According to Fourie (2015 p.22) metadata standards define the, “scheme/schema (metadata sections, entities and elements) and how metadata should be captured and represented”. This implies that if all data custodians capture geospatial spatial information using similar standards it allows easy integration into the EMC as required to make data available to users. Thus, standards are needed to ensure uniformity in capturing of data about data to promote interoperability of such spatial information.

The International Standards Organization (ISO) through its geographical information standards subcommittee TC/211 developed the following metadata standards: “ISO 19115-1:2014 – Geographic Information – Metadata – Part 1: Fundamentals; and ISO 19139: 2007 – Geographic Information – Metadata – XML schema implementation” (Fourie 2015 p.22). In line with these international standards, the South African National Standards (SANS) also developed local schema of metadata standards facilitating capture of geospatial information metadata by custodians. These standards are; “SANS 1878-1: 2005 South African spatial metadata standard, Part 1: Core metadata profile and SANS 1878-2: 2010 Geographic information – Metadata – Part 2: Extensions for imagery and gridded data” (Fourie 2015 p.23). Interoperability of geospatial information relies on adequate capturing of metadata, which make it easier to search and easily access such information. This implies as much detail as possible needs to be captured for the available datasets by each responsible data custodian, agency or vendor as assigned. Table 5.2 presents the SANS 1878 metadata standards in line with ISO 19115 for South Africa. The various information that needs to be captured to ensure interoperability of geospatial datasets, to answer the what, where, when, who, whom, and how questions about geographic data.

Table 5.2: Standards: Metadata capture requirements

<ul style="list-style-type: none"> ❖ Identification or Citation (what, by whom, why): <ul style="list-style-type: none"> • Title (M) • Resource online URL (C) • Subject (M) • Publication/reference date (M) ➤ Author/Responsible party (who to contact): <ul style="list-style-type: none"> ✓ Author/creator responsible party/individual (M) ✓ Publisher responsible organisation (M) ✓ Address (O) ✓ Position/role (O) ✓ Contact details (O) ➤ Associated party/co-author(s): <ul style="list-style-type: none"> ✓ Contributor individual (C) ✓ Contributor organisation (C) ✓ Address (O) ✓ Position/role (O) ✓ Contact details (O) • Topic category, keywords (M) • Abstract/description (M) ❖ Usage, restrictions, constraints (for whom, for what): <ul style="list-style-type: none"> • License and user rights (M) • Provenance/lineage statement (M) ❖ Methodology (how): <ul style="list-style-type: none"> • Main step(s) (O) • Detailed documentation/description (O) • Instrumentation (O). <p>(M) Mandatory (C) Conditional (O) Optional</p>	<ul style="list-style-type: none"> ❖ Technical parameters (what): <ul style="list-style-type: none"> ✓ Language (M) ✓ Character set (M) ✓ Scale/resolution (M) ✓ Distribution format(s) (M) ✓ Format version (C) ✓ Data/spatial representation type(M) ✓ Spatial reference system (M) and Projection (C) ✓ Data Quality (M) ✓ Maintenance (m) ❖ Data dictionary/schema (what): <ul style="list-style-type: none"> • Object type/name (M) • Attribute name(s) (O) • Definition, valid values (O) • Column/field name(s) (O) • Value type (O) • Dictionary URL or schema (O) ❖ Coverage/dimensions of the data (where, when): <ul style="list-style-type: none"> ➤ Spatial coverages - provide at least one: <ul style="list-style-type: none"> ✓ Geographic identifier/location/name (M) ✓ Geographic Reference: <ul style="list-style-type: none"> ✓ Latitude (C); Longitude (C) ✓ Bounding coordinates: <ul style="list-style-type: none"> ✓ North (M); South (M); West (M); East (M) ➤ Vertical Extent: <ul style="list-style-type: none"> ✓ Minimum (C); ✓ Maximum (C); ✓ Unit of measure (C); ✓ Datum (C) 	<ul style="list-style-type: none"> ➤ Temporal extent/coverage <ul style="list-style-type: none"> ✓ Begin date (M) ✓ End date (M) ➤ Physical measurement/ observation coverage: <ul style="list-style-type: none"> ✓ Quantity (O) ✓ Unit (O) ➤ Taxonomic coverage: <ul style="list-style-type: none"> ✓ Rank(s) (C) ✓ Value(s) (C) ❖ Metadata elements: <ul style="list-style-type: none"> ➤ Online resource: <ul style="list-style-type: none"> ✓ Metadata online URL (C) ✓ Protocol (C) ✓ Name (C) ✓ Description (C) ➤ Metadata standard: <ul style="list-style-type: none"> ✓ Metadata standard name (C); ✓ Version (C) ✓ Language (M) ✓ Character set (M) • Metadata file identifier (M) • Metadata creation date/time stamp (M) • Maintenance (m) ➤ Custodian (metadata): <ul style="list-style-type: none"> ✓ Metadata contact/individual (M) ✓ Organisation (M) ✓ Address (O) ✓ Position/role (O) ✓ Contact details (O) <p>Key:</p> <ul style="list-style-type: none"> ❖ Section, • element ➤ Entity, ✓ element
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Source: Fourie (2015 p.24)

The standard required metadata or information about the available spatial datasets as compiled by Fourie (2015 p.24); Cooper (2017 p.10) is presented in table 5.2. It shows the fields that are mandatory, conditional and optional when data custodians are capturing metadata. In relation to some fields, the SANS 1878, purposefully changed some of the ISO 19115 metadata core elements into mandatory (M) for South African standards. These fields are further grouped as section and its element, and entity as well as its element. For instance on the first section, identification or citation seeks to answer question on what dataset is this? Who created it, the custodian? And why such geodata was created. The mandatory (M) elements that answer this section include, title, subject and publication reference data and lastly the resource online URL which is conditional (C). When all this information is captured and embedded in the EMC it then appears on the search results when a user search for spatial datasets that fits the user commands. Basically without metadata it will be difficult to find any geospatial data on the internet search engines like Google. In light of this data custodians, vendors and agencies are mandated to capture metadata about their geographical data.

SDI Act provides for development of regulations and policies, as part of SASDI policy framework, on any other matters such as ensuring interoperability of geospatial data. In line with this, SAEON developed policy guidelines on government procurement of spatial datasets, recommending that a clause should be added to requests for quotations, tenders and service level agreements. The clause states that, "The service provider or contractor will be required

to provide metadata compliant with the provisions of the SDI Act and the specifications developed by NSIF for each dataset indicated as a deliverable under this contract, and will assent to the fair use provisions required by the client” (SASDI, 2020 <http://www.sasdi.net/ppage.aspx?index=0,1>). This clause is essential, local authorities are also contributing custodians to the production of geospatial information. However, most municipalities lack the technical expertise required to generate such geospatial information resulting in appointment of service providers to render services such as development of spatial development frameworks (SDF's), and precincts plans. On one hand the appointed service providers deliver the required products in the form a soft or hard copy documents, and on the other hand their geospatial data submitted to the municipality is mostly inadequate, some files do not open. Similarly, such a situation was encountered in the case study setting, the geospatial data files submitted to the City of Polokwane by other service providers were inadequate, not useful for mapping spatial transformation. Simply because other GIS files from appointed service providers collected from the municipality, were not opening in ArcMap. This clearly shows a violation of this policy clause, and by extension limiting access to data needed to generate empirical evidence needed to support spatial planning and public investment decisions.

In another perspective, despite all organs of state being mandated to register their datasets, capture their metadata, and by extension the same applies to other geospatial data agencies the slow pace they are taking heed of the call on capturing metadata is disappointing. According to Siebritz and Fourie (2015) pointed out that the SASDI node showed that only four stakeholders had registered on the SASDI node namely Stats SA, Department of Environmental Affairs, National Geo-spatial Information, and City of Johannesburg. This same number, did not change even in 2020 as noticed by the researcher on the same website, as accessed on the following web link, http://nsif.dirisa.org/nodes/folder_contents. On another platform, capturing of metadata is facilitated by registering on the <http://www.sasdi.net> website presented in Figure 5.5 were various stakeholders can register their profiles for contribution of metadata.

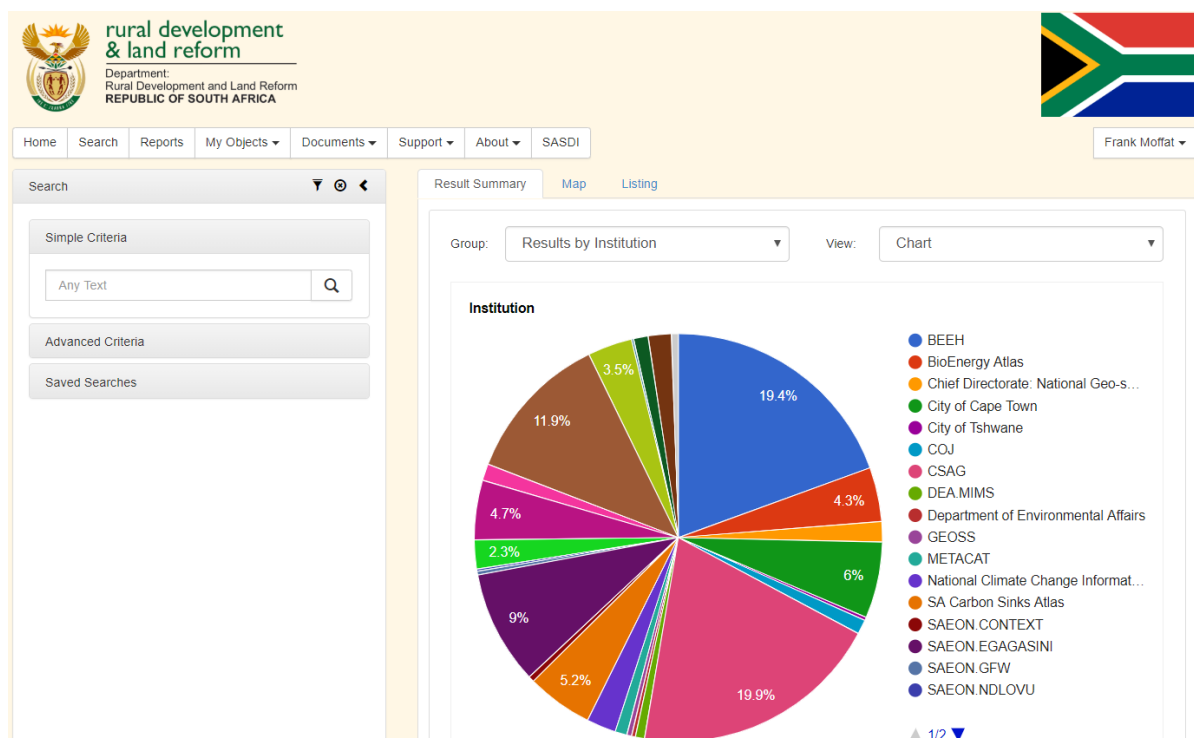


Figure 5.5: Electronic Metadata Catalogue Search and Discovery on SASDI website

Source: SASDI 2020 (<http://www.sasdi.net/search.aspx>)

The number of stakeholders registered on the EMC shows that there is a dire need of strategies to enhance the contributory custodians understanding of their role in facilitating a functional SASDI for the republic. The registered stakeholders through the sasdi.net website as noted by the researcher after registering for a user profile are 59 namely;

- 1.Pixley Ka Seme, 2.Dept. of Environmental Affairs, 3.City of Johannesburg Metropolitan, 4.Dept. of Rural and Land Reform, 5.Dept. of Water and Sanitation, 6.Chief Surveyor General, 7.Statistics South Africa, 8.SA Carbon Sinks Atlas, 9.Limpopo Provincial Government, 10.South African National Biodiversity Institute, 11.South African Environmental Observation Network, 12.Chief Directorate: National Geo-spatial Information 13.Surveyor General Gauteng, 14.Directorate: Land Use and Soil Management, 15.Forestry Regulation and Oversight, 16.Rural Environment and Agricultural Development, 17.ESKOM, 18.UCT Geomatics Division, 19.Climate Systems Analysis Group, 20.GEOSS, 21.Passenger Rail Agency of South Africa, 22.Dept. of Social Development, 23.METACAT, 24.Branch: National Geomatics Management Services, 25.Gauteng Provincial Government, 26.DEA, 27.Witzenberg Municipality, 28.Eden, 29.Theewaterskloof, 30.BioEnergy Atlas, 31.University*, 32.City of Tshwane, 33.Kayamandi, 34.Surveyor General KwaZulu Natal, 35.Emfuleni, 36.Municipal Demarcation Board, 37.Higher Education and Training, 38.Western Cape Government: Department of the Premier, 39.Umgeni Water, 40.SARVA.ENERGY, 41.Ekurhuleni, 42.Eastern Cape Dept. of Cooperative Governance and Traditional Affairs, 43.Dept. of Local Government and Traditional Affairs, 44.Right to Care, 45.Ngaka Modiri Molema, 46.Mangaung Metropolitan, 47.Surveyor General: Free State, 48.CSIR, 49.City of Cape Town Metropolitan, 50.City of Mpumalanga, 51.Dept. of Economic Development Environment and Tourism, 52.The new School*, 53.Dept. of Science and Technology, 54.Dept of Cooperative Governance and Traditional Affairs, 55.Royal HaskoningDHV, 56.National Climate Change Information System, 57.Western Cape Department of Agriculture, 58.Central European University, 59.3A South African National Space Agency (<http://oa.dirisa.org/Institutions>) 2020.

This list shows that 59 institutions signed for metadata provision, in support of the SASDI. This is of great concern, the registered number of stakeholder is less than a quarter of the 257

municipalities in South Africa all of which are key contributor custodians of geospatial information. This implies they are not constantly sharing the geospatial information they are generating when engaging in various planning activities. A further analysis and browsing from the EMC, presented in Figure 5.5, shows that available geospatial data provided through this SASDI facility is inadequate for tracking spatial transformation. The local municipalities are key contributors of geospatial data, but they are not undertaking their responsibilities making it difficult to access such essential data through the EMC. To add on, part of the geospatial data provided by the custodian institutions are inadequate for tracking spatial transformation. In particular, Stats SA datasets provided in this EMC are mere polygons of Small Area, Main Place, Sub-place without the required census data, which implies that this dataset not fit for use to map spatial transformation. The implication of these constraints are that the researcher had to source geospatial datasets that are fit for mapping spatial transformation directly from the various geographical agencies, and vendors.

5.6 Geospatial mapping datasets, applications and constraints

This section assesses geospatial data fitness for use in tracking or mapping spatial transformation. This was prompted by earlier discussion which evidences that some of the geospatial datasets from the authoritative data custodians are inadequate, limited, constrained and are not fit for mapping spatial transformation. Key to understanding spatial transformation is tracking of social statistics, as evinced in table 2.2 (refer to chapter 2) which shows that various spatial transformation indicators within the broad aspects of demographic distribution, urban texture and urban structure are largely measured quantitatively using social statistics. Thus, to map spatial transformation the researcher requires geospatial data with polygons that are linked to existing social statistics data between 1996 and 2016. Figure 5.6 presents the identified geospatial data sets identified and assessed for their fitness, constraints in mapping spatial transformation.

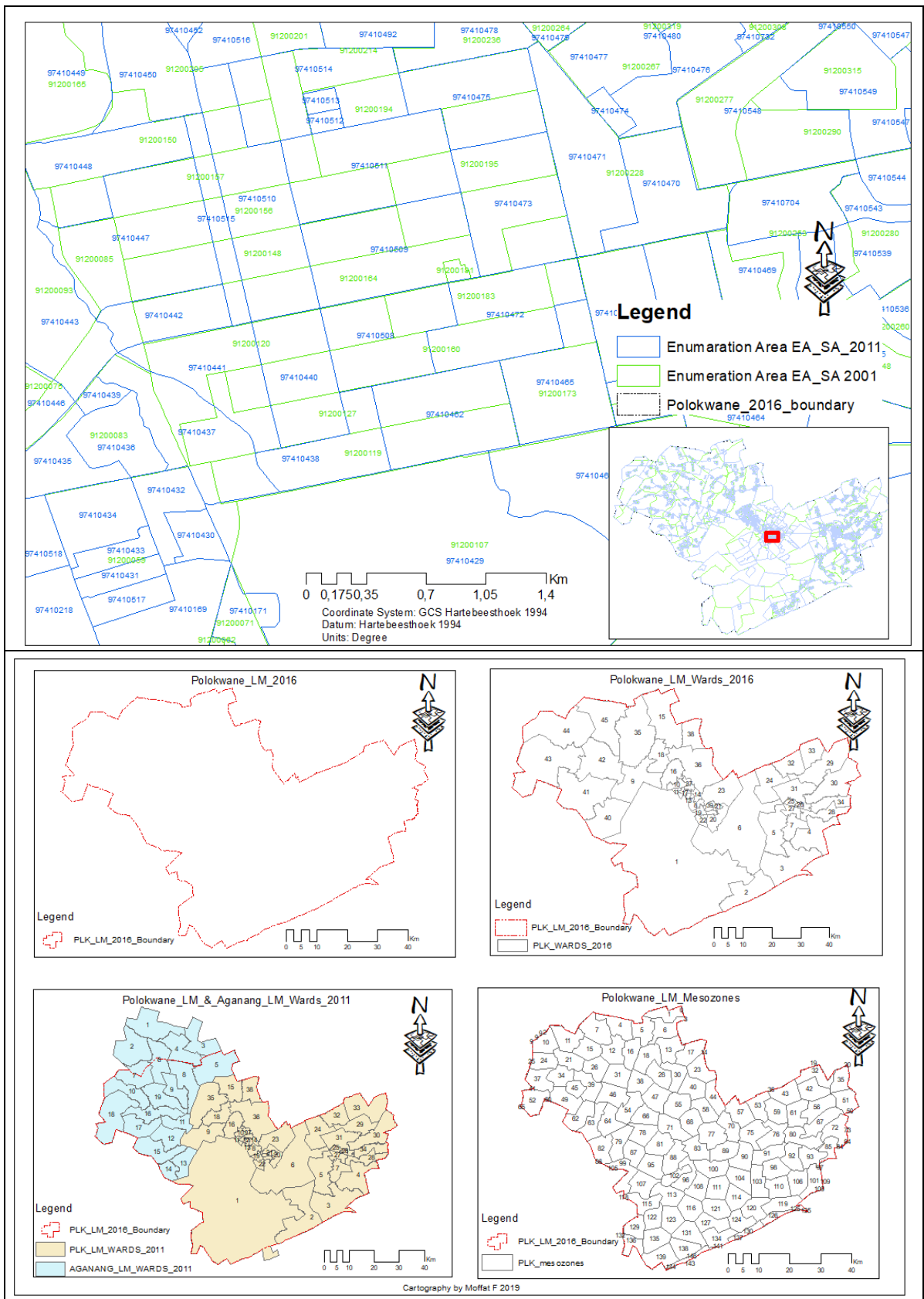


Figure 5.6: Geospatial data scale comparison for spatial transformation analysis

Source: Author, 2020

Figure 5.6 above shows some of the different possible scales of analysis that could have been adopted in mapping spatial transformation. However, the research comparatively assessed these different scales of analysis to decide the best suitable spatial scale for this study as presented in table 5.3.

Table 5.3: Assessment of geospatial data fitness for mapping spatial transformation

Geospatial dataset	Constraints/fitness for application	Decision
Enumeration Areas (EA)	Stats SA boundaries for enumeration areas (EA) keep changing as shown in Figure 5.6 with green polygons for 2001 EA and blue polygons for 2011 EA, with each census year attributed to population growth and expansion of built areas. This implies the boundaries for enumeration areas have to change to ensure the areas are manageable during census enumeration. The implication of this is that although enumeration areas offers fine grained details the data sets are not aligned making this geospatial data not fit tracking spatial transformation.	Not suitable
Polokwane LM 2016	It is the recent municipal boundary for Polokwane LM as per Municipal Demarcation Board (MDB) of South Africa. It covers the whole municipal area wide as a single polygon. Social statistics between 1996 and 2016 are available, however the coverage is too wide, it misses fine grained changes happening at lower level. Thus, this geospatial dataset is not fit for the purpose of this study in tracking fine grained details of spatial transformations.	Not suitable
Polokwane LM Wards 2016	This geospatial dataset present recent municipal ward boundaries by MDB 2016. The wards make up 45 polygons, however these ward polygons are not aligned to available 1996-2016 social statistics. This implies the data set is not fit for application in tracking spatial transformation in this study.	Not suitable
Polokwane LM and Aganang LM Wards 2011	The polygons shown are based on 2011 ward demarcations by MDB before part of Aganang LM was disbanded and incorporated in Polokwane LM. It presents a total of 57 polygons, 38 for Polokwane LM and 19 from former Aganang LM. They are also not evenly distributed in terms size. Census data for these ward polygons are available from the StatsSA (Supercross software) for 1996, 2001 and 2011. However, social statics for 2016 are high aggregate data at municipal level. Thus, this data set is slightly suitable in cases when there is no any other geospatial data sets.	Slightly suitable
Polokwane LM Mesozones	The mesozones were developed by CSIR for the entire republic of South Africa. These mesozones were aligned to the 1996 to 2016 social statistics from Stats SA, through the dasymetric mapping process. This is a great comparative advantage for this geospatial dataset. Furthermore it comprises of 147 mesozone polygons which are approximately of equal size and are evenly distributed across the entire municipal area, making it easier for trend analysis to understand spatial transformation dynamics from 1996 to 2016. Thus, this dataset is	Suitable

Source: Author, 2020

Table 5.3 discusses the interoperability of various geospatial datasets for mapping spatial transformation. The discussed datasets are enumeration areas, Polokwane municipal boundary 2016, Polokwane municipal wards 2016, Polokwane and Aganang LM wards 2011, and Polokwane Mesozones. The assessment shows that the mesozones are the only geospatial datasets linked to social statistics from 1996 to 2016, making it the most suitable for tracking spatial transformation in this study. To add on, in a scenario that the mesozone polygons data was inadequate to map the spatial transformation, this was augmented by the geospatial data for 2011 ward boundaries.

5.7 Spatial transformation mapping methods for the City of Polokwane

This section discusses the methods adopted in mapping spatial transformation using the following spatial indicators, distribution of population, age, youth, unemployment, and human capital development.

5.7.1 Change in population distribution

This indicator of spatial transformation assesses population distribution changes over the specified time frames using actual numbers and percentages as unit of measurement. This indicator is relevant for informing policy makers (UN 2007 p.96), on areas they must concentrate resources in spatial transformation investment to redress apartheid legacy of spatial injustice. Population data is associated with errors of overcounting and undercounting, the following mathematical model was adopted in calculating the percent error associated with the population estimates of the mesozones cell-polygons in the City of Polokwane.

$$\delta = \left| \frac{{}^v E - {}^v A}{{}^v A} \right| \cdot 100 \quad [5.1]$$

Where δ = percent error; ${}^v E$ = Estimated value ; ${}^v A$ = Actual value.

The mathematical model adopted in calculating the population changes is as follows;

$$P_{t, t+n} = P_{t+n} - P_t \quad [5.2]$$

Where,

$P_{t, t+n}$ = population change between the different time periods $t+n$ and t .

P_{t+n} = total population for year $t+n$ in any given area (i.e. 2016).

P_t = total population for base year t (i.e. 1996).

In an attempt to further understand the trends in population changes, the researcher employed GIS ArcMap 10.5, normalization function (as percentage of total) to generate thematic maps presenting relative percentage increase or decrease per mesozone over time. The mathematical model adopted to normalize the population changes is as follows;

$$\Delta\nabla\%POP\ CHANGE = \left| \frac{P_{t+n} - P_t}{\text{Sum of all features } (TP_{t+n} - TP_t)} \right| \cdot 100 \quad [5.3]$$

Where

$\Delta\nabla\%POP\ CHANGE$ = Population change as percent of total;

P_{t+n} = Population for year $t + n$ in any given area i. e. 2001;

P_t = total population for base year t i. e. 1996;

TP_{t+n} = Total Population for year $t + n$ in any given area i. e. 2001;

TP_t = Total Popolatiom base year t i. e. 1996.

5.7.2 Change in age distribution

Tracking the changes in spatial distribution of population age structure is crucial because people at different stages of life, make choices on residential location and size, thereby impacting on spatial transformation of cities. Different age groupings are used to map geographical distribution of age structure. In a case study of Xi'an town China, Wang and Liu (2017) employed three age groupings broadly categorized as, <14years, 14 and 59 years and 60>; Gariazzo *et al.*, (2019) employed <18 years, 18-30, 31-40, 41-50, 51-60 and 60> to analyse spatiotemporal urban mobility derived from cellular phone traffic in Rome, Italy. Furthermore, Terama *et al.*, (2017) employed thematic resolution age groups of 0-14, 15-29; 30-49; 50-64; 65-74 and 75 onwards in modelling urban growth and land use change in Europe. These differences in age groupings employed is also attributed to the interoperability of available geospatial data. The mathematical model adopted to compute the changes in spatial distribution of age structure is as follows;

$$PC_{i-m} = P_{t+n(i-m)} - P_{t(i-m)} \quad [5.4]$$

Where,

PC_{i-m} = Population Change i.e. $i-m$ for age group 0-14

$P_{t(i-m)}$ = Population for age group $i-m$ base year i.e. 1996

$P_{t+n(i-m)}$ = Population for age group $i-m$ for year $t+n$, i.e. 2016

To add on, literature from South African context shows another perspective on mapping age distribution in relation to understanding spatial transformation of cities. Interestingly, CSIR BE (2015e p.1) points out that it is significant to understand the spatial distribution and quantities of youth for provision of infrastructure and services to manipulate the built environment for the betterment of people's livelihood. Thus understanding youth changes over time will aid in policy evaluations and in making spatial transformation decisions to create opportunities for youth development. However, literature shows that there are different views on the age group classified as youth, 14-35 (National Youth Commission Act 1996); 16-35 (STEPSA 2016j;

CSIR BE 2015h); 14-25 or 35 (Stats SA 2010, p.76). In realization of lack of universally agreed utilizable thematic youth age bracket, Stats SA (2010), suggested that in any analysis the exact youth age group employed should be specified. In this study, youth and middle age groups were aggregated to come up with economically active age group (15-64years), which is more meaningful in understanding spatial transformation patterns.

5.7.3 Change in percentage unemployment

Understanding the spatial distribution of unemployment over time across the city is crucial in evaluation of investment decisions for spatial transformation. Various policies have been put in place since the dawn of post-apartheid to address unemployment in South African cities. Thus, tracking spatial distribution of unemployment will help in generating empirical evidence to evaluate spatial transformation policy implications on reducing unemployment. The study adopted a mathematical model by Weir-Smith (2016 p.129), to calculate unemployment change as follows,

$$\%U = \left| \frac{U}{L} \right| \cdot 100 \quad [5.5]$$

Where;

%U → is percentage unemployment;

U, → unemployment; and

L, → labour force which is derived from L (unemployment number + employed number).

The mesozones geospatial dataset was used which is linked to social statistics on unemployment, employment and labour force for South Africa. In executing this model in ArcMap some of the mesozone polygons had values of zero which created conflicts and errors. To address this, the methodology adopted was not a simple expression of the equation model provided. The researcher, had to write a script or provide new commands to exclude areas with 0 as denominator.

The mathematical model, 5.5 was used to compute the actual numbers of unemployment changes in the City of Polokwane;

$$UC = U_{t+n} - U_t \quad [5.6]$$

Where;

UN = is percentage point change unemployment;

U_{t+n} , = percentage unemployment year $t+n$ (i.e. 2001)

U_t , = percentage unemployment base year t (i.e. 1996); and

In addition, actual numbers of unemployment changes were further augmented by percentage point changes in unemployment. In simple terms it is the difference in percent unemployment

between a given period. The mathematical model adopted in computing percent point unemployment change is as follows;

$$\%PPCU = \%U_{t+n} - \%U_t \quad [5.7]$$

Where;

$\%PPCU$ = is percentage point change unemployment;

$\%U_{t+n}$, = percentage unemployment year $t+n$ (i.e. 2016)

$\%U_t$, = percentage unemployment base year t (i.e. 1996);

5.7.4 Change in poverty

Changes in the spatial distribution of household poverty is another essential indicator for measuring the progress of spatial transformation. Household poverty is measured by combining all income forms of persons living in the same house. The mesozone geospatial data provided households that are poor within income bracket of R0-54344 per annum for the census years 1996, 2001 and 2011. For further details on how the census data was aligned to this poor income bracket refer to [CSIR BE \(2015j p.2\)](#).

The mathematical model adopted to normalize the spatial distribution of household poverty is as follows;

$$\%HHPoorf_x = \left| \frac{HHPoor_t f_x}{THHPoor_t f_x} \right| \cdot 100 \quad [5.8]$$

Where

$\%HHPoorf_x$ = Percentage of household poor in feature (mesozone polygon)x;

$HHPoor_t f_x$ = Household poor for year t i.e. 1996 in feature polygon x ;

$THHPoor_t f_x$ = Total Household poor for t i.e. 1996 in feature polygon x ;

$$HHPoor\ Change_{t, t+n} = HHPoor_{t+n} - HHPoor_t \quad [5.9]$$

Where,

$HHPoor\ Change_{t, t+n}$ = Household poor change between the different time periods $t+n$ and t .

$HHPoor_{t+n}$ = Household poor for year $t+n$ in any given area (i.e. 2016).

$HHPoor_t$ = Household poor for base year t (i.e. 1996).

In an attempt to further understand the trends in population changes, the researcher employed GIS ArcMap 10.5, normalization function (as percentage of total) to generate thematic maps presenting relative percentage increase or decrease per mesozone over time. The mathematical model adopted to normalize the population changes is as follows;

$$\Delta\nabla\%HHPoor\ Change = \left| \frac{HHPoorf_{x_{t+n}} - HHPoorf_{x_t}}{\text{Sum all features}(THHPoor_{t+n} - THHPoor_t)} \right| \cdot 100 \quad [5.10]$$

Where

$\Delta\nabla\%HHPoor\ Change$ = Percent Household poor Changes as percent of total;

$HHPoorf_{x_{t+n}}$ = Household poor feature x for year $t + n$ i.e. 2001;

$HHPoorf_{x_t}$ = Household poor feature x for base year t i.e. 1996;

$THHPoor_{t+n}$ = Total Household poor for all features in year $t + n$ i.e. 2001;

$THHPoor_t$ = Total Household poor for all features base year t i.e. 1996.

5.7.5 Change in human capital development,

Šlaus and Jacobs (2011 p.98) argue that human capital is multi-dimensional, it encompasses a wide range of human capabilities which includes the skills, education, capacities and attitude of individuals among others. These aspects possessed by human beings are critical for socio-economic growth and sustainable development (Ozturk 2001, p.39; Šlaus and Jacobs 2011 p.111). According to UN, (2016 p.23) numerous methods and approaches are used to measure human capital, these approaches are broadly categorized as direct and indirect approaches. The indirect approach is suitable for application at a broader scale such as large number of countries attributed to limited statistical information. On the other hand the direct approach measures stock of human capital from information on various components employing three approaches. These approaches are i) cost-based approach, ii) the lifetime income-based approach and iii) the indicators-based approach (refer to UN Human capital guide for further details on each). Amongst these approaches the indicators based approach measures human capital using educational output as indicators. However there is no universal metric for measuring education as it differs across countries. A common approach used is comparing absolute numbers over time of highly qualified people. The advantage of this approach is the availability of routinely collected data from learning institutions and census. The assumption of this approach is that its closely related to investment in education therefore it's a key indicator of human capital development.

In line with the UN indicator based approach, the researcher discussed the mesozone census information, recorded human capital development data using a different number educational levels that ranged from no schooling to those which have higher degree excluding other unspecified level of education. In this spatial indicator it was deemed significant to only reflect on percentage population with qualifications above matric certificate (STEPSA 2016k; CSIR BE 2015i p.1). The idea is that there is an association between level of educational and improved standards of living thereby influencing spatial transformation. CSIR BE (2015i, p.1)

corroborates this pointing out that education contributes to improved quality of life, personal development, creativity, productivity, entrepreneurship, and innovativeness, which impact on socio-spatial transformation towards people's living desires and preferences. The model adopted for calculating human capital development is as follows,

$$\%Above\ matric_{yx} = \left| \frac{AM_{yx}}{P_{yx}} \right| \cdot 100 \quad [5.11]$$

Where,

$\% Above\ matric_{yx}$ = percentage of population with qualifications above matric for given year

AM_{yx} = total number of people with qualification Above Matric for year x,

P_{yx} = total population for the same year x.

5.8 GIS components for mapping spatial transformation

This section summarises the GIS components, linked geospatial methodology adopted in this study in mapping spatial transformation in this study. The pragmatic spatial transformation philosophical world view underpinning this study pointed out that the researcher can choose the best tools and approaches to answer the research objectives. In line with this view, the approach adopted in this study is also informed by the complexity theory. This implies to successfully map spatial transformation, there is need for putting together various components that are critical for the functioning of a GIS system; data, hardware, software, procedures and people to operate the geographic information system to produce required outcomes in the form of maps. The aggregated components of the GIS system as adopted in this study are shown in figure 5.7.

The discussion on SASDI, pointed out that the EMC does not have geospatial data that is interoperable or fit for mapping spatial transformation for the purpose of this study. Thus, geospatial data for mapping spatial transformation in this study was acquired from other sources. This decision is informed by the pragmatic spatial transformation paradigm that the researcher has the choice to select geospatial data that is interoperable to map urban changes over time. The geospatial data employed in this study was collected from City of Polokwane, in the form of documents and shapefiles. The internet was also used to gather geospatial information from various data agencies and websites. In particular, the mesozones were accessed from the website <http://stepsa.org/data/2018%20CSIR%20Typology%20v2.rar>.

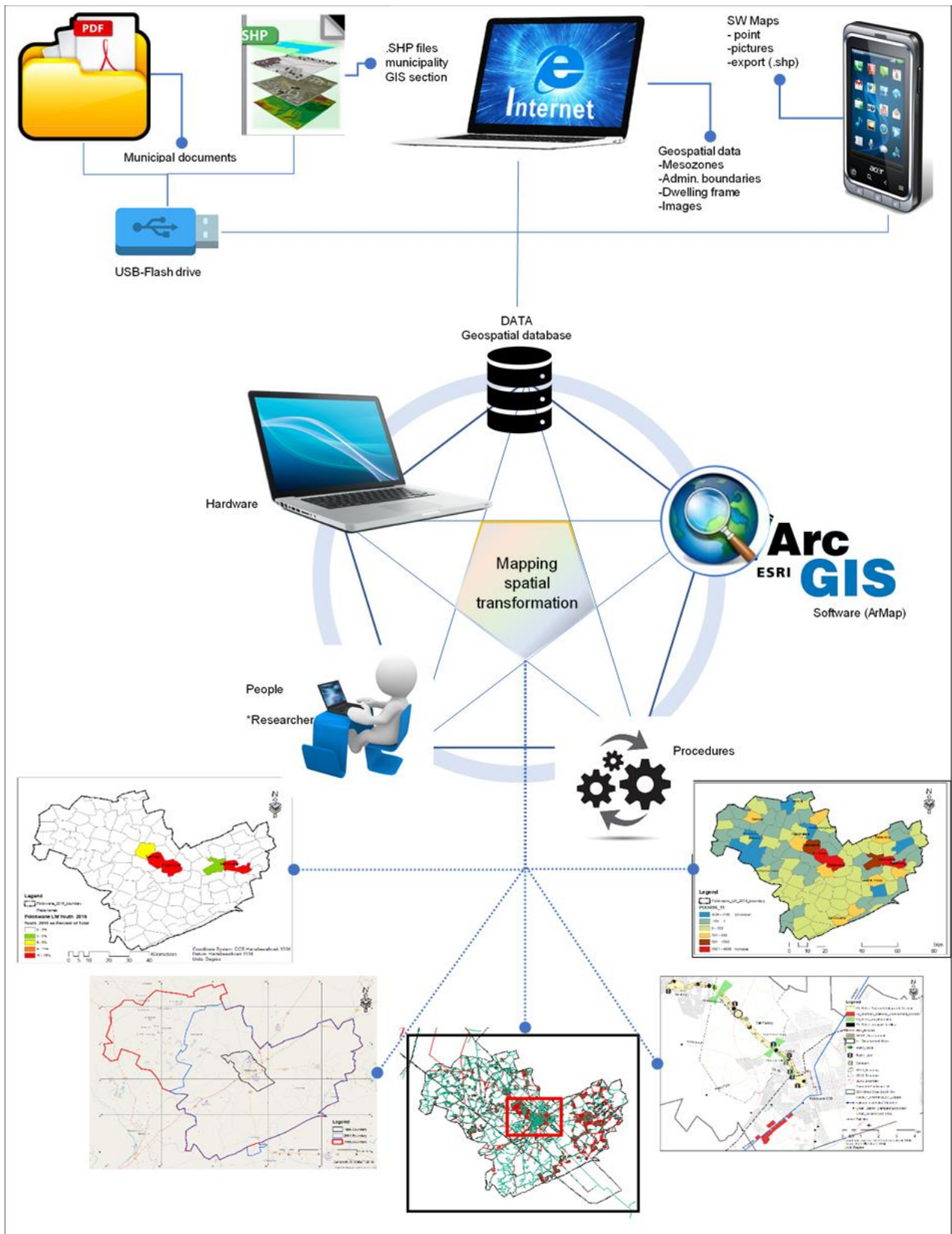


Figure 5.7: GIS components and mapping spatial transformation

Source: Author, 2020

The collected data from various sources created a geodatabase saved within the hardware, laptop used by the researcher. All the different geospatial datasets gathered together are characterised by the structure summarised in table 5.4.

Table 5.4: Data organization of models and GIS

Data objects	Model data organisation	GIS data organisation
Area data	Stock matrix: a two-dimensional matrix where the rows indicate the areas and the columns contain attributes. It is implicitly assumed that attributes are uniformly distributed throughout the area.	Polygons: areas are represented as polygons and area data are stored in polygon attribute tables. It is implicitly assumed that attributes are uniformly distributed throughout the polygon.
Interaction data	Interaction matrix: square matrix where rows and columns represent areas. The cells of the matrix contain impedances or flows between areas.	There is no equivalent to interaction matrices in GIS.
Network data	Link: each link record is identified by from-node and to-node and contains link attributes such as length, travel time, capacity. The alignment is not coded.	Links are stored as arcs and link attributes in arc attribute tables. The alignment is also coded. The convenience of digitising and editing links is an advantage.
Point data	List: a sequence of records where each record refers to an object (a household, a firm, a building) in an area. Each record contains attributes of the object; the location in the area is not recorded.	Point data are stored in point attribute tables. The advantage is that points have micro locations, i.e. pairs of co-ordinates.
Area/point data	Raster: the topology is implicit in the data model, which simplifies processing. If the raster cells are small, quasi-continuous surfaces can be constructed.	Raster-based GIS correspond directly to raster-based models with raster attributes stored in value attribute tables.

Source: Author, 2018

Table 5.4 shows the parts of data making up the geodatabase for mapping spatial transformation. The data objects include area data for the different mesozone polygons linked to social statistics between 1996 to 2016, which are critical for tracking spatial transformation. Other essential data characteristics include the network data, point data and raster data.

GIS ArcMap 10.5 software was employed, following various procedures to map spatial transformation. For instance procedures employed include the models of tracking spatial transformation discussed in relation to changes in distribution of population, age, unemployment and human capital development. The procedures involved, opening mesozone layer → attribute table → table options → add field → right click the newly added field → select field calculator → a new window opens then python script writer was selected and the new model or equation was then written and executed. The new results from the created field were then used to create the choropleth maps using a graduated scale to show the differences in spatial transformation. To add on, discourse analysis theories articulates that spatial transformation is a result of written and spoken communication. However, historical GIS data a discourse informing the desired path of spatial transformation in the City of Polokwane could

not be accessed because the system was reported to have crashed. With the power of ArcMap toolbox and other functionalities of the software, essential historical geospatial data from some of the municipal pdf documents was reconstructed by the researcher. The procedures followed included employing conversion tools, converting maps from pdf to tiff files in ArcMap. The newly converted tiff files were then georeferenced in ArcMap, followed by tracing the features of interest which were then converted into feature (.shp) files to generate the desired output maps.

5.9 Chapter summary

This chapter discussed the evolution of the spatial data infrastructure and the developmental history of the South African Spatial Data Infrastructure (SASDI). The discussion also unpacked the key components of SASDI, namely policy framework, institutional framework and the technical framework. The interoperability or fitness of geospatial data for mapping spatial transformation from the EMC was also assessed. It is evident that the researcher had to look for alternative sources of geospatial data to attain the research objectives. To add on, the spatial transformation mapping methodology adopted in this study was also graphically summarised. It pointed out the sources of the geospatial data, hardware, software, procedure and people as a crucial resource required to operate the system. Furthermore, other procedures followed i.e. mathematical models 5.1 to 5.11 were also discussed as employed by the researcher in chapter 7, in computing census geospatial data to map out spatial transformation in the City of Polokwane.

CHAPTER 6: ANALYSIS OF LEGISLATIVE AND POLICY FRAMEWORK DIRECTIONS FOR SPATIAL TRANSFORMATION IN THE CITY OF POLOKWANE

6.1 Introduction

This chapter provides an analysis of legislative and policy frameworks to determine the intended directions for spatial transformation in the City of Polokwane. The aim of this chapter is to examine envisioned changes between 1996 and 2016, and it is divided into seven sections as presented in figure 6.1.

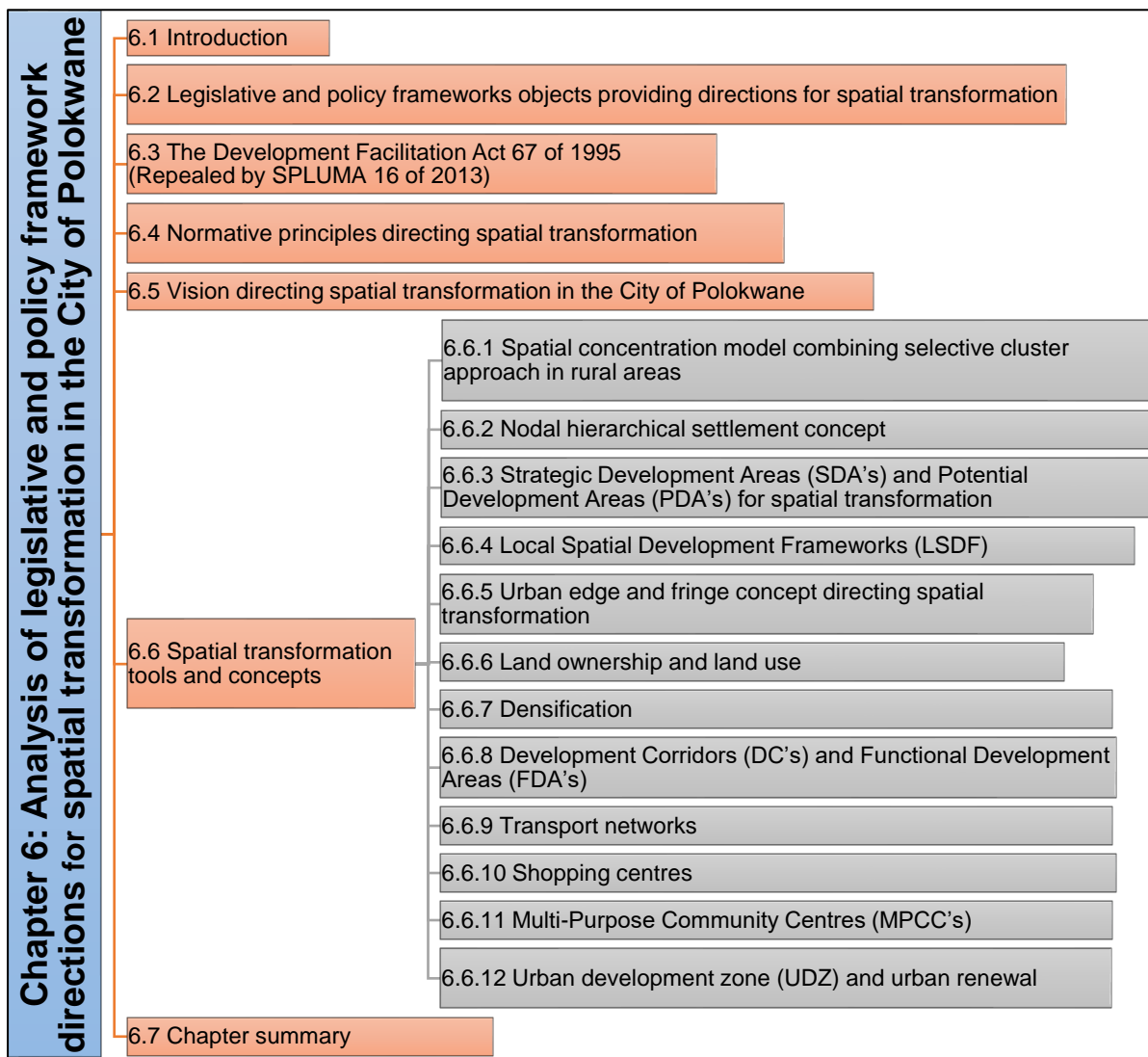


Figure 6.1: Chapter 6 Orientation

Source: Author, 2020

Section 1 provides an introduction to this chapter covering orientation and background linking theories framing this chapter. Section 2 discusses the overarching objects of legislations and policy frameworks directing spatial transformation in Polokwane. Section 3 is a discussion of the DFA 67 of 1995 a key piece of legislation in spatial transformation discourses. Section 4

identifies the normative principles directing spatial transformation from the overarching legislations and policy frameworks, followed by section 5 which explains the spatial transformation vision in Polokwane. Section 6 discusses the spatial transformation tools and concepts an attempting to understand how the vision, overarching objects, and normative principles are operationalized in Polokwane. Lastly section 7 provides a summary for this chapter.

To unravel, the intended directions for spatial transformation from the legislative policy framework discourses, the study adopted abductive reasoning, a critical methodology of informed grounded theory. According to Thornberg (2012 p.249) in the logic of abduction, literature is used as a heuristic tool, method; for critical reflections, as a lens, source of ideas, creativity, and inspiration. This denotes that literature review on spatial transformation case studies in chapter three and the researcher's knowledge in urban planning was employed as a lens, source of ideas during discourse analysis to identifying the directions for spatial transformation from the legislative policy frameworks. This is also in line with the perspective, from theory of change (ToC) as an outcome based approach for change initiatives (Paina *et al.*, 2017 p.31). It outlines the need for planning, implementation and evaluation of such particular initiatives. This implies a spatial turn, a retrospection towards identifying the planned initiatives, in particular the policy directions for spatial transformation in the City of Polokwane.

A wide variety of laws existed before 1994 underpinning the ideology of spatial planning in South Africa. The policy intentions of pre-1994 spatial planning policies were spatial segregation which characterized Polokwane city like any other city in South Africa. SACN (2017 p.16) reiterates that during colonial and apartheid era, planning policy intentions were spatial segregation which manifested into poor housing standards, increased informality, poor amenities, infrastructure and service delivery. In addition, Urban LandMark (2010 p.7) point that during apartheid era, majority of poor black people lived in squalid dormitories and sprawling townships, underserved, lacked socio-economic opportunities. Whereas, the white minority lived in well serviced areas, closer to opportunities, utilities and facilities in lager areas compared to populated blacks in small townships. The institutional legislations that existed ensured that places outside the white minority areas remained underdeveloped. Such as sperate municipal structures for whites and blacks. The systems of land use management was fragmented across the country without a uniform legislation to govern land development in the republic. This enabled white areas to develop more from own revenue collection sources and attraction of external investors. While black areas failed to develop attributed to high populations living in abject poverty and lack of economic development opportunities (Urban LandMark 2010 p.7).

To address the grim legacy of apartheid planning characterised by spatial segregation, the South African state assumed a central interventionist role. This was not because of the socialist ideology rather there was a dire need for massive investment in key spatial transformation programmes to redress apartheid spatial planning legacy in South African cities. In order to understand the realities of spatial transformation in Polokwane LM, it is worth analysing the directions of legislative and policy frameworks that were established in post-apartheid era. The legislations and policies are continuously being shaped and reshaped to provide directions, rules and conventions for normative planning and land development for spatial transformation towards redressing the grim legacy of apartheid planning.

6.2 Legislative and policy framework objects providing directions for spatial transformation

The review of City of Polokwane policy discourses mainly the 2010 Spatial Development Framework (SDF) and the 2008 Integrated Development Plan (IDP) highlights that objectives of various legislative and policy frameworks inform the directions of spatial transformation in the city. These legislative policy documents include UN Millennium Development Goals, RSA Constitution 1996, White Paper on Reconstruction and Development Programme 1994, Development Facilitation Act 67 of 1995 (Repealed by SPLUMA 16 of 2013), Urban Development Framework 1997, Limpopo Spatial Rationale 1999 (reviewed 2002), Municipal Systems Act 32 of 2000, National Spatial Development Perspective 2003 (reviewed 2006), Breaking New Ground (BNG) 2004, National Development Plan (NDP) 2030 (2012); Spatial Planning and Land Use Management Act (SPLUMA) 16 of 2013. In the view of Jaipal-Jamani (2014 p.4) discourse analysis is a methodological strategy to illuminate meaning in texts. This implies discourse analysis, as a methodology is being employed to illuminate meaning on spatial transformation directions from the objectives of the various key legislative policy frameworks. These identified legislative policies are being used to inform spatial transformation towards the redress of the apartheid grim legacy of spatial injustices in the City of Polokwane. Table 6.1 provides the summary of spatial transformation directions from the identified key legislative policies.

In order to understand how City of Polokwane redresses the apartheid legacy of spatial injustices discussed, it was necessary to analyse the objectives of the legislative policy frameworks that guided spatial transformation initiatives. In another perspective, bulk of the legislative policies providing directions for spatial transformation are from the central government. In particular local policies developed are influenced by the directions from the central government. Similarly, Hangzhou China evidences that the central government policy direction had a critical role to play in spatial transformation of the city (Wei 2012 p.397).

Table 6.1: Spatial transformation directions from the legislative and policy objects discourses

Legislative policies	legislative policy objects discourses and directions towards spatial transformation
UN-Millennium Development Goals (MDG's)	<i>Goal number 7: Ensure environmental sustainability</i> 1) <i>By reversing environmental resources loss, integration of sustainable development principles within spatial transformation policies and programmes, 2) By increasing peoples access to basic services through spatial transformation initiatives i.e. proportion of people without access to portable water to be halved by 2015, By spatial transformation in order to significantly improving approximately 100 million slum dwellers lives by 2020.</i>
RSA Constitution 1996	<i>Chapter 7 Local Government objectives (Sec 152)</i> 1) <i>To be democratic and accountable local authorities spear heading spatial transformation initiatives 2) To ensure spatial transformation initiatives result in sustainable service provision; 3) To provide for spatial transformation through economic and social development; 4) To ensure safety and health of human settlements through spatial transformation: 5) To encourage participation of community stakeholders in spatial transformation matters</i>
White Paper (RDP) 1994	<i>The central spatial transformation objective is that; "It seeks to mobilise all our people and our country's resources towards the final eradication of the results of apartheid...to build a democratic, non-racial and non-sexist future" This further broken down into other objective namely: "Meeting Basic Needs, Developing our Human Resources, Building the Economy, Democratizing the State and Society and Implementing the RDP".</i>
DFA ACT 1995 (Repealed)	1) <i>To facilitate and fast-track spatial transformation RDP initiatives and 2) To provide normative principles governing spatial transformation through land development in the country 3) Development and Planning commission to advise on spatial transformation policy and laws at provincial and national spheres of government 4) Establishment of spatial transformation developmental tribunals to resolve conflicts and decide on spatial transformation land development projects 5) land development objectives establishment, implementation and measurement of such spatial transformation objectives as local government performance yardstick, 6) uniformity of procedures nationally for spatial transformation, i.e. land subdivision and development, to fast track release of land for spatial transformation activities such as residential developments among others. 7) spatial transformation initiatives to ensure security of tenure, financial support for land development</i>
Urban Development Framework 1997	1) <i>Spatial transformation of cities into productive and efficient settlements by promoting local economies development and growth. 2) Spatial transformation through development of infrastructure and facilities targeted at reducing spatial disparities, 3) Spatial transformation towards improved access to quality housing and security of tenure, 4) To address spatial inefficiencies through spatial transformation concepts such as densification, efficient public transport systems to reduce travel time, distances and associated impacts, 5) To take cognisance of environmental sustainability principles in spatial transformation to improve the quality of human settlement, 6) Transformation of governance structures for effective spatial transformation through capacity building initiatives</i>
Municipal Systems Act 32 of 2000	1) <i>Provide municipalities with principles, mechanisms and processes, that enable progressive spatial transformation, improved access to basic services, social and economic upliftment of human settlements, 2) to define spatial, legal nature of a local authority as being comprised of all communities within its jurisdiction, partnering with the administrative structures and political leadership towards spatial transformation 3) provides for exercising of powers and functions by municipalities towards spatial transformation 4) Provide for right to the city, through community participation in spatial transformation matters 5) to provide for establishment of an integrated development framework centred on planning processes, management of performances, mobilisation of resources, and institutional changes to facilitate spatial transformation underpinned by developmental local government notion.6) provides a framework for municipal organization administration to effect the constitutional mandate and by extension spatial transformation 7) to ensure service delivery frameworks takes cognisance of the poor for spatial transformation existing disparities 8) establish a framework to support integration of spatial transformation initiatives at all spheres of government with respect of local natural environment for economic and social upliftment of communities</i>
NSDP 2003	1) <i>Provides a framework for the desired spatial transformation of the national space economy, 2) Provides a coarse grained maps as reference point on analysis and debate of spatial transformation and development potentials for all spheres of government 3) Provides key tension and priority areas to achieve positive spatial transformation outcomes from capital investment and infrastructure development 4) To strategically guide national government response to spatial transformation initiatives</i>
Breaking New Ground 2004	1) <i>To utilize provision of housing as a supporting instrument for spatial transformation and sustainable development of human settlements. 2) Spatial transformation through housing is further expected to help with; poverty alleviation, creation of jobs, empowerment and wealth creation assert, leveraging economic growth, improving quality of life for the disadvantaged, promoting social cohesion, prevent crime, enhancing property market.</i>
NDP 2030;	<i>Chapter 8: transforming human settlements</i> 1) <i>To provide spatial planning systems that are strong and efficient for spatial transformation, well integrated across all the spheres of government.2) Provides for spatial transformation through upgrading of informal settlements that are well located and situated in land suitable for human habitation by 2030.3) Spatial transformation towards increasing the number of people residing closer to work places; 4) Spatial transformation towards improvement of public transport quality; 5) Spatial transformation towards redistribution of job opportunities closer to densely populated townships.</i>
SPLUMA 16 of 2013 (Repeals DFA 1997)	1) <i>Provides a national spatial planning and land use management framework for spatial transformation 2) Specifies the interrelations between spatial planning and land use management and other planning instruments 3) Ensure that spatial planning initiatives for spatial transformation are efficient, equitable and inclusive at all government spheres 4) Provides a framework to coordinate, monitor and review of spatial transformation planning and management systems; 5) Provides a framework for standards, norms, normative principles and development policies for spatial transformation 6) to redress apartheid regulatory and spatial imbalances through spatial transformation 7) to provide for promotion of national uniform procedures and decision making processes to be followed by authorities dealing with spatial transformation related applications and matters 8) provides for establishment, operation and functioning of Municipal Planning Tribunals to decide on related spatial transformation matters 9) a framework that provides for the enforcement of development and land use measures facilitating spatial transformation</i>
Polokwane SDF 2010	<i>Spatial Development Objectives 1) To provide for spatial transformation and sustainable development growth with respect to the normative development principles provided in various legislations 2) To promote spatial transformation initiatives targeted at economic growth to reduce unemployment 3) To promote spatial transformation through industrial investment and development 4) To promote development of human settlements that are sustainable through spatial transformation initiatives such as spatial integration, public transport systems (BRT), and road networks taking consideration of environmentally sensitive areas 5) To provide for spatial transformation through infrastructure investment targeting priority areas 6) To promote spatial transformation through attracting investors by means of releasing strategically located land for economic development.</i>

Source: Author, 2020

Table 6.1 summarises spatial transformation directions from the objects of various legislative policy frameworks. In particular Republic of South Africa (RSA) Constitution of 1996 Chapter 7 Local government objectives provides directions on spatial transformations. The directions illuminating from the objectives are that municipalities must strive to be democratic and accountable authorities spear heading spatial transformation initiatives in their jurisdiction. The spatial transformation initiatives must also ensure sustainable service provision, economic, and social development, safety and healthy human settlements. To add on, the other direction is a promotion of right to the city, stating that municipalities must encourage participation of community stakeholders in spatial transformation matters. In another perspective, the narrative of the discourses on the various policy objects evidences that the crux of spatial transformation is to redress spatial injustices a grim legacy of apartheid planning. However, in the history of planning towards spatial transformation of human settlements in post-apartheid South Africa, the DFA is an important centre piece legislation (Berrisford 1997 p.57). This recognition is critical, it provides the crux of understanding the underpinnings of spatial transformation in South African context.

6.3 The Development Facilitation Act 67 of 1995 (Repealed by SPLUMA 16 of 2013)

The Development Facilitation Act 67 of 1995 (DFA) was repealed as a whole by Spatial Planning and Land Use Management Act (SPLUMA) of 2013. Building on the early post-apartheid narratives on complexities and inadequacy of legislations that existed, there was an urgent need to develop a national planning legislation setting out principles and uniform procedures to facilitating the implementation of RDP spatial transformation programmes in South Africa (Urban LandMark 2010 p.8). Accordingly the DFA was then established being the first major centre piece of planning legislation to provide directions for spatial transformation of human settlements in post-apartheid South Africa, promulgated at the end of 1995, (Berrisford 1997 p.57; Bloem 2001 p.22; Urban LandMark 2010 p.9). It championed redressing of apartheid legacy by setting out objectives, a normative path way that provided directions for spatial transformation in South Africa through land development. The ideology was that; the complex mosaic of the old fragmented planning tools (Urban LandMark 2010 p.vi), inadequate municipal capacity, frustrated and hindered the desired land reconstruction and development (Berrisford 1997 p.57) to address the spatial reality of segregation and inequality from apartheid planning. The spatial transformation directions from the DFA 67 of 1995 objectives are highlighted in table 6.1. To add on, the identified key tenets emanating from DFA of 1995 Chapter I on general principles for land development and Chapter IV on land development objectives, to facilitate and fast track spatial transformation are presented in figure 6:2.

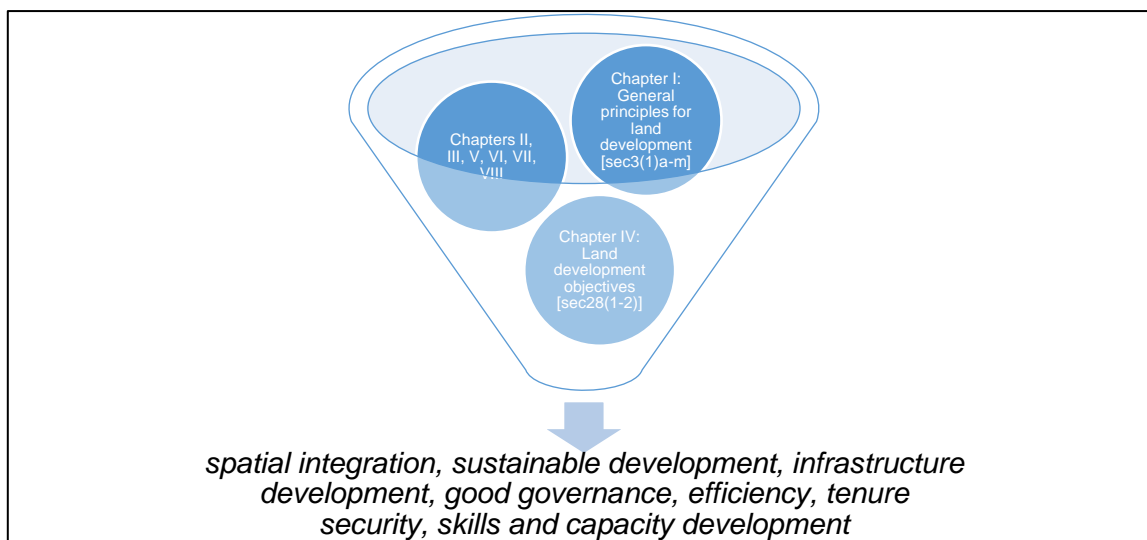


Figure 6.2: DFA 1995 Spatial transformation tenets

Source: Author, 2020

Figure 6.2 presents a summary of DFA tenets that were directing spatial transformation of human settlements in the City of Polokwane and South Africa at large. In support of this, Berrisford (1997 p.58) stated that the then Northern province (Limpopo province) is one of the provinces in South Africa to first establish a developmental tribunal, promulgate Land Development Objectives (LDO's) in line with the DFA to provide directions for spatial transformation. Gemey (2017 p.23); Polokwane (2010a p.183) further substantiates that the DFA normative principles provided directions for spatial transformation in the City of Polokwane. It can be noted from figure 6.2 that the desired spatial transformation from apartheid settlement form was to be attained through promoting spatial integration of the physical, institutional, economic and social aspects. This implies the need for spatial indicators to map out the demographic distributions, city structure and texture aspects to be able to understand the base spatial patterns to be used as reference point to assess the progress and performance towards attaining the desired spatial transformation.

However to ensure success in spatial transformation, further directions from the normative principles are that; prioritise infrastructure development, promote sustainable development, walkability, mixed land uses, densification, compact developments, urban edge, ensuring efficiency in land development procedures and laws. The principles also provided for exercising right to the city, by ensuring good governance through prioritising participation of affected stakeholders in spatial transformation matters. In this whole process, the provisions promoted skills and capacity development for communities and the municipality at large to achieve desired spatial justice through spatial transformation. In another perspective, the Act also provided for security of tenure in human settlements redressing spatial apartheid injustices. In support of this perspective, Emdon cited in Donaldson and van de Westhuizen (2011 p.684) reiterates that the DFA principles promoted restructuring of human settlements

to correct the apartheid spatial injustices of racial segregation settlement pattern; compact cities to prevent spatial splintering, mixed land use and integrated development; sustainable cities; stakeholder involvement and capacity building. Furthermore, the Act was commended as 'innovative and ambitious' piece of legislation to address the grim of apartheid legacy, it succeeded in changing the mindset of people on spatial transformation through legislations, and normative principles for land development (Urban LandMark 2010 p.vii).

6.4 Normative principles directing spatial transformation

Emerging from the legislative policy discourse analysis is that, in addition to the DFA normative principles there are other principles providing directions for spatial transformation presented in figure 6.3. This is attributed to the fact that there are various progressive policy frameworks that were developed in post-apartheid era, a disjointed incrementalism approach. This process builds on failures and success of other initiatives, to provide other spatial transformation tools to aid the whole process of redressing apartheid spatial injustices.

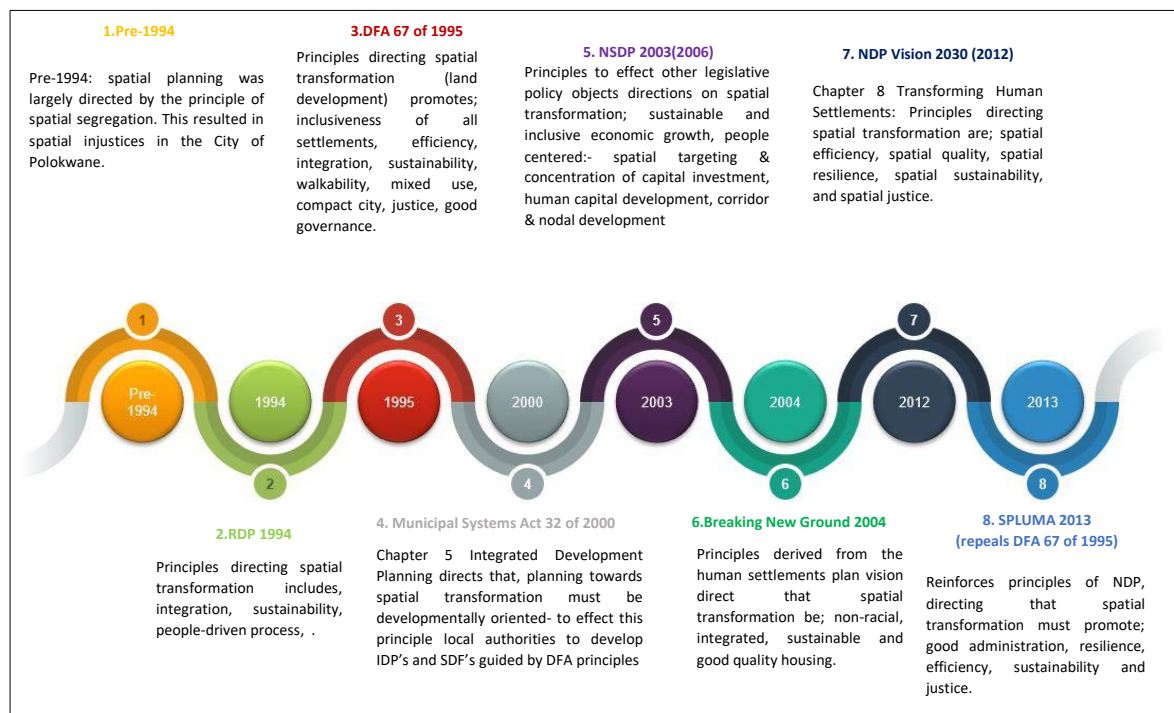


Figure 6.3: An overview of legislative policy principles directing spatial transformation

Source: Author, 2020

Figure 6.3 indicates the legislative policy principles directing spatial transformation to address the grim legacy of apartheid injustices in the City of Polokwane. In particular, the Municipal Systems Act 32 of 2000, Chapter 5 Integrated Development Planning provides an overarching principle directing that local authorities must be developmental oriented towards spatial transformation. To effect this principle in directing spatial transformation, municipalities are directed to develop an integrated development plan and a spatial development framework

underpinned by the principles in Chapter 1 of DFA 67 of 1995. The directions from the DFA principles are that governance systems and spatial transformation (land development) must promote the development of inclusive human settlements (urban, rural, formal and informal), efficiency, integration, sustainability, mixed use, compact city, spatial justice, and good governance. In addition to DFA principles, the development of spatial development frameworks to guide spatial transformation is also further directed by the principles which include; people-centred, spatial targeting and concentration, corridor and nodal development (NSDP 2006 p.iii); non-racial, good quality (BNG 2004 p.9). In another perspective, these normative principles providing directions for spatial transformation in post-apartheid era are further reinforced by NDP Vision 2030 and SPLUMA 16 of 2013. Polokwane (2010a p.183) substantiates that the discussed principles also direct the development of spatial development frameworks to guide spatial transformation in the city.

6.5 Vision directing spatial transformation in the City of Polokwane

Anderson and Holloway (2020 p.190), views discourse as a way of seeing the world, similarly a vision is also another view or perspective providing directions on spatial transformation towards the desired future. In support of this the ‘gold rush mentality’ resulted in Berlin envisioning itself competing with big league cities of the world i.e. London, Paris, New York which resulted in massive spatial transformation through megalomaniac planning (Arandelovic and Bogunovich 2014 p.4). This entails that policy directions from the city’s vision have a profound effect on spatial transformation. According to then Department of Rural Development and Land Reform (DRDLR) (2011 p.30), the spatial vision statement is not a replication of IDP vision, rather a reflection of municipal desired spatial transformation characteristics/nature in line with DFA principles. This implies the vision is purported to be providing a world view, that informs the city’s spatial transformation goals and objectives. These will then provide the socioeconomic, sustainability and smart growth spatial transformation interventions required to redress the inherent spatial injustices. Thus, assessing the vision of Polokwane SDF will aid in deepening the understating of policy directions on spatial transformation in the city. Table 6.2 provides the vision of City of Polokwane as outlined in the available discourse on legislative policy documents collected from the municipality and the internet.

Table 6.2: legislative policy spatial transformation vision statement

Legislative policy	Vision statement
IDP 2008-2011	<i>“A safe, prosperous and caring municipality, free of poverty and inequality; promoting participatory development and providing sustainable quality services for a better life for all.” (Polokwane 2008a p.58; Polokwane 2009 p.93; Polokwane 2010b p.69).</i>
Polokwane SDF 2010	<i>“Enhance sustainable development and alleviate poverty by focusing scarce resources on areas with economic growth potential and the highest return on capital” (Polokwane 2010a p.161).</i>

Source: Author, 2020

Table 6.2 shows the IDP and SDF visions providing directions for spatial transformation in the City of Polokwane. The vision statements are different, however it is evident from the statements that Polokwane is characterised by spatial inequality, marginalization and unsustainable development. Thus, the spatial development vision of Polokwane (2010a p.161) provides a departure point for understanding spatial transformation within the municipality. Although, the SDF does not explicitly indicate the notion of spatial transformation (Abrahams 2017 p.25), it can be noted the spatial vision boldly states that the municipality needs to enhance spatial transformation through sustainable development, an acknowledgement that the current spatial development structure of the municipality is not sustainable. Furthermore, the spatial vision alludes that available limited resources at the disposal of the municipality be directed towards spatial transformation through targeted investment in areas of economic growth potential to get highest return on their capital. To add on, the spatial vision also reflects the DFA principles in informing the desired spatial transformation paths and development dynamics within the City of Polokwane. In another perspective, the spatial development vision is also aligned to the spatial transformation directions of the NSDP principles. The principles directions are that capital investments towards spatial transformation must be focused in areas that have potential for fostering development that is effective, sustainable and support spatial re-structuring (Polokwane 2010a p.171).

In order to attain the aforementioned desired spatial transformation vision, development objectives were set out. These objectives are discussed in table 6.1 which summarizes the spatial transformation directions from the legislative policy objectives. Furthermore, Abrahams (2017 p.25) pointed out that although an SDF was developed long ago, the spatial development objectives for Polokwane 2010 SDF, are also broadly in line with the recent progressive policies which include Integrated Urban Development Framework (IUDF) of 2016, Spatial Planning and Land Use Management Act (SPLUMA) of 2013 and the National Development Framework (NDP) of 2012.

6.6 Spatial transformation tools and concepts

According to the DRDLR (2011 p.55), a municipal SDF should outline the spatial tools and concepts to be employed to achieve the desired spatial transformation as set out by the legislative policy objectives, such as those indicated by the Polokwane 2010 SDF. In line with this perspective this section adopts informed grounded theory to identify and discuss the spatial models, tools and concepts emerging from legislative policy framework discourses. This entails a spatial turn using the lens of the spatial triad and theory of change (ToC) to deepen the understanding on the policy directions for spatial transformation in the City of Polokwane.

6.6.1 Spatial concentration model combining selective cluster approach in rural areas

The theoretical approach underpinning spatial transformation in Polokwane LM is the spatial concentration model combining selective cluster approach in rural areas (Abrahams and Marais 2019 p.186; Polokwane 2010a p.163). The point of departure for this approach is to direct and concentrate investment and development at regional nodes that serve the adjacent areas, 'a trickle-down effect approach'. This is also in line with the 2006 NSDP vision of focusing economic growth and employment creation in potential areas that promote development which is effective, sustainable and support spatial restructuring (Polokwane SDF 2010 p.162). This model implies that to foster spatial transformation towards the desired spatial vision of the municipality, development should be concentrated and be capitalized on the growth point of Polokwane because of its characteristic as the gateway, provincial growth point of Limpopo Province among others. In addition, this approach also acknowledges the significance of rural villages thereby advocating for selective cluster approach to develop rural development strategy to facilitate concentration of development in strategic rural areas with potential to support sustainable development. This selective cluster approach is in-line with Raveinstein (1885) laws of migration that migration happens in form of local migration, short journey and by stages wherein people migrate to nearby larger villages that are in close proximity looking for better opportunities, before moving on to other larger areas among others. Hence, the selective approach requires the clustering of villages to identify potential rural nodes to concentrate higher level services and social facilities using the differential level of service (LOS) approach, equitable and cost effective manner to facilitate migration to these selected nodes. Polokwane (2010a p.163) adds that this spatial transformation approach is also in tandem with proposals outlined by the Limpopo SDF. What is emerging from this theoretical approach is that the direction taken to facilitate spatial transformation in Polokwane LM is to strategically select potential development nodes in both urban and rural areas and concentrate development in such areas.

6.6.2 Nodal hierarchical settlement concept

Literature from case study reviews evidences that policy directions such as the nodal concept contributes to spatial transformation. In particular, the Official Plan of Toronto channelled development in certain nodes resulting in increased spatial transformation (Ibrahim 2017 p.16). Similarly, to give effect to the legislative policy directions on spatial transformation, City of Polokwane adopted the hierarchical settlement concept (Abrahams 2017 p.16; Polokwane 2010a p.113; Polokwane medical node 2001 p.vi). Discourse analysis of the legislative policy frameworks, Polokwane (2008a p.69); Polokwane (2010a p.109) points out that the Limpopo Provincial Spatial Rationale settlement hierarchy concept provided the following settlement

orders; 1st order settlement or Growth Points which are further categorized as Provincial Growth Point (PGP), District Growth Points (DGP) and Municipal Growth Point (MGP). The 1st order settlements are considered the major human settlements and spatial transformation initiatives must be concentrated in these areas. The 2nd order settlements or Population Concentration Points (PCP) comprising a group of villages, towns without an economic base. The 3rd order settlements- Local Service Points (LSP) exhibiting potential for service functions and population growth above 5000. The 4th order settlement- Village Service Areas (VSA) are a group of three or more villages located together and interlinked by social infrastructure facilities. The last, 5th order settlement- Small Settlement, self-sustainability in these areas is considered non-existent or limited.

This settlement ordering typology is indicative of the directions for investment areas towards spatial transformation. On the contrary this provincial settlement order was considered inadequate to effect the desired spatial transformation. The argument is that some of the settlements (GP, PCP, LSP) are in close proximity despite being of different settlement order making it difficult to treat these settlements separately when directing investment on spatial transformation. This prompted the modification of the provincial settlement hierarchy (Polokwane 2008a p.71). In another perspective, the term 'settlement order' is inadequate it does not provide meaningful directions for spatial transformation. Hence the move by the municipality to use a more meaningful phrase 'nodal hierarchy' in line with the SDF guidelines, which expresses the notion of spatial transformation of the municipality.

Nodes are "areas where higher intensity of land uses and activities are supported" (DRDLR 2011 p.6). This implies identification of nodes provides for spatial transformation by directing investments and land use activities in such identified nodal areas. Polokwane (2008a p.71) substantiates that the settlements were grouped as nodal clusters because of their close proximity to each other and that they are functionally interdependent on each other as a huge settlement. Thus, the grouping of different settlements using the adopted municipal nodal hierarchy facilitates the identification of strategic potential settlements both urban and rural to concentrate high intensity investment and development activities to attain desired spatial transformation. Similarly, literature from the case study review pointed out that spatial transformation in Berlin was also contributed by the annexation of surrounding areas (Arandelovic and Bogunovich 2014 p.3). In line with this perspective the new nodal hierarchy adopted by City of Polokwane resembles this annexation of settlements clustered together. Figure 6.4 presents this new nodal hierarchy of settlements as pointed out in the legislative policy framework discourses.

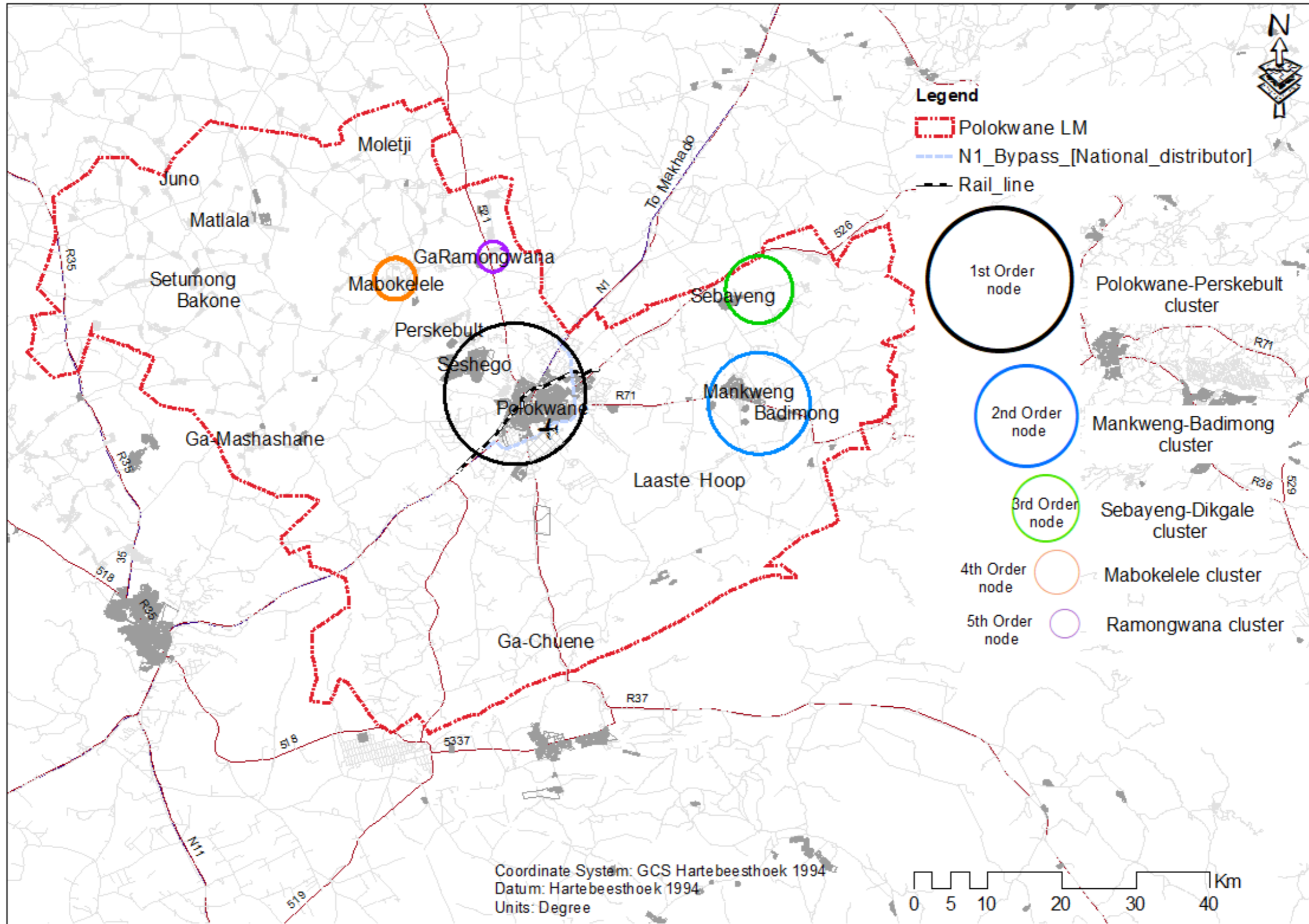


Figure 6.4: City of Polokwane nodal areas targeted for spatial transformation initiatives

Source: Own construction2020

The City of Polokwane nodal hierarchy in figure 6.4 illustrates the classification of settlements into nodes of varying sizes within the boundary of the city at a macro-level. The legislative policy directions are that spatial transformation initiatives must be targeted in these nodal areas. In particular, the 1st order node is Polokwane-Perskebult a huge settlement that comprises of the following areas which are clustered together; Polokwane (PGP); Seshego (PGP) and Perskebult (PCP). Polokwane (2001 p.74) further substantiates that Polokwane Seshego cluster and Mankweng are the major settlements with largest population concentration, hence they are the main focal areas for development initiatives.

6.6.3 Strategic Development Areas (SDA's) and Potential Development Areas (PDA's) for spatial transformation

Using the lens of Lefebvre's (1991 p.31) spatial triad pillar on conceived space, it is evident that the policy discourses reveals conceptualized spaces in the form of maps, providing macro-level directions for spatial transformation in the City of Polokwane. In support of this, Polokwane (2010 p.170) pointed out that the development concepts adopted to provide directions for spatial transformation are; Strategic Development Areas (SDA's) and Potential Development Areas (PDA's). These SDA's and PDA's were identified by the 2007 SDF within the nodes discussed in the previous narrative on nodal hierarchy. The legislative policy discourse provides directions that the SDA's are the focal, primary areas for future development and township expansions through residential developments among others. This implies the policy directions are that SDA's are the targeted 1st level priority areas for spatial transformation initiatives such as investment, development and expansion. Figure 6.5 provide the identified SDA's in the City of Polokwane.

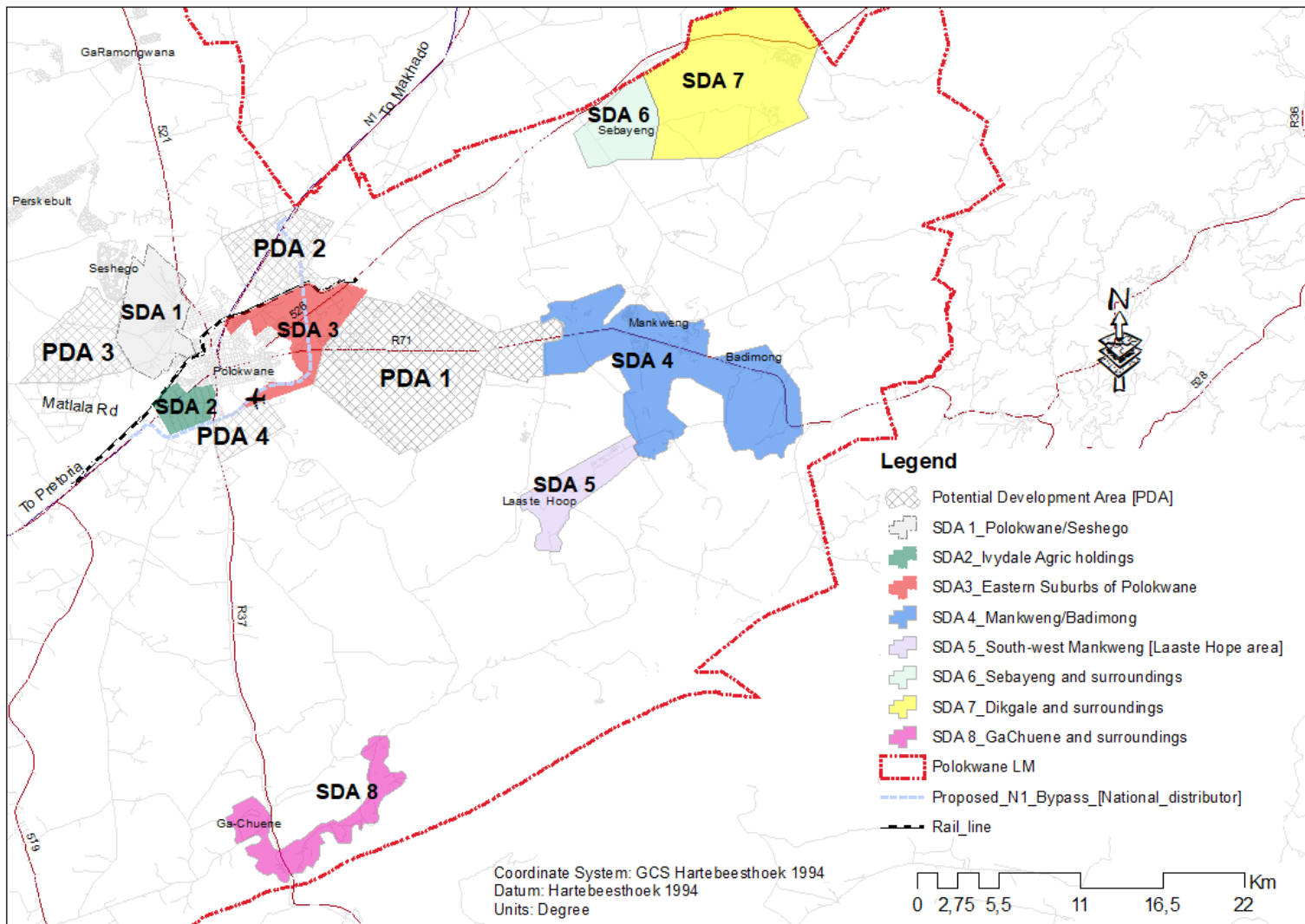


Figure 6.5: Strategic Development Areas (SDA's) and Potential Development Areas (PDA's)

Source: Author, 2020

Polokwane (2010 p.115); Polokwane LSDFP SDA 1 (2007a p.8); pointed out that, the 2007 SDF direction or mandate for the City of Polokwane was to facilitate, promote and support development in the SDA's through; providing bulk infrastructure services, development incentives which include no contribution to bulk services, simplifying-fast tracking application procedures to facilitate spatial transformation, development of detailed local spatial development framework plans for the SDA's. This implies the spatial transformation directions from the policy frameworks are that investments must be spatially concentrated in these strategically identified areas.

Also observed from figure 6.5 are strategically identified potential development areas (PDA's) 1 to 4. The PDA's are regarded as 2nd level priority areas of development that are adjacent to the SDA's (Polokwane 2010a p.126). The spatial transformation policy directions are that, these areas are crucial for structuring future development in the municipality, they also point out the desired future expansion of settlements in the city. In particular, PDA 1 is an area along

the R71 Development Corridor (DC) 1, between the settlements Mankweng-Badimong cluster and Polokwane-Perskebult cluster. This area provides development potential for spatial integration of these segregated human settlement. Thus, the policy directions for development along this intends to attain the desired spatial transformation in redressing the apartheid grim legacy of spatial segregation.

6.6.4 Local Spatial Development Frameworks (LSDF)

Despite the possibilities of SDA's and PDA's approach in providing directions for spatial transformation it received heavy criticism as outlined by Polokwane (2010 p.170). In particular, this approach directed for the development of detailed local spatial development framework plans (LSDFP) for the SDA's. This implies development of a total of eight LSDFP's for each SDA, ultimately this creates a fragmented spatial transformation planning system for the city. Other criticisms levelled against the SDA's and PDA's approach include implementation shortfalls, lack of delineated urban edges, exclusion of rural nodes such as Perskebult, Mankweng-Badimong, Sebayeng-Dikgale. The implication of this was that there was lack of comprehensive spatial plan for the entire municipality. This resulted in a distorted and fragmented planning system, consequently leading to planning challenges in land use management and development control in tribal areas within the municipality (Polokwane 2010a p.170). Hence, to address this challenge Polokwane (2010a p.170) proposed a new approach, of developing Local Spatial Development Framework Plans (LSDFP's) to provide directions for spatial transformation in specific areas as summarised in figure 6.6.

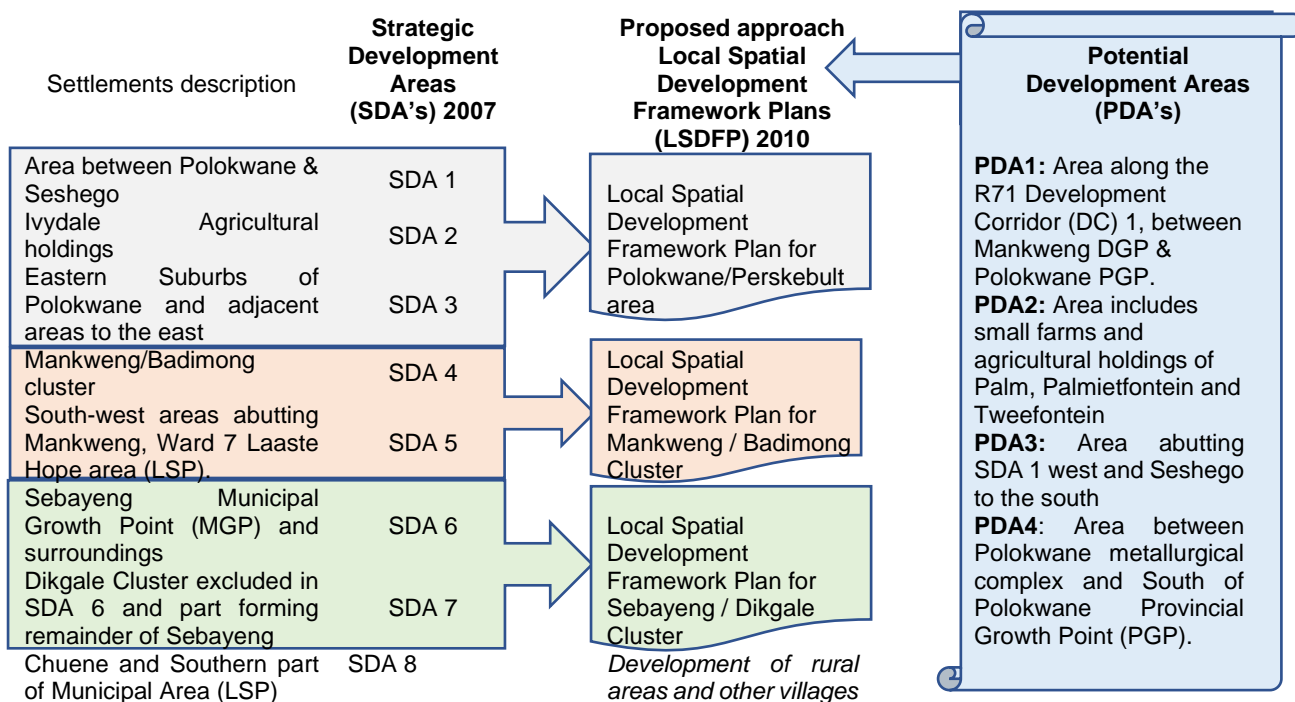


Figure 6.6: Proposed new approach LSDFP's for spatial transformation
Source: Author 2019

Central to Rogers (2014 p.1) view on theory of change (ToC) is that certain, activities are understood that they will yield outcomes contributing towards the realization of the intended impacts, in particular the broader legislative policy objects and city's vision. In line with this perspective, the City of Polokwane adopted the 3 level approach to development of SDFs which provides direction for the desired spatial transformation (Abrahams and Marais 2019 p.190). These approaches are; 1. macro-level municipal wide area, 2. LSDF's for the settlement clusters Polokwane-Perskebult, Mankweng-Badimong and Sebayeng-Dikgale; 3. other rural areas and villages. This approach adopted in targeting areas for development of LSDFP is aligned to the nodal settlement hierarchy of City of Polokwane. It abandons the fragmented SDA's approach towards an integrated settlement cluster approach providing for the development of LSDFP's for Polokwane-Perskebult cluster, Mankweng-Badimong Cluster and Dikgale cluster. In particular, the Polokwane-Perskebult LSDFP does not abandon the already developed individual LSDFP's directing spatial transformation in SDA1, 2 and 3, rather it incorporates them to form the basis and part of a broader framework plan. The SDA 1 is an area between Seshego and Polokwane Central, SDA 2: Ivydale Agricultural holdings, and SDA 3: Eastern suburbs of Polokwane and adjacent areas to the east. These SDA's were clustered together forming part of a comprehensive framework plan indicating an integrated development plan for the broader Polokwane-Perskebult cluster (Polokwane 2010a p.171). To add on, the PDA's concept was abandoned and where desirable the PDA's were incorporated into the LSDFP's

6.6.5 Urban edge and fringe concept directing spatial transformation

In redressing the criticism levelled against the concept of SDA's and PDA's, on lack of clearly delineated boundaries, urban edge and urban fringe were demarcated providing directions on areas for concentrating spatial transformation initiatives. Abrahams and Marais (2019 p.191) reiterates that Polokwane LSDF's for the nodal clusters identified the urban edges to guide spatial transformation activities. The demarcated urban edge, fringe and future development area are presented in figure 6.7. Cole (2017 p.2) substantiates that demarcating urban edges influences spatial transformation as evidenced by Auckland Unitary Plan which resulted in the structural changes of urban edge from the Metropolitan Urban Limit to the new Rural-Urban Boundary which extended the spatial coverage of the city.

Conceived space observable from figure 6.7 are the boundaries for the urban edge, urban fringe and future development areas for the 1st order node. The urban edge comprises of Polokwane central, Seshego, and the SDA's 1 to 3. This approach to provide a comprehensive conceptual framework plan helps to address challenges of fragmented and distorted planning systems posed by the limitations of individual SDA's framework plans.

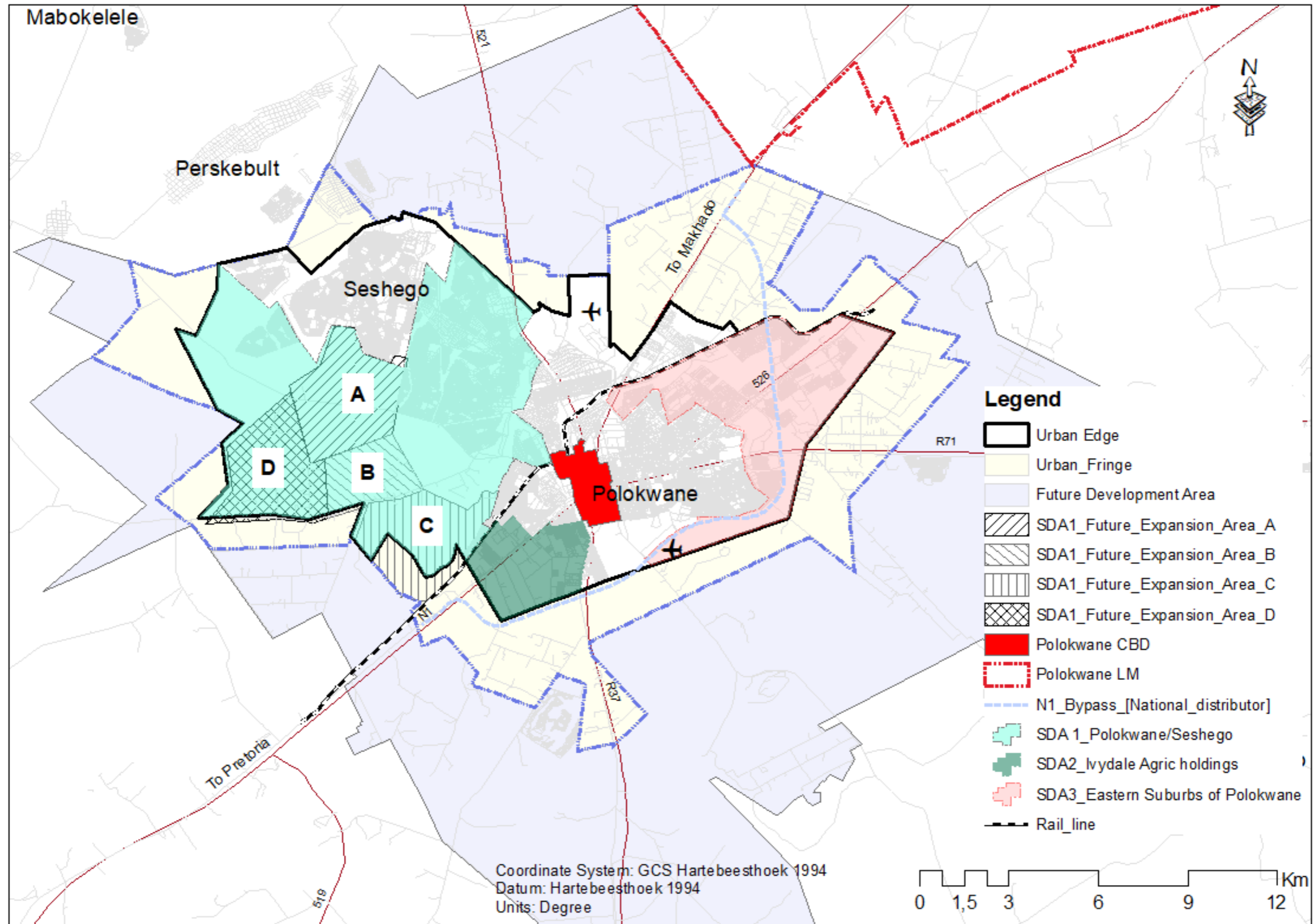


Figure 6.7: Spatial transformation activity concentration areas: urban edge, fringe

Source: Author, 2020

The interim measure put in place was that the SDA 1, 2, and 3 framework plans remained in effect being that there is no comprehensive urban development framework for the greater Polokwane-Perskebult cluster (Polokwane 2010a p.171). To add on Polokwane (2007a p.49) further identified future expansion areas for SDA 1. The priority areas for the expansion were A and B because of access to existing bulk infrastructure facilities. Future expansion area D is last priority area of development because it lacks access to bulk infrastructure services. This implies for each SDA, future development or expansion areas had to be identified, such an approach is fragmented, perpetuates disjointed planning. In terms of spatial dialectics and didactics, this approach of spatial transformation using the individual SDA's concept is a clear contradiction towards the policy objectives. In particular, post-apartheid policy frameworks are expected to reduce parallel planning systems, yet development of individual SDA's reinforces fragmentation of spatial transformation planning systems.

The identification of the urban edge, fringe and future development is indeed a spatial turn towards redressing fragmentation and perpetuation of spatial injustices. The urban edge indicate the areas where spatial transformation developments should be concentrated to limit urban sprawl and its negative implications. The policy discourse points out that the urban edge is established to provide directions for the desired spatial transformation. To add on the directions for spatial transformation include, compact developments, densification, integration, urban infill, bulk infrastructure, service developments and maintenance, protection of environmentally sensitive areas and agricultural areas, township establishments, and economic development activities (Polokwane 2010a p.203). On the other hand, the urban fringe is considered a transition zone outside the urban edge and surrounding rural hinterland.

The legislative policy directions limiting spatial transformation activities in the urban fringe includes protection of agricultural land and environmentally sensitive areas, promoting urban agriculture, development approval is on merit and the municipality will not fund bulk and other external services in the urban fringe (Polokwane 2010a p.203). Furthermore, it is highlighted that the urban edge should be at least 90% developed before establishment of townships can be approved in the urban fringe (Polokwane 2010a p.203). To add on, the policy framework also provides directions on future development area, where spatial transformation activities are permitted as part of expansion of the settlement cluster. Similarly, Polokwane (2013a map 10), also shows the area proposed for the expansion within Sebayeng-Dikgale cluster. This implies that the policy directions seek to limit spatial transformation development activities in these areas to promote compact human settlements, curbing spatial splintering and the resultant spatial fragmentation which exacerbates apartheid spatial injustices.

6.6.6 Land ownership and land use

Land ownership has a significant influence on attainment of legislative policy objects on the direction of spatial transformation. Fan *et al.*, (2012 p.6); Liu *et al.*, (2011 p.708) substantiates that land ownership influences spatial transformation, as evidenced from central state land banking in Hangzhou China. Similarly, the White paper on RDP (1994 p.9) objectives provides for making land available to facilitate spatial transformation initiatives towards meeting basic needs of the citizens. In essence, the ability of local government to attain the RSA Constitutional mandate of spear heading spatial transformation-spatial justice in redressing the apartheid legacy of spatial injustices is determined by how much public land they own, its availability and desirability for development. This implies that there is need to examine land ownership to deepen the understanding of policy directions on spatial transformation in the nodal clusters. Discourse analysis of the available LSDFP for the SDA's 1, 2 and 3 policy documents indicates land ownership as shown in figure 6.8.

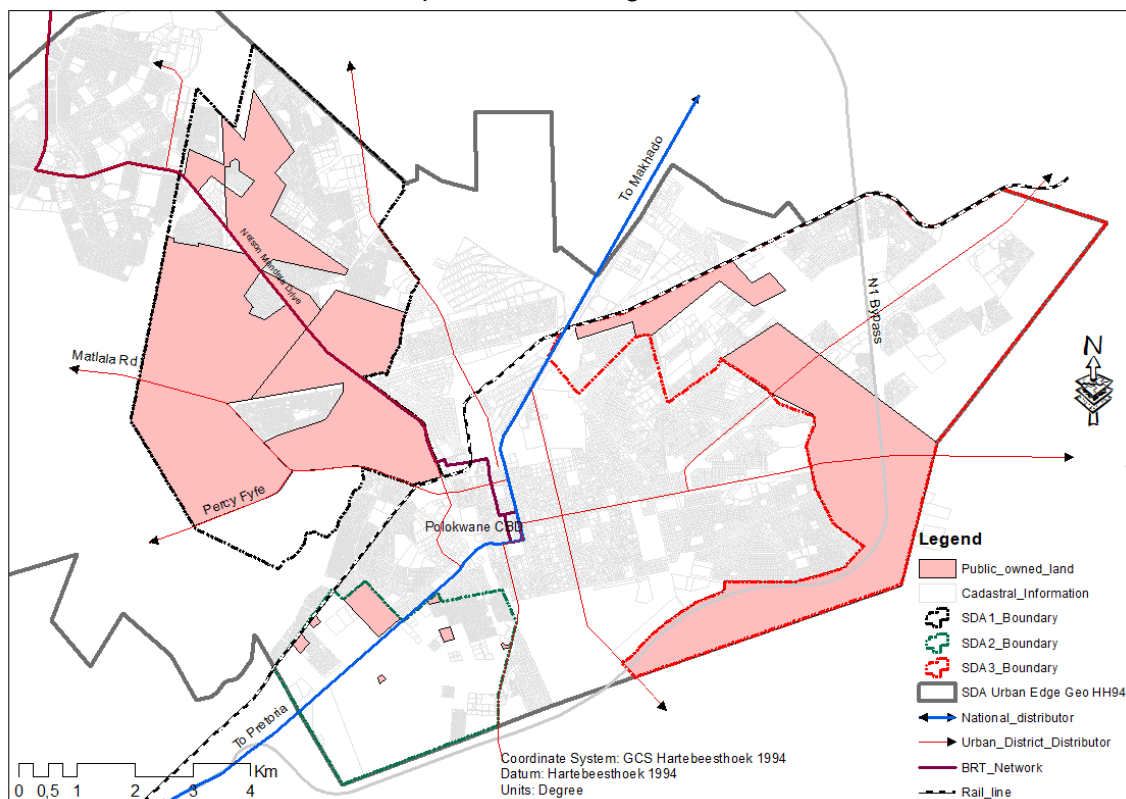


Figure 6.8: Public owned land targeted for spatial transformation activities

Source: Author, 2020

Figure 6.8 illustrates public land ownership within the SDA 1, 2 and 3. In SDA 1 area between Polokwane-Seshego it is evident that most land is publicly owned, on the contrary SDA 2 – Iydale agricultural holdings south-west of Polokwane shows that there are a few pockets of publicly owned land. This figure clears the uncertainty of how much land pockets within the nodal clusters is publicly owned. This is crucial for understanding the land ownership question, dynamics and the spatial transformation directions in the City of Polokwane. Polokwane

(2013b p.11) reiterates that land owned by the public is an invaluable asset that has potential leverage for spatial transformation in the City of Polokwane. In another perspective, in Mankweng/Badimong nodal cluster and Sebayeng/Dikgale nodal cluster there are few pockets of proclaimed land and majority of the land falls under tribal authorities. The major drawback of this scenario is that local authorities do not have direct control of spatial transformation activities in the tribal areas. Polokwane Sebayeng (2013a p.4) substantiate this stating that the tribal authorities are responsible for allocation of land including land for residential development which has a bearing on the nature of spatial transformation.

Furthermore, discourse analysis from the policy documents LSDFP (SDA1 2007a; SDA 3 2007b; and SDA 2 2009) provided the land use directions for the publicly owned land. This approach contributes to spatial transformation as supported by the policy directions of the Special Housing Areas for Auckland, which identified brownfield and greenfield areas for housing development (Salmon 2015 p.28). Similarly, the policy frameworks discourses also indicated land earmarked for spatial transformation residential developmental activities in each of the SDA's 1 to 3.

Land use planning contributes greatly to spatial transformation of human settlements towards the desired broader policy objectives. In light of this, the policy frameworks for SDAs 1, 2 and 3; also indicated the spatial transformation land use direction for the vacant land compiled and presented in figure 6.9.

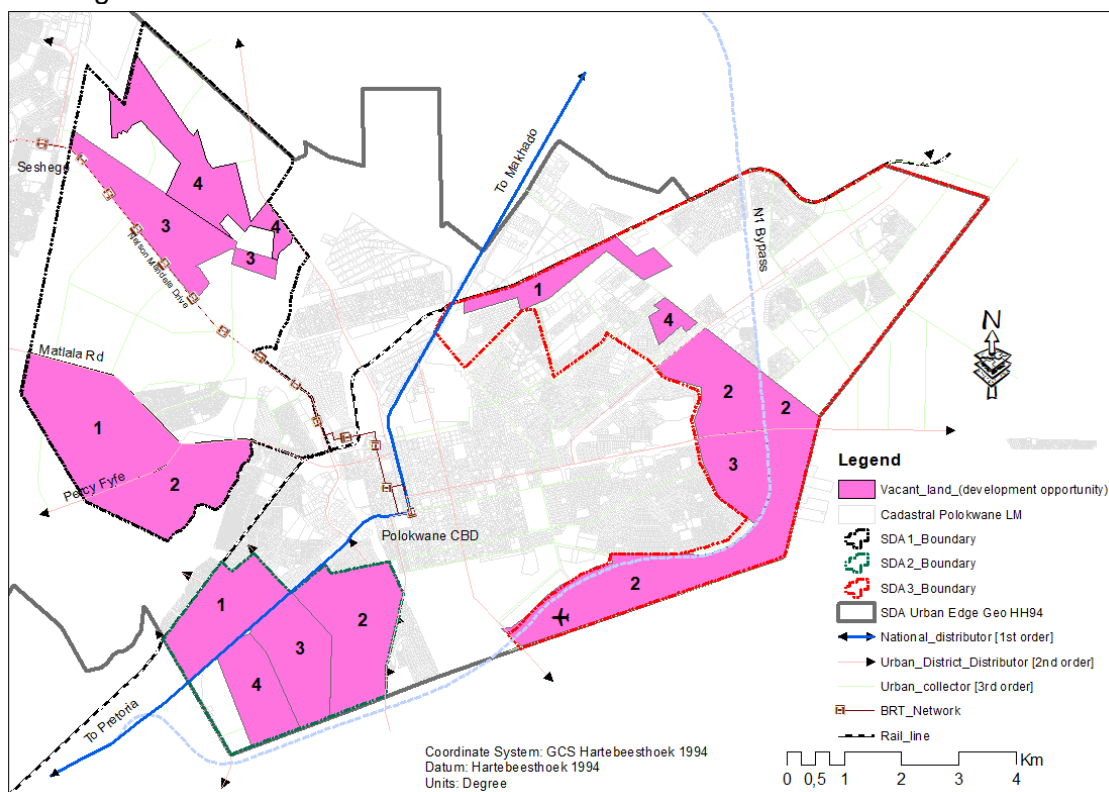


Figure 6.9: Vacant land spatial transformation potential

Source: Author, 2020

Land use planning also provides directions for alteration of the available land, towards the achievement of spatial transformation policy objectives. In particular, the discourse analysis of the policy frameworks provided spatial transformation direction for the identified vacant land as summarised in table 6.3.

Table 6.3: Vacant land spatial transformation potential

Strategic Development Area	Description	Precinct	Erven	Population
SDA 1	Vacant land; spatial transformation potential	1	4729	14534
		2	3773	11598
		3	3984	12244
		4	4988	15330
		Total	17 474	53 706
	Approved			10 514
Overall SDA 1 Total			27 988	86 021
SDA 2	Vacant land; spatial transformation potential	1	2 450	9 800
		2	3 214	12 856
		3	4 356	17 424
		4	3 125	12 500
		Total	13 143	52 580
	Existing and/ Approved			4 373
Overall SDA 2 Total			17 516	70 068
SDA 3	Vacant land; spatial transformation development potential	1	2 265	7 721
		2	1 423	4 852
		3	1 831	6 241
		4	7 944	27 081
		Total	13 463	45 895
	Approved			10 550
Overall SDA 3 Total			24 013	81 859

Source: Author, 2020

Table 6.3 summarizes the spatial transformation potential through residential development such as social housing for the identified vacant land in figure 6.9. The land use for vacant land in SDA 1, points out that the earmarked residential developments are; Precinct 1: 4729 Erven for a population of 14 534; precinct 2: 3773 Erven's catering a population of 11 598; precinct 3: a total of 3 984 Erven's for a population of 12 244 and for precinct 4; a total of 4988 catering a population of approximately 15 330. To add on, 10 514 Erven's were approved catering for a population of 32 315. Therefore, the land use directions for spatial transformation in the City of Polokwane is residential development in SDA 1 of about 27 988 Erven's and catering a population of approximately 86 021.

In another perspective, this identified vacant land is suitable for residential development leveraged by the existing infrastructure and its location, which is in close proximity to the area of opportunities, Polokwane central. Typically in SDA 1 there are established transport networks that provide easy access which include, Matlala road on the southern side of the strategic development area, Nelson Mandela Drive dissecting SDA1 and in the northern areas there is Polokwane Drive and Dendron road. Hence, an approach for using residential development as a leverage for spatial transformation is essential in attaining the broader legislative policy framework objectives outlined in table 6.1. In particular, it echoes that residential developments assist redressing spatial injustices by; meeting basic needs (White

Paper on RDP 1994), social development (RSA Constitution 1996), addressing spatial inefficiencies, (UDF 1997; SPLUMA 2013), spatial transformation (BNG 2004; NSDP 2006). To add on, the policy directions for residential development on the vacant land which is also promoting development within the urban edge, resulting in compact city, sustainable development and spatial integration of the previously segregated Seshego and Polokwane central.

6.6.7 Densification

Discourse analysis of the legislative policies reveals that densification is among the concepts providing directions for spatial transformation in the City of Polokwane. Polokwane SDA1 (2007a p. 39); Polokwane (2010a p.128) substantiates this stating that, it is part of the policy objectives to promote higher residential densities to ensure optimum use of resources, services, infrastructure, sustainability and compact city structure. To add on, legislative policies acknowledges the significance of densification in providing directions for spatial transformation towards the redressing of apartheid spatial legacy of spatial mismatch (DFA 67 of 1995; BNG 2004 p.19; NSDP 2006 p.xii; Polokwane Urban Densification Policy 2013 p.114). This implies densification is being used as spatial transformation strategy towards redressing of apartheid legacy of spatial segregation and the manifestations of rapid urbanization being experienced in the City of Polokwane. Literature also substantiates the use of densification by indicating that Auckland Housing Accord policy made provisions for spatial transformation through densification, permitting 2 storey mixed housing in suburban zone and 3 storey mixed housing in the urban zone (Salmon 2015 p.21; Early *et al.*, 2015).

Densification refers to, the increased vertical or horizontal use of space, through increasing the number of units, population threshold incrementally for existing or from the onset in newly developed human settlements (DRDLR 2011 p.i; Polokwane densification policy 2013 p.8). The spatial transformation directions emanating from this definition underpinned by apartheid legacy and rapid urbanization are that; land use schemes must permit horizontal development of more than one building unit per erven and also the vertical development of high rise buildings to maximize the use of available spaces. This in turn increases population densities, which supports the viability of integrated rapid public transport networks, mixed land uses, and decentralization of economic opportunities to the densely populated nodal township settlements. This in turn redresses spatial legacies of apartheid injustices in the City of Polokwane. Early (2015 p.231) substantiates that rapid urbanization contributes to positive spatial transformation through increased population densities as evidenced in Auckland. This implies that, with proper planning, rapid urbanization does not result in negative spatial transformation implications as experienced in most cities within developing countries.

Despite the significant contributions of densification directions in spatial transformation, the lack of comprehensive land use scheme for the whole municipal wide area is a drawback towards redressing spatial injustices (Polokwane SDF 2007 cited in Polokwane 2010a p.128). In particular, the town planning scheme employed by the municipality was limited to the Polokwane-Seshego built areas exposing other nodal clusters to ad-hoc subdivisions. The implication of this was discouraged densification, distorted spatial patterns and unsustainable developments. In response to these unsustainable post-apartheid spatial transformation pathways, a densification policy (Polokwane Urban Densification Policy Draft 2013) was then established. It indicates the demarcated urban edges, where spatial transformation initiatives must be concentrated to promote densification in the major nodal clusters namely; Polokwane-Perskebult, Mankweng/Badimong and Sebayeng/Dikgale clusters.

In another perspective, City of Polokwane is largely characterized by low to medium density settlements. These lower densities are also exhibited along activity corridors, and urban sprawling areas in the periphery of the city. There are densification potentials between Polokwane-Seshego an area which is the main focus of spatial transformation initiatives in the city. Polokwane (2013c p.115) substantiates this stating that there are existing vacant areas between Polokwane-Seshego approximately 6488 stands (11%) of the total 58 692 stands leading to a potential increase to 12.07 units per hectare. This implies that the spatial transformation direction to increase density along Polokwane Seshego area is to promote development activities in the vacant stands in this area. Furthermore, Polokwane (2007a p.41) pointed out that the Nelson Mandela Drive provides an opportunity of high residential density developments of 80 units/ha, compared to the average density of 30units/ha in other areas. This entails that the directions for spatial transformation are to concentrate high density residential development along the Nelson Mandela Corridor. This promotes the redress of spatial injustices, by extension promoting sustainable development and enhancement of traffic required to support a viable BRT system being established along this corridor.

6.6.8 Development Corridors (DCs) and Functional Development Areas (FDAs)

The legislative policy framework discourses also shows that the other concepts providing directions for spatial transformation is the development corridors (DC's) and functional development areas (FDA's) concept. The concept of development corridors is widely considered a key spatial planning instrument towards the redress of economic, social and spatial challenges affecting our cities. Literature on case studies also points out that corridor development approach influenced spatial transformation in Curitiba, Brazil (Rosário 2016 p.115; Lindau 2010a p.17); Auckland (Salmon 2015 p.17; Early *et al.*, 2015 p.223). In the context of South Africa, the NSDP (2006 p.6) normative principle 5 boldly provide directions that spatial transformation activities must be channelled along the corridors linking nodal

settlements, a strategy that assists to redress apartheid spatial distortions. Corridors refers to, the networks links such as public transport routes between settlement nodes in which areas along (functional development areas) these links is encouraged for high intensity and density uses (DRDLR 2011 p. ii). This implies that spatial transformation directions are to intensify land uses and density in the functional areas along the network links to redress spatial apartheid injustices. Polokwane (2010a p.157) encourages the municipality to harness the opportunity, that prominent routes create in facilitating integrated transport and land use management along the routes linking the municipal nodes and clusters to unlock economic opportunities.

The notable conceived spaces (Lefebvre 1991 p.33), in the form of corridors and functional development areas where spatial transformation activities are directed in the City of Polokwane are presented in figure 6.10. The DC's and FDA's are significant in facilitating economic development and redressing apartheid injustices. There are 2 development corridors (DC's) illustrated in figure 6.10 namely; DC1 represents the route; Gauteng/Pretoria – Polokwane – Mankweng/Tzaneen. That is a route from the south west to Polokwane CBD and then leads to the eastern side towards the Mankweng/Badimong nodal cluster. The DC 2 represents the route; Makhado – Polokwane – Burgersfort/Chuenespoort from the north east side down to the south. It is evident that along these corridor routes, functional development areas are running along.

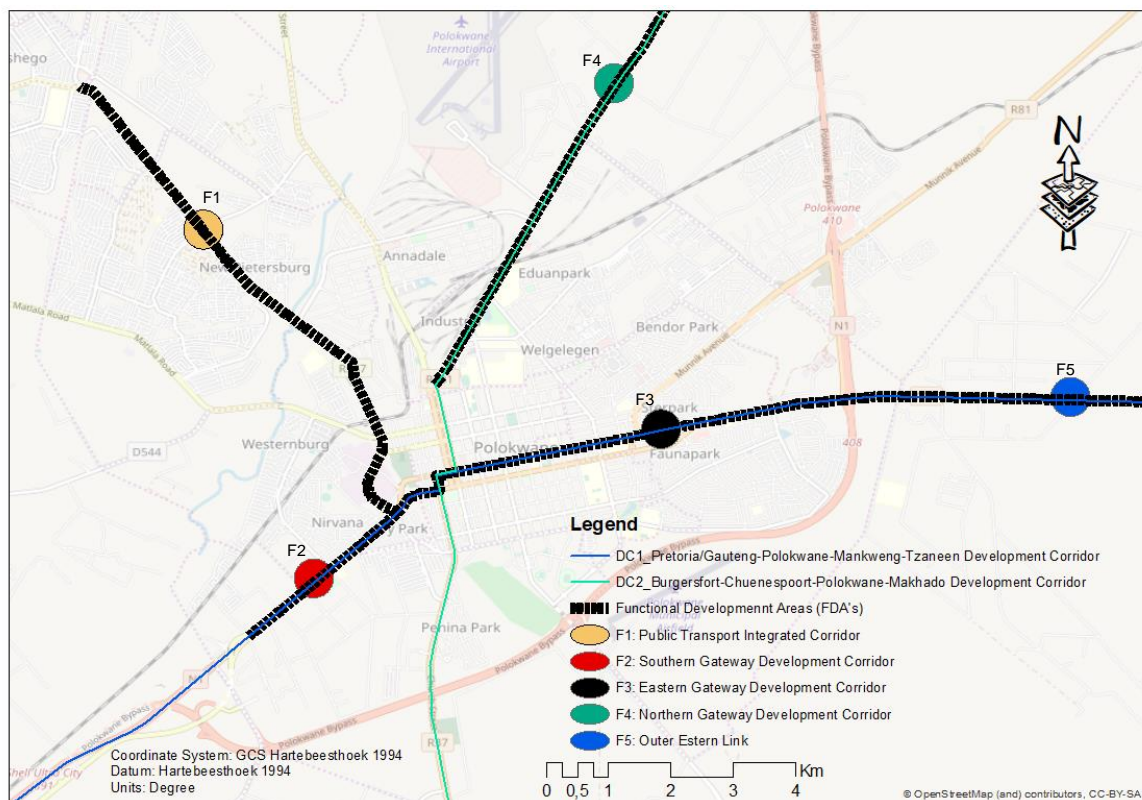


Figure 6.10: Development corridors and Functional Development Areas

Source: Author, 2020

There are several functional development areas presented in figure 6.10. In particular, the functional development area (FDA) F1 is along the major settlement nodes Polokwane CBD and Seshego township. This route is also considered the public transport integrated corridor, which promotes spatial integration between Seshego and Polokwane CBD. To add on, legislative policy discourses substantiates the directions for spatial transformation capitalizing on development corridors. In particular the spatial transformation directions for the F3 Eastern Gateway Development Corridor include the expansion of the medical node an initiative that started as early as 1988 and further strengthened by City of Polokwane 1998 Land Development Objectives in line with the DFA of 1995 (Polokwane medical node 2001 p.5-7). Despite not being flagged by the municipality in the 2010 SDF, the N1 by-bypass is another potential functional development area and development corridor evident on the map that can play a key role in spatial transformation. This is evidenced by the economic node, Mall of the North that was developed along the N1 by-pass and is also stimulating massive developments in this SDA 3. In another perspective, Polokwane (2010a p.127) pointed out that the southern corridor entrance from Lebowakgomo is less significant compared to the northern and eastern corridors. The reason being the smelter complex located in this area poses health risks making it incompatible with other land uses. Therefore the implications on spatial transformation are that development must be restricted from this area and be concentrated along other identified DC's and FDA's.

6.6.9 Transport networks

The case study of Curitiba Brazil, evidences that its heralded success in sustainable development and restructuring of the city is attributed to policy directions on investment in transport systems (Rosario 2016 p.113). Transport infrastructure plays a significant role in facilitating the redressing of apartheid legacy of spatial segregation. This is attributed to the inextricable relationship that exists between transport and land uses, whereby transport network infrastructure attracts land use developments leading to spatial transformation. Similarly, the legislative policy discourses also reveals that there is strong emphasis on development of transport infrastructure networks as a leverage for spatial transformation in the City of Polokwane. This is echoed by the various legislative policy frameworks substantiating development of transport networks to give effect to spatial transformation towards the redress of apartheid spatial segregation in the City of Polokwane. These policy frameworks providing the basis for development of transport infrastructure networks include, "Public Transport Integration Corridor Development Plan alongside Nelson Mandela Drive, August 1999 cited in LSDFP SDA 1 (2007)"; "LSDFP SDA 3 2007"; "LSDFP SDA 2 2009"; "Integrated Urban Realm and Movement Plan for Polokwane Municipality (IURMP) 2009"; "Polokwane SDF (2010a)"; "Polokwane IRPTN Operational Plan (2010)"; "Comprehensive

Integrated Transport Plan Polokwane Local Municipality 2012”; “Sebayeng LSDFP 2013”; “Mankweng/Badimong LSDFP 2013”; “Operational Plan for the Implementation of the Integrated Rapid Transit System Polokwane Local Municipality 2014b.” This implies the City of Polokwane is leveraging on transport network infrastructure development in spear heading spatial transformation. In support of this, discourse on the policy frameworks shows that the leveraging of transport networks for spatial transformation can be understood at the macro-level and micro-level within the City of Polokwane.

6.6.9.1 Macro-level public transport mobility networks

The City of Polokwane is characterized by human settlements that are scattered, fragmented and spatially segregated. In order to promote spatial integration of these settlements, the policy frameworks pointed out the municipality is leveraging on transport mobility networks. To add on, public transport mobility networks also ensures eradication of social and geographical barriers to opportunities. SACN (2017 p.40) substantiates that City of Polokwane has initiatives to eradicate the urban and rural divide that is inherent in the city. In particular, the transport mobility networks radiate from the city centre like the spokes of a wheel as presented in figure 6.11. The major mobility networks includes the N1 Arterial road which dissects the City of Polokwane into 2 parts, namely north western and the eastern parts as shown in figure.6.11. The north western part consists of Seshego, Perskebult, Mabokelele, GaRamongwana, Moletji, Matlala, Juno settlement clusters. The major public transport network linking and traversing through these settlements are route R521 and in particular R567 which feeds into the integrated rapid public transport system passing through the F1 functional development area. Polokwane (LM 2014b p.1) substantiates that such a public transport network is an enabler for spatial transformation, social upliftment and economic growth.

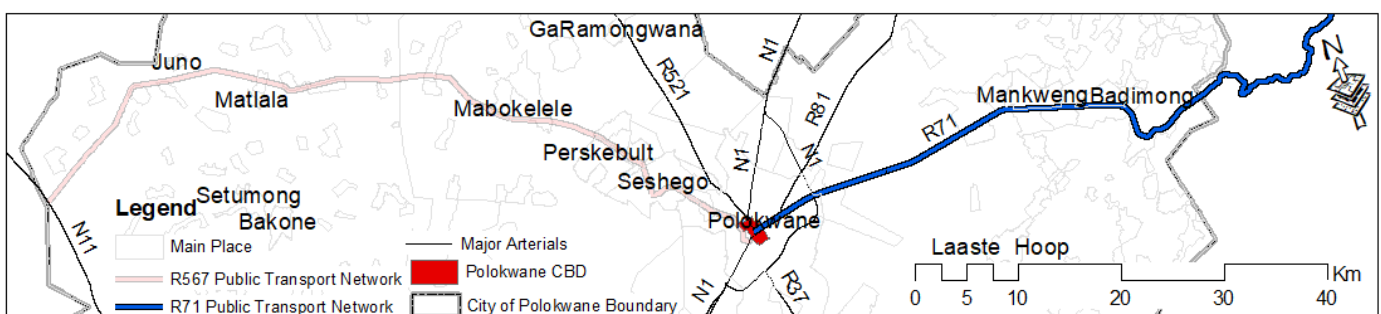


Figure 6.11: Macro-level public transport networks

Source Author, 2020

The R37 transport mobility network is also the southern part of development corridor 2 connecting Chuenspoort and other rural settlements to Polokwane central. The other key mobility network in the eastern side of the city is the R71, which forms part of the development corridor 1. It links Polokwane-Perskebult cluster to Mankweng, Badimong, Moria, Tzaneen

and other areas. In support of this, Polokwane (2013b p.38) substantiates that R71 is a priority public transport mobility network. To the spatial transformation role played by this transport network, the following developments are proposed; regular maintenance of the road, preventions of illegal developments and land invasion along the road reserve, construction of access roads to businesses along the corridor, dedicated lanes used for turning at the intersections with R71, providing bus stops, or layby points properly developed to shelter people from the weather.

6.6.9.2 Micro-level transport networks

This section discusses the legislative policy directions on transport networks to facilitate spatial transformation at micro-level in the City of Polokwane.

6.6.9.2.1 Nelson Mandela Drive

Nelson Mandela Drive is a typical example of the notable transport network corridors heavily invested on for its successful contribution to spatial transformation through integration between Seshego and Polokwane centre. In support of this, the August 1999 Public Transport Integration Corridor Development Plan alongside Nelson Mandela Drive cited in Polokwane (2007a p.20), outlined spatial transformation directions for this transport network corridor. Using the lens of the spatial triad (Lefebvre 1991 p.33), the conceptualization of this conceived space for the public transport integrated corridor is presented in figure 6.12. The spatial transformation directions linked to the Nelson Mandela Drive corridor included promoting; public transport and related facilities, mixed use and high density residential developments, pedestrian friendly movement, nodal development, and Small Medium and Micro-Enterprise developments among others. These directions for land uses along the Nelson Mandela Drive corridor clearly indicates the strong relationship between transport infrastructure and land use developments.

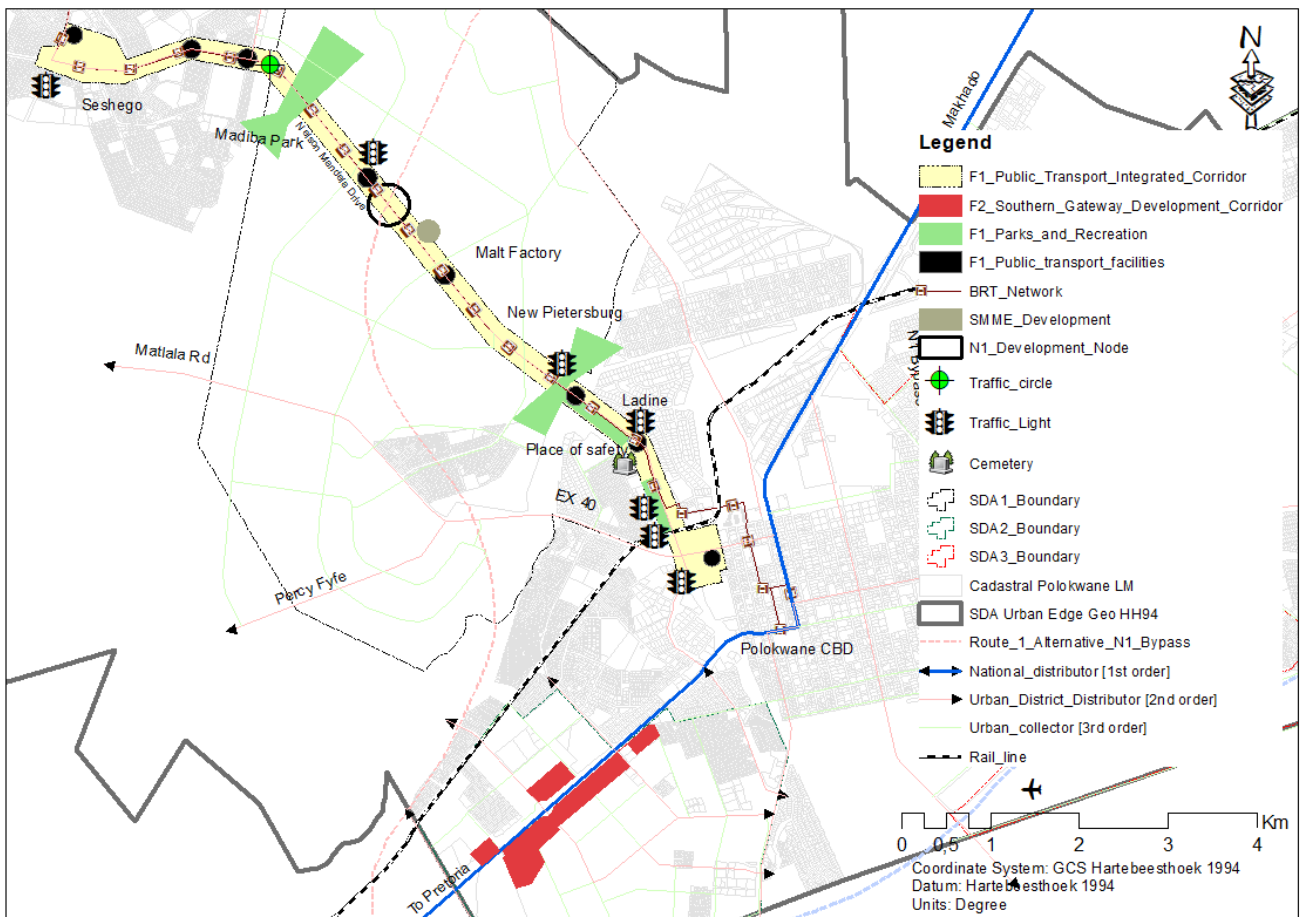


Figure 6.12: Seshego-Polokwane Integrated Public Transport Corridor
Source: Author, 2020

6.6.9.2.2 Integrated Rapid Public Transport Network System (IRPTN) - Leeto la Polokwane

In acknowledgement and reinforcement of the key role that transport plays in facilitating spatial transformation, policy frameworks further revealed the upgrading Nelson Mandela Drive into an integrated rapid public transport system (IRPTS). This IRPTS, was named Leeto la Polokwane which means the journey of Polokwane (Abrahams and Marais 2019 p.188). In support of this, the IURMP cited in Polokwane (2014b p.5) pointed out that transport plans for the city seeks to promote integration of the BRT system within existing public transport corridors and facilities. This plan also proposed the introduction of the Bus Rapid Transport (BRT) system in Polokwane Centre. This resulted in upgrading of Nelson Mandela Drive up to Moletji settlement cluster to accommodate the development of an IRPTN's as it is a high demand corridor. A study conducted revealed high traffic volumes from Moletji-Seshego towards the CBD of 17 425 compared to 9 535 for Polokwane-Mankweng corridor (Polokwane 2014b p.16). This implies that Seshogo, Perskebult, Moletji settlement cluster are highly populated generating so much traffic and in turn supports the feasibility of developing an IRPTS along this route. In addition to this, it is also pointed out that $\pm 80\%$ of the land area

along the corridor is residential areas making it highly suitable compared to the R71 corridor which has limited residential development.

The IRPTS trunk or main corridor can be a rail, road or combined system, in the case of City of Polokwane it is a road network. The upgrade of the main corridor or trunk from Polokwane CBD stretches beyond Seshego township where the Nelson Mandela Drive ends, to Moletji rural settlement cluster situated approximately 40km from the CBD. The directions of this system also include other parts of the network trunks being extended to run on some residential streets, and linking it to pedestrianization of some streets within Seshego and in the CBD for example Churchill Street (Polokwane 2014b p.66). In particular, a study conducted pointed out that the Nelson Mandela Drive link to the CBD had the highest pedestrian volume count of 2550, and for other settlements outside the CBD the Seshego link to New Polokwane had a pedestrian volume count of 1820 (Polokwane 2014b p.62). This implies the transport network system spatial transformation directions are to promote integration of the segregated human settlements, social upliftment and sustainability in the City of Polokwane.

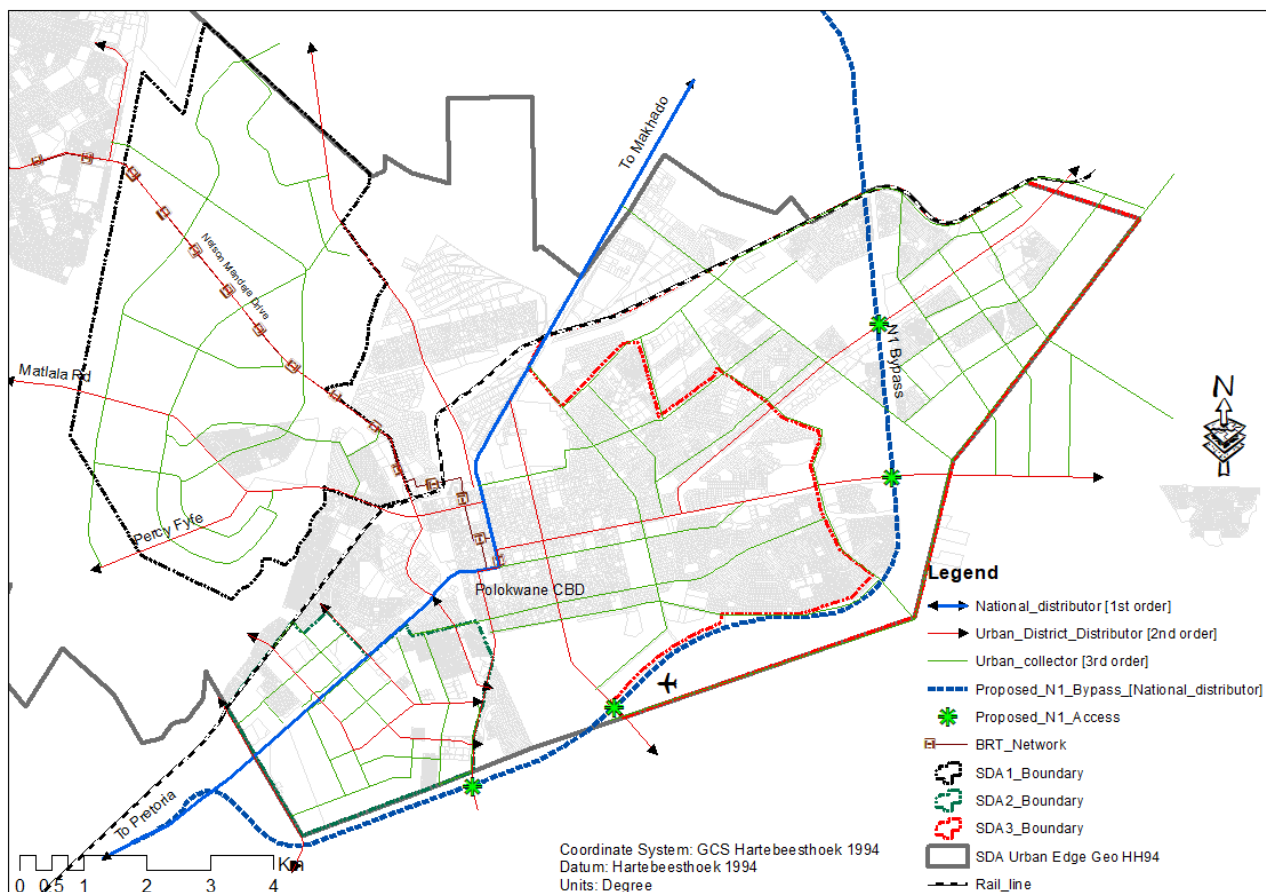


Figure 6.13: spatial transformation transport network in the City of Polokwane urban edge

Source: Author, 2019

A part of the conceptualized main trunk of the IRTPN as conceived in the policy discourses, is presented in figure 6.12 labelled as BRT and figure 6.13 illustrates the proposed road

network hierarchy in the area to facilitate spatial transformation in the area. The transport network development proposals can be categorized in relation to the road hierarchy, namely national distributor (1st order), District distributor (2nd order), Local distributor roads.

6.6.9.2.3 National Distributor (1st order)

The development of a national distributor road, N1 bypass was proposed for Polokwane to guide spatial transformation in the area. In support of this, the Polokwane (2007a p.30) states that the policy directions were that the eastern road be upgraded as the N1 by-pass or ring road shown in figure 6.13. Polokwane (2007b p.7) reiterates that amongst the proposed projects the N1 eastern bypass has a prominent spatial transformation impacts on SDA 3. In particular, this N1 bypass road also attracted the development of a regional shopping complex or retail centre, Mall of the North, greatly contributing to spatial transformation of the surrounding areas.

6.6.9.2.4 Urban District Distributor (2nd order)

Polokwane (2007a p.40) reiterates that spatial transformation being noticed in the area through township developments is being facilitated by availability transport networks among other facilities available in the area. This clearly indicates that transport networks play a key role in leveraging spatial transformation. Polokwane (2007a p. 25; p.40) pointed out that there is limited access in SDA 1 which needs to be improved on the following distributor (2nd order) roads Dendrone, Monama Drive, Pietersburg/Matlala road and Nelson Mandela Drive. This entails that improvement of permeability in SDA1 is aimed at facilitating spatial transformation in the area. Similarly, Polokwane (2007b p.34) points out that the prominent district distributors linking Polokwane to the greater region are Munich Avenue (R81) leading to Modjadjieskloof and Grobler street (R71) leading to Tzaneen. However these roads were considered as having limited permeability for local traffic from settlements within SDA 3 on the western and eastern sides of the N1 bypass. To counter this challenge, the policy directions were to provide additional crossings (green stars in figure 6.13) and or development of parallel roads. This implies promoting functioning, and just spaces through eradication of access barriers, a redress of apartheid access restriction to certain geographical areas. To add on, Polokwane (Gildenhuys 2015 p.86) also provided directions for spatial transformation in Seshego through development of new roads in order to complete the urban form. The underpinnings, for these directions is that properly connected transport networks breaks larger blocks leading to improved accessibility and functionality of an area in serving its community.

6.6.9.2.5 Urban collector (3rd order)

Emerging from the legislative policy discourses are directions for development of urban collectors within the SDA's to facilitate spatial transformation through the uptake or occupation

of land in these areas previously restricted for occupation during apartheid era. In support of this Polokwane (2007a p.62) provides directions for development of 3rd order roads not only to improve accessibility but rather to also unlock the area for potential development, which in turn facilitates spatial transformation of the area. Similarly, Polokwane (2009 p.50) acknowledges the existing transport networks, however it outlines that the transport network in SDA2 is spatially distorted, low design standards, limited traffic capacity, forming large poorly permeable blocks. In particular, the north western area between N1 and the railway line in SDA 2 has limited movement network. Hence, it proposes the revision and expansion of the transport network to improve its traffic carrying capacity and in turn facilitate spatial transformation in the area. Polokwane LSDFPSDA3 (2007 p.40) further provides proposed 3rd order roads to facilitate spatial transformation in SDA 3.

6.6.10 Shopping centres

Shopping centres play a critical role in spatial transformation of human settlements. Oranje (2014 p.47); Wei (2012; 399) substantiates that development of shopping centres also influenced spatial transformation of Hangzhou, China. In particular, shopping centres act as the focal point for further developments by extension spatial transformation. Ideally, an effective and properly functioning retail centre developed on a green field attracts further developments around it such as offices, hotels, apartments and other specialized activities leading to spatial transformation of the area. Similarly, other retail centres are established modelled around the concept of mixed land use but rather developed in phases starting with the mall, followed by other planned mixed land use such as a big hardware store ultimately leading to spatial transformation. In addition shopping facilities are also important for easy access to essential goods within local communities. Apartheid planning resulted in unjust geographical distribution of economic opportunities and utilities such as shopping facilities. People had to travel long distances from the rural areas and townships to get access to economic opportunities and utilities such as retail centres located in the major towns and cities where affluent people reside. Polokwane (2013a p.51) reiterates that people in rural areas commute to Polokwane for banking services and higher order goods. Emerging from the legislative policy discourses are directions on facilitating spatial transformation in redressing apartheid injustices through development of retail shopping facilities. Polokwane (2007a p.31) substantiates this stating that shopping facilities are limited for convenient access to goods and services.

The identified (existing, approved, and proposed) shopping centres from the policy frameworks to stimulate spatial transformation within the urban edge of Polokwane-Perskebut settlement cluster are presented in figure 6.14. Polokwane (2007a p.51) pointed out that for the initial 2007 SDA 1 boundary approximately 100 000m² of retail space was estimated which

is inline with a population threshold between 80 000 to 100 000, in particular SDA 1 anticipates to cater for about 86 021 as presented in table 6.3. Similarly Polokwane (2013b p.40) pointed out that in Mankweng-Badimong settlement cluster retail centres have a defined land use budget of approximately 104 363m² by the year 2025 and only 29 128m² is currently developed, with a potential of further 75 235m² retail space development potential. To add on, a space for a shopping mall is also indicated in the framework plan for Sebayeng settlement cluster (Polokwane 2013a p.80). This entails that the policy directions encourage development of shopping centres as leverage for spatial transformation. The shopping centres not only will they limit the long travel distances, saving people from losing their income from the high travel costs, they also help redress other unwarranted apartheid injustice legacies. The shopping centres also attract residential developments and other activities that would relocate from the high rentals in the CBD leading to polycentric developments. Thus the shopping centres act as convenient stores to the local communities, at the same time being magnets attracting other economic developments in the surrounding areas leading to spatial transformation.

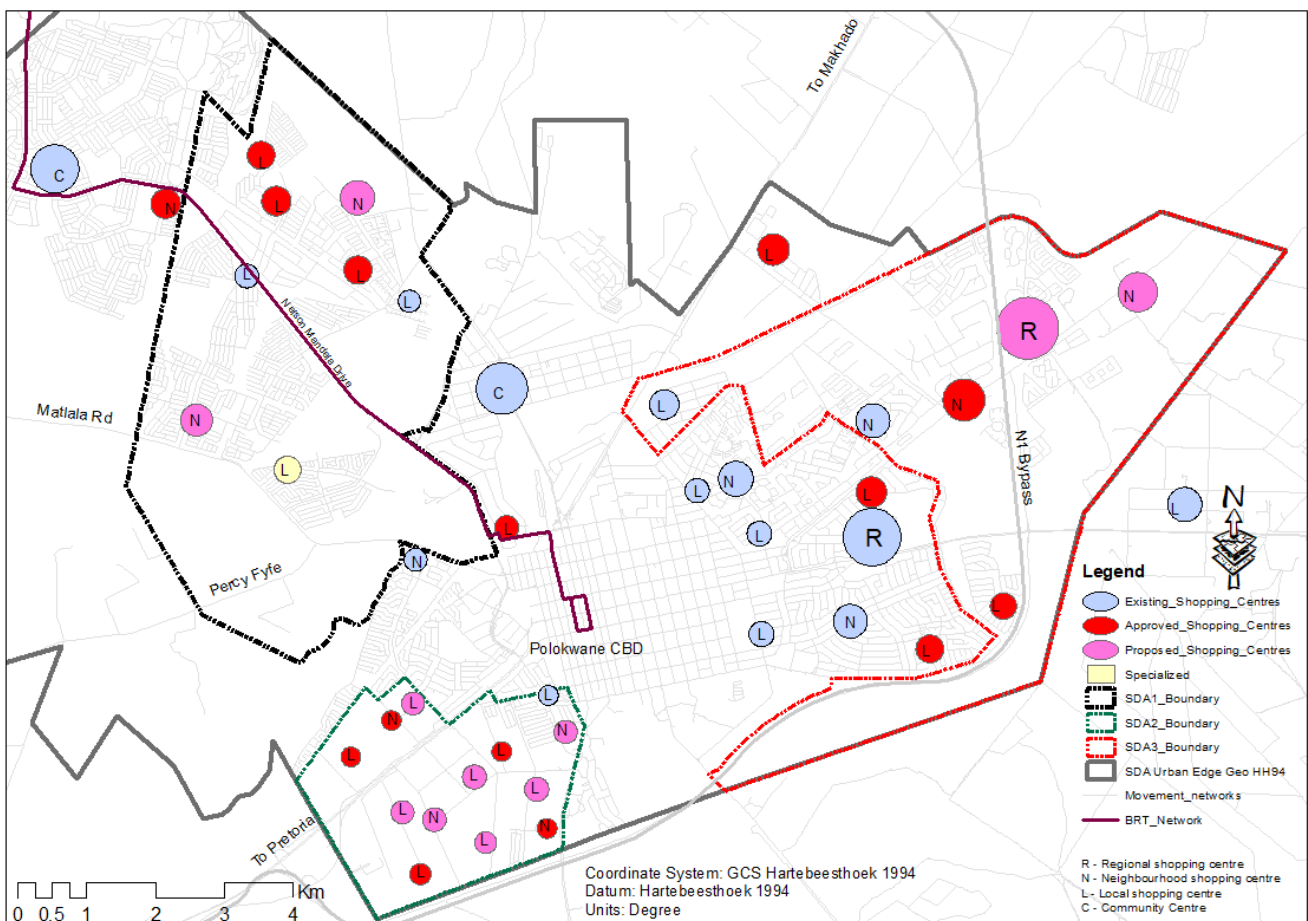


Figure 6.14: Shopping centres to stimulate spatial transformation in the urban edge

Source Author 2019

6.6.11 Multi-Purpose Community Centres (MPCC's)

A Multi-Purpose Community Centre refers to, “a focal point at which a comprehensive range of essential services can be obtained by people living in its vicinity. In turn it acts as a pool of human and physical resources from which the inputs necessary for development can be distributed efficiently, and from which a community can draw to promote their development” (Polokwane 2007a p.56). The concept of developing Multi-Purpose Community Centres also gained traction as a spatial transformation tool in post-apartheid South Africa, towards the redress of the inherent spatial injustice on distribution of community service centres. In support of this, Polokwane LSDFP (2007a p. 51) points out that 8 MPCC's are proposed for development in SDA1. For example, policy directions for spatial transformation are that the 3 nodal areas or road intersections along Nelson Mandela Drive within SDA 1 and the southern-end be earmarked for MPCC's developments as shown in figure 6.15. Similarly, 5 MPCC's are also proposed for development to serve the various functional parts or settlements in SDA3 (Polokwane 2007b p.43). To add on, Polokwane (2013b p.35) also reiterates that Mankweng framework plan must strengthen the functioning of Mankweng Badimong settlement cluster as a rural service centre (MPCC).

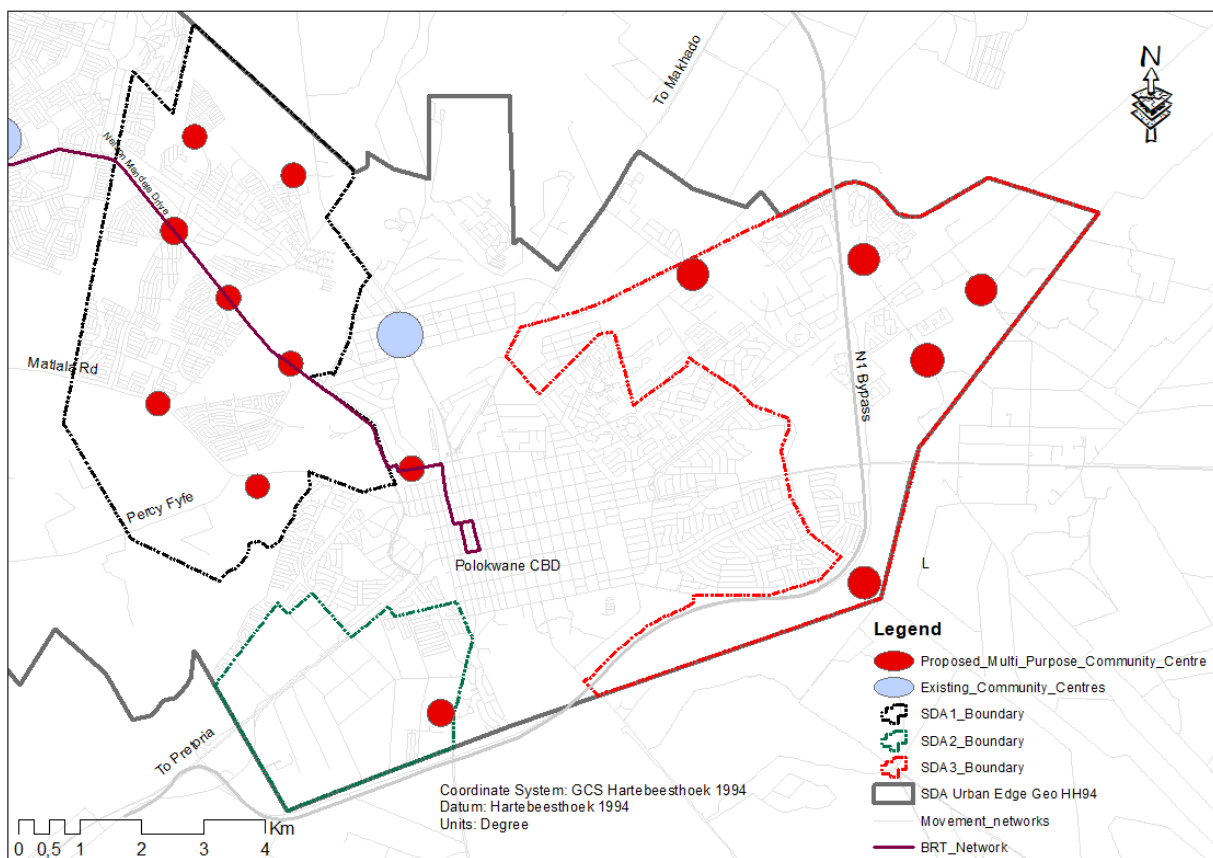


Figure 6.15: Multi- Purpose Community Centres

Source: Author, 2019

Previously disadvantaged areas were deprived of access to essential community services in their vicinity. Poor people resorted to travel long distances in order to get access to service functions in the apartheid affluent town centres. In another perspective, Polokwane (2007a p.51) reiterates that the MPCC's are expected to result in concentration of people and activities, which then creates spatial transformation opportunities through public-private partnerships (PPP's) for the development of other businesses. This concept of MPCC also gained recognition for spatial transformation because the developed centre would also act as an economic hub attracting both informal and formal retail businesses, and industries. To add on, because of the frequency of traffic to such centres it would also result in the development of a taxi rank. This makes it highly favourable to develop MPCC's along transport corridor networks to maximise on accessibility and traffic passing through the area.

This concept facilitates collaboration from various stakeholders which include local, provincial and national spheres of government to bring services to the local communities. The community centres also act as a one stop centre, a nucleus or a node that attracts other economic activities and reduces multiple trips by bringing services closer to people. In addition, the MPCC is viewed as a vehicle to spearhead spatial transformation because, with appropriate design it will aid attain the broad "principle of stimulating diverse and complex urban areas" Polokwane 2007a p.57).

6.6.12 Urban development zone (UDZ) and urban renewal

Polokwane (2005 p.49) pointed out that the significant role played by the CBD includes; being the primary activity node and hub of provincial government offices and also for other institutions. To add on, the CBD is a key contributor to the overall city's economy and GDP. It is part of the heart of Polokwane Central, provincial growth point (PGP), the 1st order and highest settlement cluster, a provincial convergence point of transport networks, regionally serving the whole of Limpopo province (Polokwane 2005 p.10). This warrants the need for spatial transformation initiatives to redress the challenges faced in the CBD such as urban decay, to reach its maximum potential capacity as a primary activity node for serving the surrounding communities and the province at large. In support of this, (Polokwane 2005 p.11) provides directions that spatial transformation initiatives must be prioritized for the regeneration and continued development of Polokwane CBD. To add on, case study review evidences that urban renewal initiatives influence spatial transformation. For example, spatial transformation in Berlin during the 'gold rush mentality' was also attributed to massive urban renewal initiatives as part of megalomaniac planning of Berlin (Bernt *et al.*, 2013 p.14).

Polokwane promulgated a UDZ for the CBD in 2005 which is approximately 150ha (Polokwane 2008b p.128). In line with the spatial triad lens (Lefebvre 1991 p.33), the conceptualized space for Polokwane UDZ is presented in figure 6.16. This figure also shows that the UDZ covers

the following functional zones in Polokwane CBD; 1. low density office zone, 3. trading zone, 4.eastern office or retail zone, 5. motor town or accommodation zone, 6. western office or trading zone, and 7. transition zone. The 2 areas in the CBD that are excluded from the Polokwane UDZ are; 2. institutional zone and 8. infill zone. The underlying reasons for establishment of the UDZ includes; rapid general decay attributed to several reasons such as physical, social and economic related problems in the CBD. In support of this, Polokwane (2010a p.116) states that a UDZ is a revitalization or redevelopment initiative by the National Treasury to promote vitality of Polokwane CBD.

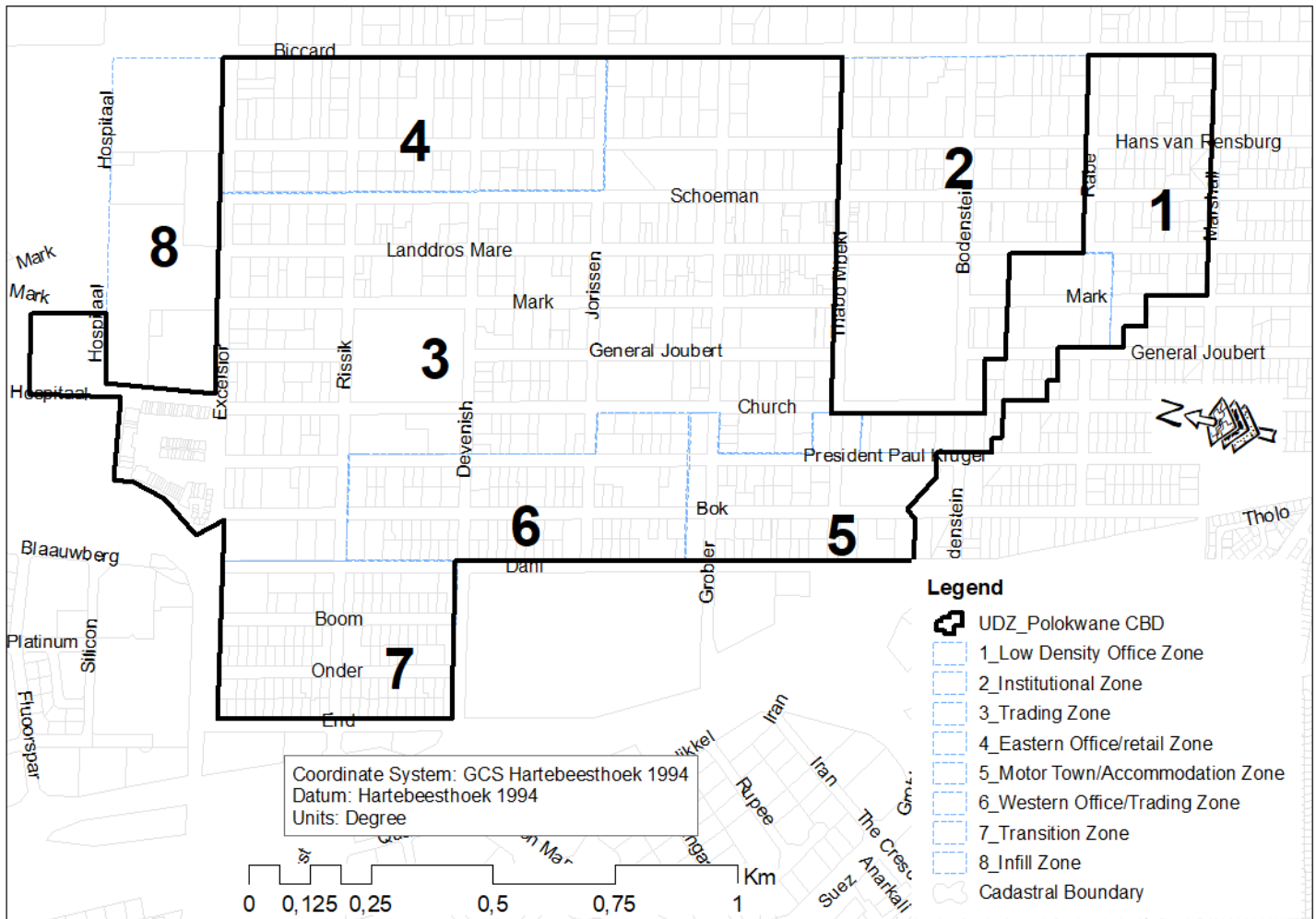


Figure 6.16: Polokwane spatial transformation UDZ

Source: Author, 2020

According to Polokwane (2008b p.118), the UDZ refers to the National Treasury “urban renewal tax incentive scheme.” The underpinning of the UDZ concept is that inner cities are experiencing dereliction attributed to decentralized nodal developments taking businesses from the inner city to new nodes identified in the city such as the retail centres. In terms of the bid rent theory, rentals are expensive at the city core and decrease with increased horizontal distance from the CBD. The implication of this is that city centres as the main primary activity nodes are suffering from accelerated depreciation as businesses are relocating to the new

secondary nodes in the outskirts. Hence, the UDZ is intended to provide property owners and developers with spatial transformation incentive for revitalizing, development, combat dereliction, optimise resource use, promoting compact cities, and to improve inner city aesthetics. In essence the UDZ tax incentive provides for tax payers (investors and developers) the “benefit of deduction of cost of the erection, extension, addition or improvement of any commercial (business) or residential building within an Urban Development Zone (UDZ) from their taxable income” (2008b p.122). This act as a discouragement of decentralized and polycentric developments which manifests in spatial splintering exacerbating the injustices of spatial segregation inherent in the city.

In another perspective, emerging from the legislative policy discourses are directions for establishment of other spatial transformation interventions since the UDZ incentive is not effective alone. Polokwane (2008b p.122) substantiates this stating that, “the municipality must provide additional measure to support and enhance regeneration within the demarcated UDZ”. In addition to this, policy discourses shows that City of Polokwane committed itself to extent the tax incentive beyond service tariffs but to include development costs, rezoning costs among others. To ensure that developers and investors are attracted to the UDZ at the same time contributing to urban renewal, a similar approach from the DFA 67 of 1995 was borrowed of fast tracking finalization of development applications within 90days in this zone (Polokwane 2008b p.122). This approach is also similar to the Housing Accord for Auckland New Zealand, it mentions of fast tracking housing delivery process to attain the desired spatial transformation (Early *et al.*, 2015 .227). This denotes that fast tracking development processes by cutting unnecessary red taps have a positive influence towards the desired spatial transformation.

Other spatial transformation initiatives done to compliment urban regeneration in the CBD include studies such as; Polokwane CBD Business Zoning: Market demand Model for retail and office markets in the Polokwane CBD (Polokwane 2008b) to accommodate the increasing demand and future expansion of office and retail spaces in the CBD. In particular it was projected that the retail market demand will rise from 417 000m² in 2008 to 581 000m² in 2020 and office demand will rise from 655 000m² in 2008 to 759 000m² in 2020 (Polokwane 2008b p.38). This spatial transformation directions from these projections are that the municipality has to undertake conversion of land uses to accommodate the demand or either expand the CBD boundary. This makes the inner city to be more vibrant and having capacity to play its regional development role in the province.

In addition, to rejuvenate the CBD and the broader Polokwane-Perskebult cluster several other spatial transformation interventions were also initiated. These interventions emerging from the policy discourses include; CBD boundary expansion, transport facilities and networks- N1

Bypass, tourism, supporting informal businesses and SMMEs such as development of African Market, developing transportation hub, Gateway international airport, convention centre, Jewellery Hub, The Mapungubwe Theatre, sport and recreation facilities, social housing to eradicate crime, mixed use zoning, urban management issues pedestrianization, public open spaces, and the business improvement districts (BIDs) (Gildenhuys 2015 p.82-98; Polokwane 2005 p.73-94; Polokwane 2008b p.141-142). Some of the policy directions for spatial transformation are related to enhancing tourism activities to boost the vibrancy of the regional node. The case study of Hangzhou China also narrates how the city was spatially transformed into a world-class tourism through opening of museums, cultural sites, temples; hand craft industries (Oranje 2014 p.47; Wei 2012 p.399). This implies policy directions on spatial transformation through tourist related activities are crucial for supporting the vibrancy of City of Polokwane regional node.

6.7 Chapter summary

This chapter analysed various legislative policy frameworks providing directions for spatial transformation in the City of Polokwane. Discourse analysis theory was adopted aided with spatial turn theory, spatial triad and theory of change were adopted to unravel the policy direction for spatial restructuring. The policy discourses pointed out that the directions for spatial transformation that emerged include; Legislative policy frameworks: objects and normative principles, and vision for City of Polokwane. In addition, this chapter also discussed the legislative policy tools and concepts providing direction for spatial transformation namely, spatial concentration model combining selective cluster approach in rural areas, nodal hierarchical settlement concept, strategic development areas (SDA's) and potential development areas (PDA's) for spatial transformation, local spatial development frameworks (LSDF), urban edge and fringe concept; Land ownership and land use, densification, development corridors (DC's) and functional development areas (FDA's), transport networks, shopping centres, multi-purpose community centres (MPCC's) and the urban development zone (UDZ) and urban renewal initiatives.

CHAPTER 7: TOWARDS AN INTEGRATED SPATIAL TRANSFORMATION TRACKING FRAMEWORK

7.1 Introduction

This chapter serves to present empirical evidence on spatial transformation in the City of Polokwane (1996-2016) and advance an integrated spatial transformation tracking framework. Section 1 introduces this chapter and its orientation, as presented in figure 7.1.

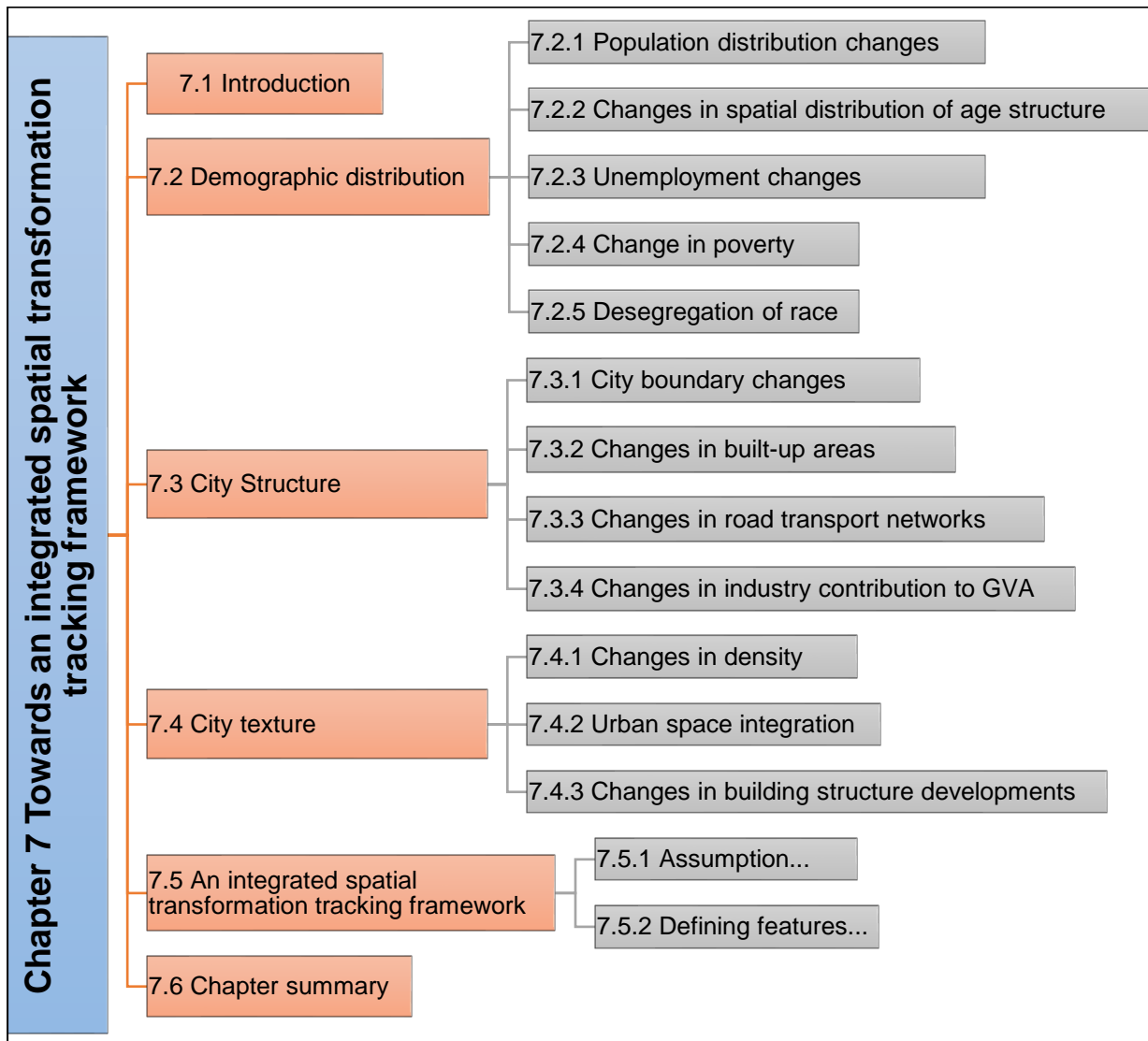


Figure 7.1: Chapter 7 Orientation

Source: Author, 2020

This study employs the spatial transformation mapping triad as discussed in chapter 2 building on the work of Turok (2014 p.74). This triad provides that key dimensions to understand spatial transformation in cities are tracking changes in; demographic distribution, city structure and city texture as discussed in sections 2, 3 and 5 respectively. This is followed by section 6, a discussion of the proposed conceptual integrated spatial transformation tracking framework.

7.2 Demographic Distribution

Demographic distribution is linked to mapping the demographic changes in the City of Polokwane, to understand socio-spatial demographic transformations between 1996 and 2016. The demographic spatial indicators employed in this section are; population distribution changes, changes in spatial distribution of age structure, unemployment changes, change in poverty and desegregation of race.

7.2.1 Population distribution changes

This section presents maps on population, demographic distribution changes in Polokwane LM between 1996 and 2016 computed from mesozone polygons as unit of analysis, linked to 1996 – 2016 Stats-SA geo-spatial census information. Population changes in a given space and time is a key socio-spatial demographic aspect (Wang & Lui 2017 p.1), it helps to unravel spatial transformation dynamics. Understanding population changes is also significant in generating empirical evidence required to inform decision makers on redistribution of resources and services to facilitate spatial transformation as reinforced by the legislative framework of South Africa i.e. SPLUMA of 2013 among others.

The population estimates from the 147 mesozone polygons within the 2016 municipal boundary for City of Polokwane, created from the dasymetric mapping process that was employed by CSIR shows in 1996 the population was estimated to be 572821 people, 655 445 people for year 2001, 766 269 people for year 2011, and 812 395 for the year 2016. These computed population estimates were tested for percent error, to identify the level of tolerance for the data, benchmarking on the 2016 population estimates of 797 127 (StatsSA 2018 p.12). The mathematical model 5.1 was employed as follows to calculate percent error;

$$\delta = \left| \frac{812\,395 - 797\,127}{797\,127} \right| \cdot 100$$

Percent error $\delta = 1,92\%$

Therefore, the percentage error for the population estimate is 1,92%, which is smaller than the observed undercount or over count margin of error of 10% for Limpopo Province, and 14,6% for all areas in South Africa (StatsSA 2012 p. 42). StatsSA (2007 p. 141); StatsSA (2016 p. 49) substantiate that population data is always associated with errors of undercounting and over counting. This demonstrates that percent error is always expected and cannot be ruled out, as such a lower percent is acceptable and makes the data suffice to be used for any analysis. Therefore, the lower percent error for this study is acceptable, hence the researcher proceeded in analysing the population changes in the City of Polokwane using census data linked to the mesozone polygons as presented in figure 7.2. Part of this error also arise from the fact that the attribute data and part of the mesozone polygons bordering the edges of newly demarcated boundary were automatically selected as part of the mesozone geospatial data employed.

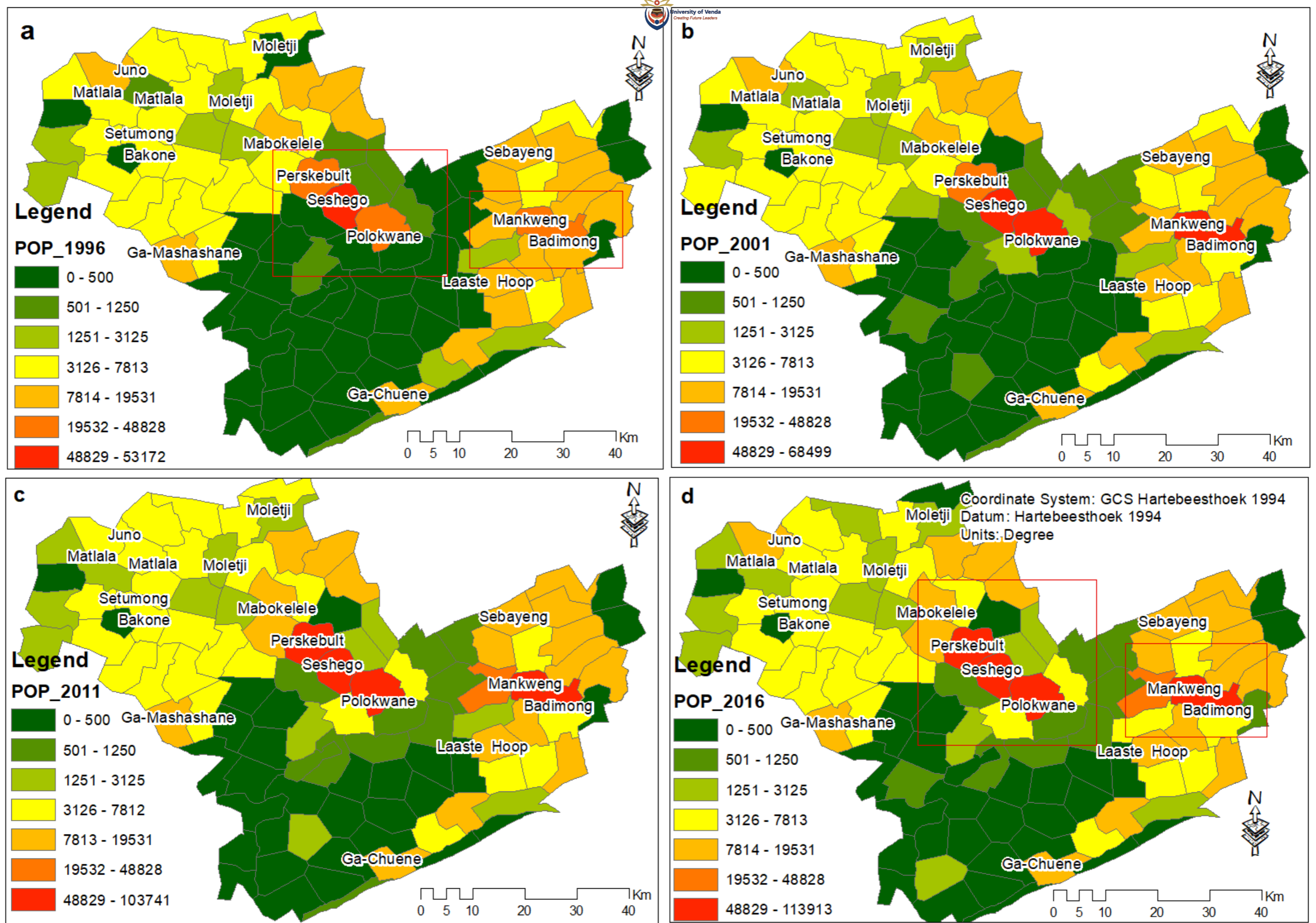


Figure 7.2: Population distribution in Polokwane LM 1996_2016

Source: Author, 2020

Abrahams (2017 p.8) agrees that the population is not spread evenly in Polokwane. Figure 7.2 substantiates this by portraying uneven population distribution in the City of Polokwane based on the population estimates for the years 1996, 2001, 2011 and 2016. These population estimates are presented using choropleth map with dark shade of green representing agricultural farm areas and red representing high population concentration areas. This choice of colour ramp for the farms areas as presented in figure 7.2a, resonates with the map drawn by Donaldson (2001 p.209), which shows that most of this area is occupied by farms for the whites. This also substantiates the noticeable lower population values ranging between 0-500 people. The settlements Perskebult, Polokwane central, and the far east Mankweng Badimong settlement cluster had relatively lower population than Seshego within the range of between 19 532 - 48 828 people. In the perspective of the spatial turn theory, taking a backward glance at population distribution for the base year 1996 figure 7.2a, it is evident that only Seshego settlement cluster had the highest population range of 48 829 - 53 172 people. This empirical evidence demonstrates the implications of apartheid social engineered spatial injustices, that was embedded in the establishment of City of Polokwane. The colonial and apartheid racial segregation ideologies, exacerbated by policies which restricted the influx of the black African population into the white owned areas reversed the urbanization trends experienced before apartheid era in then Pietersburg. In particular, the grand apartheid resulted in forced dispossession of the blacks into Seshego a dormitory township, in the former homeland area of Lebowa (Donaldson 2001 p. 208). Thus, the forced concentration of blacks in Seshego explains the witnessed higher population levels in Seshego.

A comparison between figure 7.2a and figure 7.2d evidences spatial transformation in population distribution with both the 1st order nodal area Perskebult-Polokwane settlement cluster and 2nd order nodal area Mankweng/ Badimong having the highest population concentration range of 48829 – 113913 people in 2016 figure 7.3d from the 1996 population range of 19532 – 48828 figure 7.3a. Donaldson (2005 p.362) argues that this increased urban population concentration is owed to the 1991 scraping of the Group Areas Act gave birth to the resurgence flock of rural to urban migration being experienced even today. In order to unravel the dynamics of these population distribution spatial transformations, the researcher employed the mathematical model 5.2 (refer to chapter 5), to generate the population count change to indicate the range of people decrease or increase in the mesozone polygons over the specified time frames. The results on population count change are presented in figure 7.3. Figure 7.3a-d shows population count spatial transformations in the City of Polokwane for the years 1996 to 2016. The empirical evidence presented in figure 7.2d, shows that majority of rural areas of the then Aganang LM on the north western area of Polokwane, experienced population count decrease between 1996 and 2016 which include Setumong, and Matlala with

a population decrease from 2499 to 500 people. This denotes that people migrated to areas with diverse and better economic opportunities leaving the rural areas with less population. It is also noticeable in figure 7.2d that other rural farm areas in the middle part of City of Polokwane towards Ga-Chuene in light green did not experience any significant population increase ranging between 1 to 500 people. Thus, rural farm areas are largely agrarian economies, that lack diversity and other economic opportunities that pulls people, which explains the reason for low population increase between 1996 and 2016.

Figure 7.3d, indicates that the settlements Seshego, Perskebult and Mankweng/ Badimong cluster, experienced population count change increase range of 12 501 to 62 500. Polokwane central experienced the highest population increase within the range of 62 501 – 76 843 people. This implies that the major nodes namely 1st order node: Polokwane, Seshego & Perskebult and the 2nd order node: Mankweng-Badimong are experiencing rapid population growth in the City of Polokwane. The 3rd order node, Sebayeng, and Mabokelele settlement had a population count change increase range of 2501 – 12500. Polokwane (2013d p.70); Polokwane (2008a p.26) echoes these findings citing that there is increased migration to the urban areas.

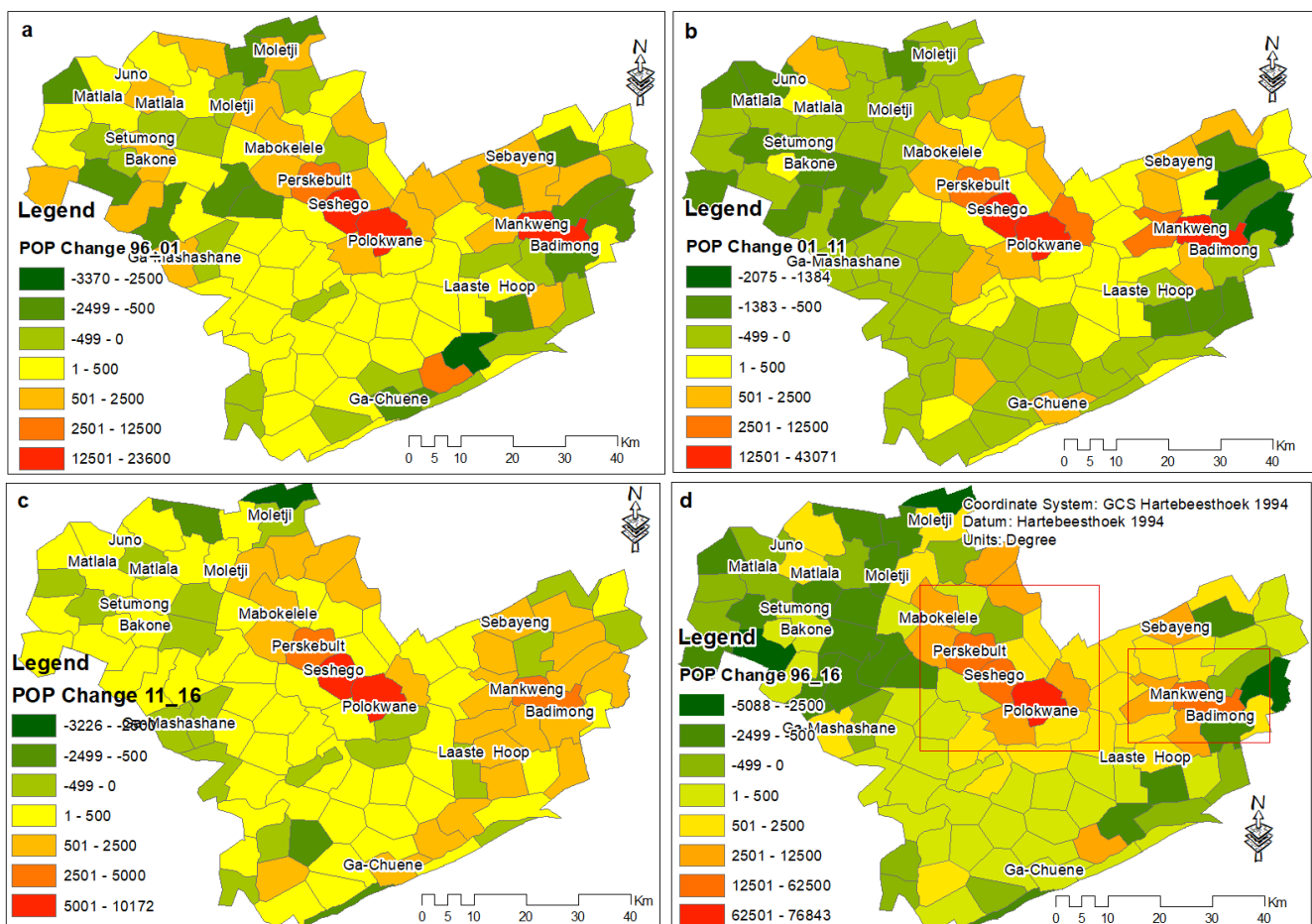


Figure.7.3: Population count change in Polokwane LM 1996_2016

Source: Author, 2020

The population distribution figure 7.2 and population count change figure 7.3 shows empirical evidence of socio-spatial spatial transformation in the City of Polokwane. However a visual comparison between 1996 and 2016 population distribution figures, shows that the following settlements are not depicting any population changes; Bakone remains in the population range of 0-500people; Matlala, and Setumong remained within the range 3126-7813 people and Ga-Mashashane, Ga-Chuene, Laste Hoop and Sebayeng remained within the range 7814 – 19 531 people. Therefore, to get a better understanding of the degree of population spatial transformation between 1996 and 2016, population changes for the individual mesozone polygons was normalized as the percentage of total population change for a given time frame. This method is significant because it unravels the degree of population changes dynamics, by showing the percent share of population change experienced in a polygon in relation to the overall population change for City of Polokwane. The mathematical model adopted to normalize the population changes is presented as equation 5.3, in chapter 5. Therefore, an example to demonstrate this normalization, the researcher employed population estimates for the selected mesozone polygon for Polokwane central (mesozone ID 2010_01375); P_{yn} = Population for year 2016, is 103 741; P_{yi} = Population for year 1996, 37 070; TP_{yn} = Total Population for Polokwane LM 2016 is 812 395; and TP_{yn} = Total Population for Polokwane LM 1996, is 572 821. The results for the normalization mathematical model are as follows;

$$\Delta\%POP\ CHANGE = \left| \frac{113\ 913 - 37\ 070}{812\ 395 - 572\ 821} \right| \cdot 100$$

$$\Delta\%POP\ CHANGE = 27,83\%$$

The results shows that the population change for Polokwane central mesozone, between 1996 and 2016 was 32.1%, which falls within the dark blue percentage increase range of 10,2 to 32,1%, as presented in figure 7.3. The socio-spatial population distribution transformation patterns emerging from figure 7.3 are that between 1996 and 2016, rural areas in the former Aganang LM around Moletji, Setumong and Bakone experienced population decrease of -0.9 to -0.1% and that south of Bakone and north of Moletji experienced population decrease within the range of -2 to -1. This population decrease is also explained by Polokwane (2013d p.67) substantiating that the 2011 census reveals that Aganang LM experienced population decrease of up to -1,2%. To add on, rural areas in the former Aganang LM have low agricultural potential (RSA DRDLR and DAFF 2015 p.3), a push factor for people to migrate to other areas with better economic opportunities. Similarly, this lack of diverse economic activities that act as pull factors to attract more people in these agrarian areas resulted in no meaningful population increase range of 0-0,8% in the following areas, Bakone, Juno, Ga-Chuene, Laaste Hoop and other farm areas as presented in figure 7.3.

In another perspective, the population differences for the years 1996 and 2001 in figure 7.4a shows that the areas that experienced significant spatial transformation in relation to

population increase between the range of 18,7 – 28,6% are Polokwane Central and Mankweng/Badimong cluster, followed by Seshego and Perskebult area within the population increase range of 4,5 – 18,6%. The population changes for the years 2001 to 2011, and 2011 to 2016 reveals that only Polokwane central, the primary activity node experienced highest population increase of 25,3 -38,9% and 14,3-22,1% respectively. This denotes that there is no doubt that Polokwane central experienced a population increase, a resurgence of urbanization in aftermath of apartheid. However, visual presentation from figure 7.4d, shows that Seshego settlement cluster experienced a high rate of population spatial transformation as it is in the same population change percent range of 10,2 -32,1%. This pattern is similar to spatial transformation experiences in the case study reviews, that spatial transformation activities are making the city centres expensive forcing the poor, to live in areas outside the urban core, reinforcing spatial injustices (Rosario 2016 p.117; Wei 2012 p.404). In another perspective, this notable population increase in the Seshego settlement cluster is also related to rental affordability, proximity to the CBD, access to transport and mainly, as a result of infill housing development such as the RDP's in this area spatially integrating these spatially segregated settlements.

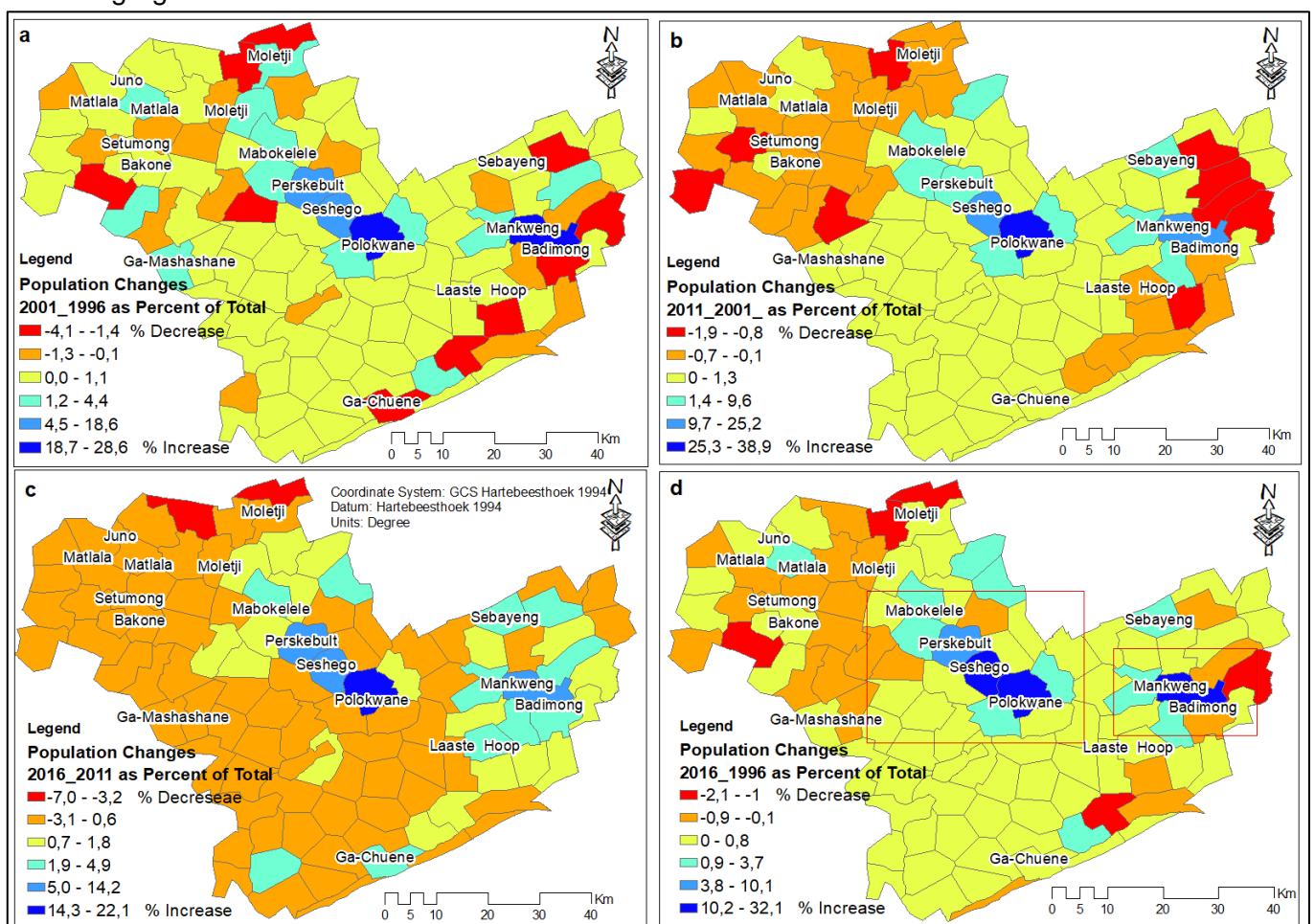


Figure 7.4: Polokwane Population Changes 1996_2016 as percentage of total

Source : Author, 2020

In general Polokwane, Seshego, Perskebult, Mabokelele, Moletji cluster; and Mankweng/Badimong cluster and adjacent areas in the direction towards Polokwane Central have been experiencing significant population increase between 1996 and 2016. Polokwane (economic growth research report 2013 p.100); Polokwane (IDP 2008 p.20) points out that Polokwane is experiencing population increase in urban areas. This substantiates that Polokwane has long been rapidly urbanizing as it is experiencing continuous population increase in the urban core. This population increase in the urban core resonates with the world trends that cities are rapidly urbanizing over the years because of rural to urban migration. The rapid population increase for Polokwane central cluster is attributed to the economic potential and opportunities associated with this settlement nodal cluster. It is classified as the 1st order settlement, a provincial growth point (PGP), the economic hub and provincial capital for Limpopo provincial government (Polokwane 2013c p.8). This population increase is also accounted for by in-migration that have happened over time in Polokwane (Abrahams 2017 p.9; Cloete and Massey 2017 p.157; Polokwane 2013d p.70; ACMS and FIC 2012 p.29). To add on, population increase in Mankweng/ Badimong settlement cluster is also attributed to services being offered in this node which include, education institutions such as the University of Limpopo which attracts people from the surrounding rural areas and beyond. The case study of Auckland New Zealand, substantiates that education institutions play a significant role in influencing population spatial transformations in their host cities (Collins 2010 p.946).

7.2.2 Changes in spatial distribution of age structure

Demographic dynamics of age distribution plays a critical role in spatial transformation of cities. It influences the decision on distribution of resources, services and infrastructure development which unlocks economic opportunities that redress the legacy of apartheid planning. Age demographic structure represents the different stages of life, which also influences the planning and management of services, infrastructure needs for the betterment life of different age groups of people (Gariazzo *et al.*, 2019; Wang and Liu 2017; Terama *et al.*, 2017; CSIR BE 2015h p.1). The mathematical model (equation 5.4) was adopted in tracking the spatial transformation of age structure in the City of Polokwane. The mesozone geospatial data interoperability permitted comparison of changes in spatial distribution of age groupings of 0 to 14years for the years 1996 and 2016 and year 2016 distribution of the old age (65 and above), as presented in figure 7.5.

The demographic distribution changes of age structure 0-14years, presented in figure 7.5a, shows that most rural areas in the north west and east of Polokwane including Ga-Chuene experienced a significant decrease range of -2580 to -1535 people. These emergent spatial transformation occurred within a period of 20years, which denotes population transition from this young age into maturity, fertility and youth age group ranging between 20 to 34years.

People have preferences of moving to places they want to live for employment or furthering education, which explains the spatial composition of uneven reproductions of ages 0-14years being reflected by these socio-spatial transformations.

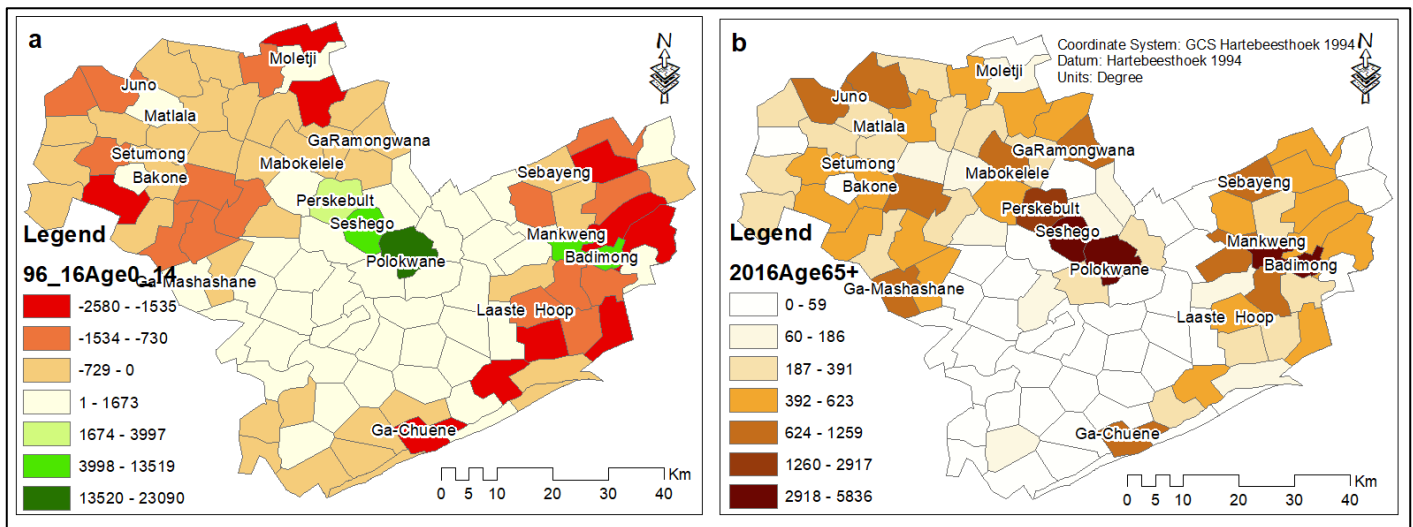
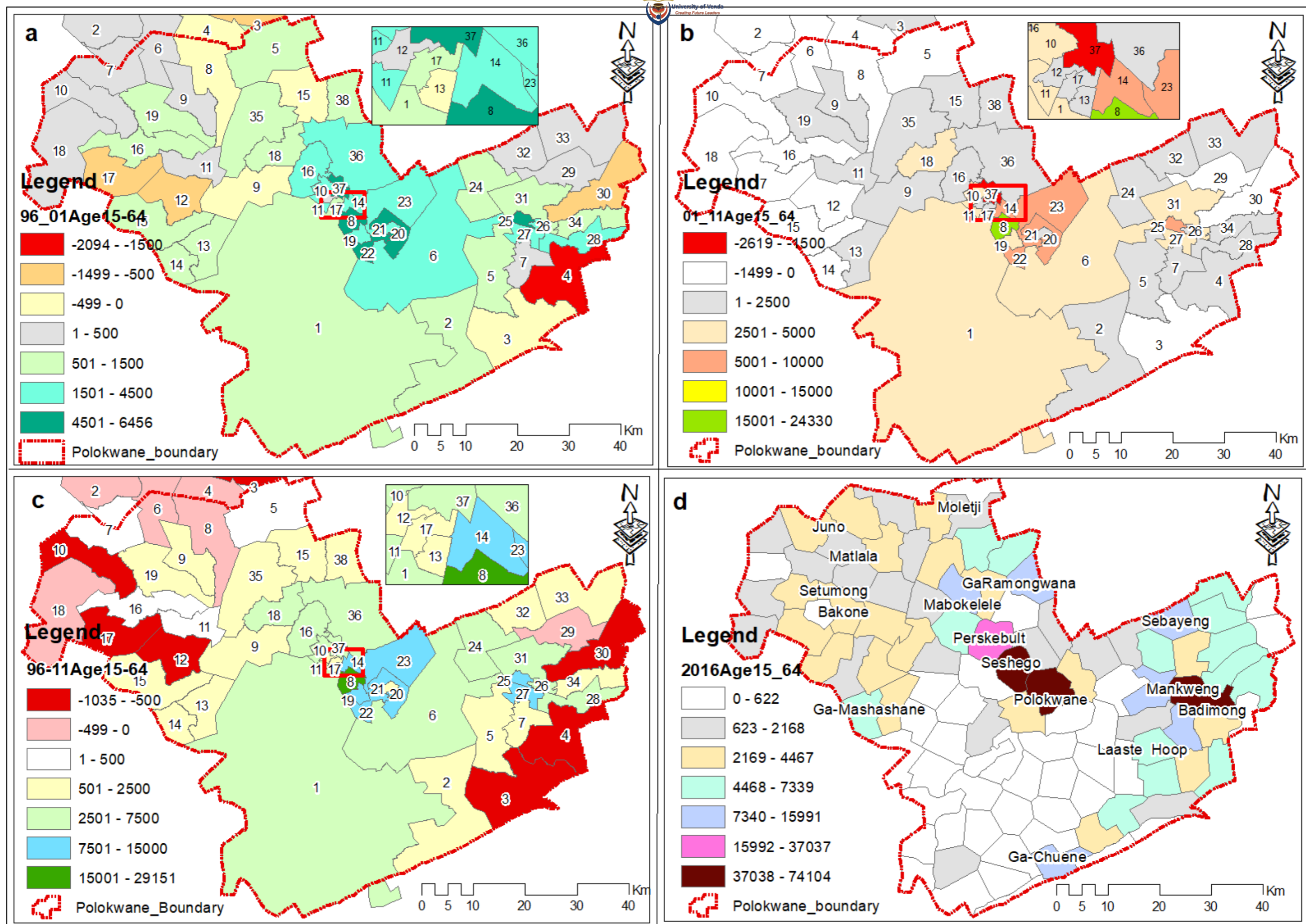


Figure 7.5: Spatial distribution changes in age groups 0_14years and 65+

Source: Author, 2020

Cloete and Massey (2017 p.157) adds that the migration of working age group leaves the elderly people which implies reduced fertility rates rural areas and explains for the reproductions in rural areas. Thus, most people in the fertility phase of the life cycle are concentrated in areas with high population of the 0-14 age group, which include Polokwane central with increase range of 13 520 to 23090 people, followed by Seshego and Mankweng/Badimong settlement cluster with an increase range of 3998 to 13519 people. Thus, the interplay of such concentrated distribution in specified areas, can also be a result of not only internal migrations within the municipality but also attributed to external migrations from other regions, provinces or international migrants.

CSIR BE (2015h), focused on mapping spatial changes on the demographic distribution of youths between 15-35years as essential to inform spatial transformation. This approach is inadequate, it excludes the middle age whose housing demands, preferences on places to live and work significantly factors spatial transformation. To address this, the study aggregated these two age groupings, the youth and middle age, alternatively giving us the economically active age group of 15-64years as presented in figure 7.6. The interoperability of StatsSA-Supercross linked to the 2011 municipal ward boundaries provided a better picture of understanding the socio-spatial transformations among this age group between the years 1996 to 2011 in the City of Polokwane. In addition, the mesozone geospatial data provided for understanding spatial distribution of the age group 15-64yrs for the year 2016.



*96_01Age15_64: Change in age structure (15_64) between 1996 and 2001

Figure 7.6: Changes in spatial distribution of age group 15 to 64 (1996-2016)

Source: Author, 2020

The emergent spatial transformations for the age group 15-64years, are presented in figure 7.6a, for the years 1996 and 2001; figure 7.6b, changes for 2001 to 2011 are shown in figure 7.6b, and that for 1996 to 2011 in figure 7.6c. Thus, figure 7.6c shows that the rural wards 3; 4; 30 in the eastern Polokwane, together with wards 10; 12; and 17 experienced a population decrease range of -1035 to -500. Donaldson (2005 p.357) argues that studies in the 1980s concurs with this exodus of the working age group from the rural homeland areas to urban areas. This pattern is not new and it will not end until such a time when there are lucrative and vibrant opportunities in traditionally rural homeland areas. The implication of this is that the economically active age groups will be always be skewed towards high concentrations in urban areas than the rural counterparts.

In this same time frame, the areas that experienced significant population increase range of 7501 to 15000 people aged 15 to 64years are wards 14; 19; 21; 22; 25 and 27. Ward 8, shows that it experienced the largest population gain in this age group with an increase range of 15001 to 29151 people as presented in figure 7.6c. Interestingly, further breakdown, shows that ward 8 (93504008) an area between Seshego and Polokwane central recorded 308 youths (14-35years) for the base year 1996, increased to 3 732 by 2001 and skyrocketed to 21 165 youths by 2011 (StatsSA Supercross 2020). This huge increase is attributed to RDP housing development by City of Polokwane in this area, which is in close proximity to employment opportunities such as the industrial areas, CBD and education institutions. Thus, it then unlocked affordable rental housing to the youth and middle age groups that migrated to this area. The case studies, also outlined that in New Zealand, preferences of the young population significantly influenced spatial transformation in Auckland (Early *et al.*, 2015 p.231). Therefore, increasing housing developments, availability of employment opportunities and education institutions has an implication on spatial distribution of the population age group 15-64 as presented in figure 7.6d. It shows that a mosaic of these areas Seshego-Polokwane cluster and Mankweng-Badimong offers specific roles, services and opportunities which factors the high population concentration of this age structure with a range of 37038 – 74 104 people. This then followed by Perskebult rural settlement cluster which is also closer to Seshego and Polokwane central with a population range of 15992 – 37037 for the age group 15-64 as presented in figure 7.6d.

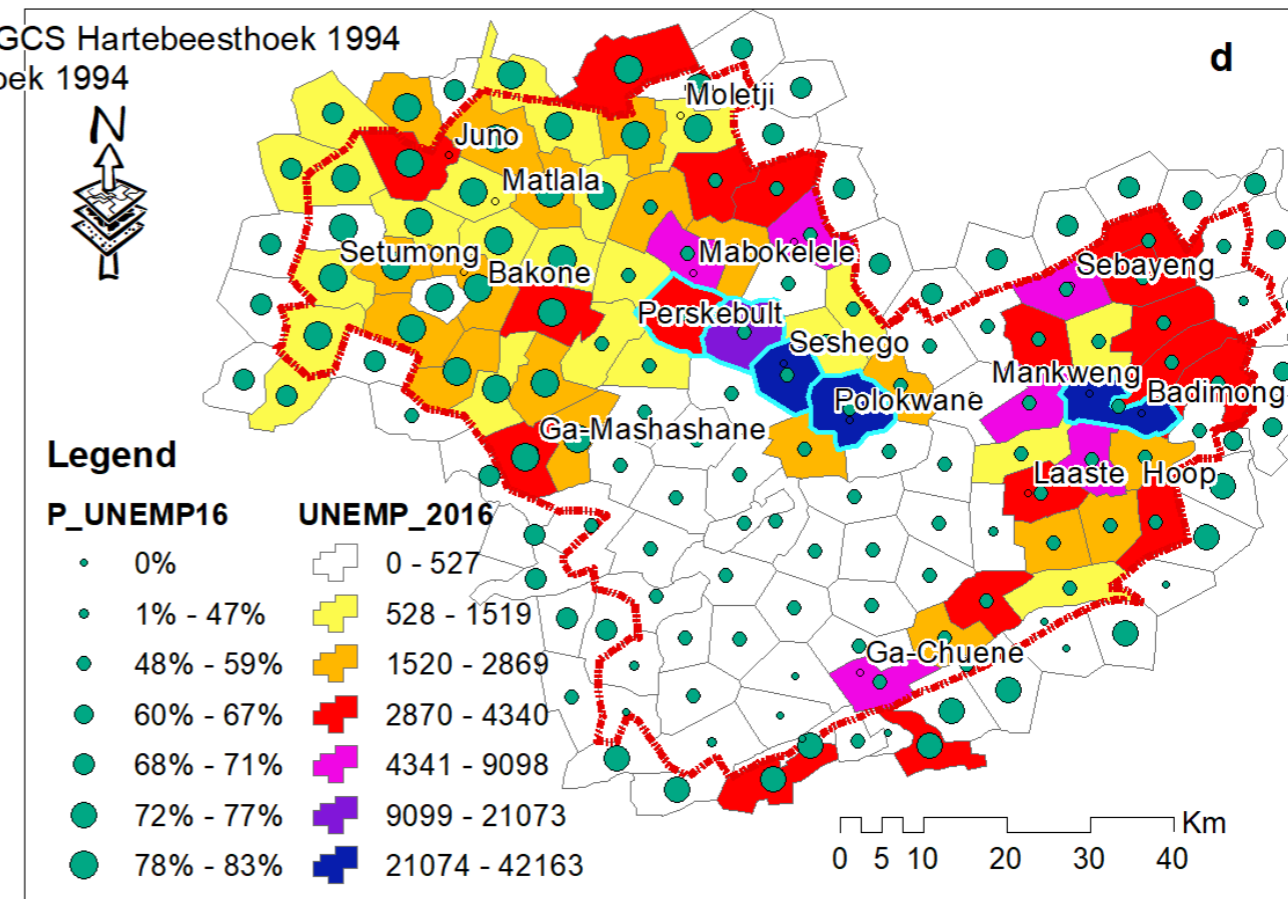
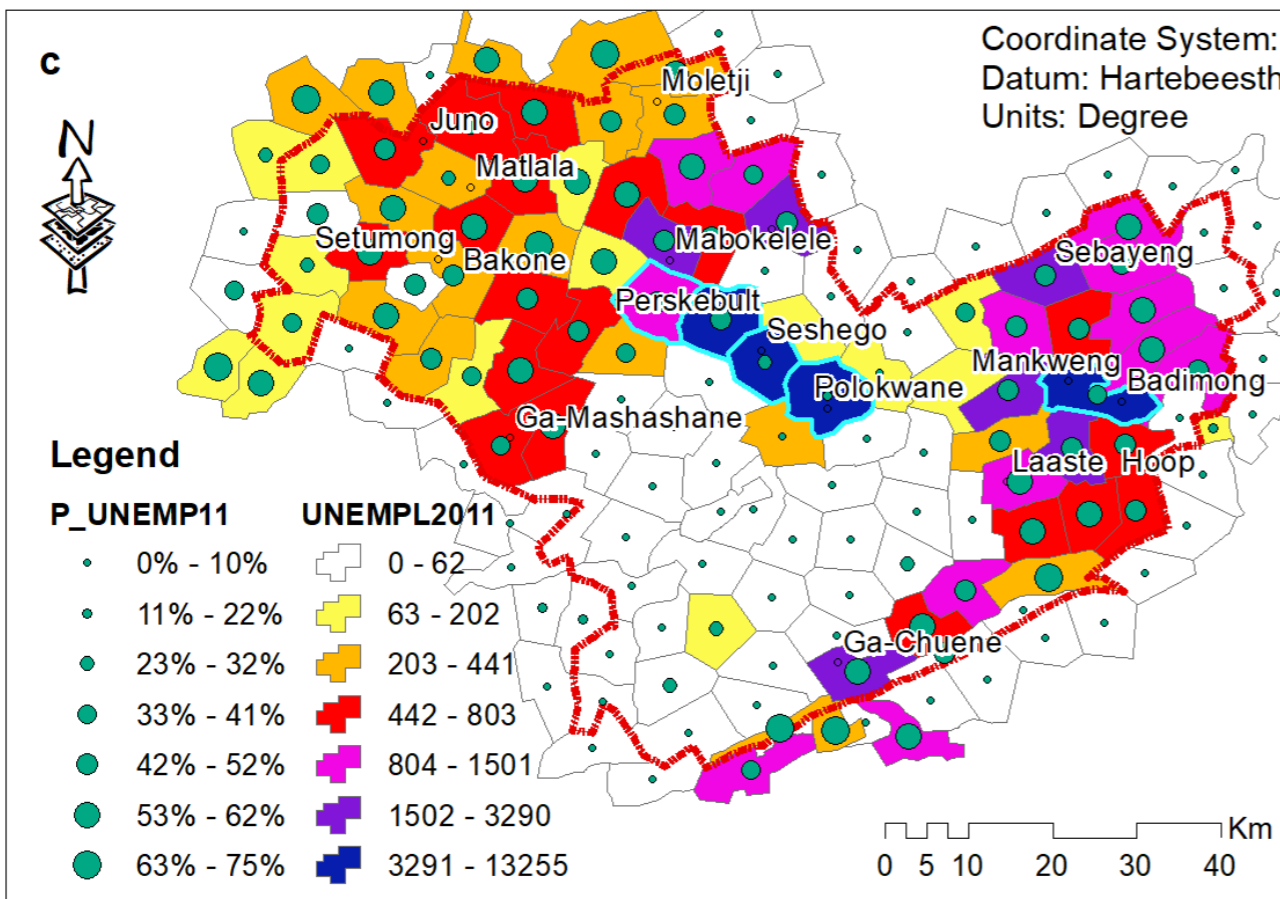
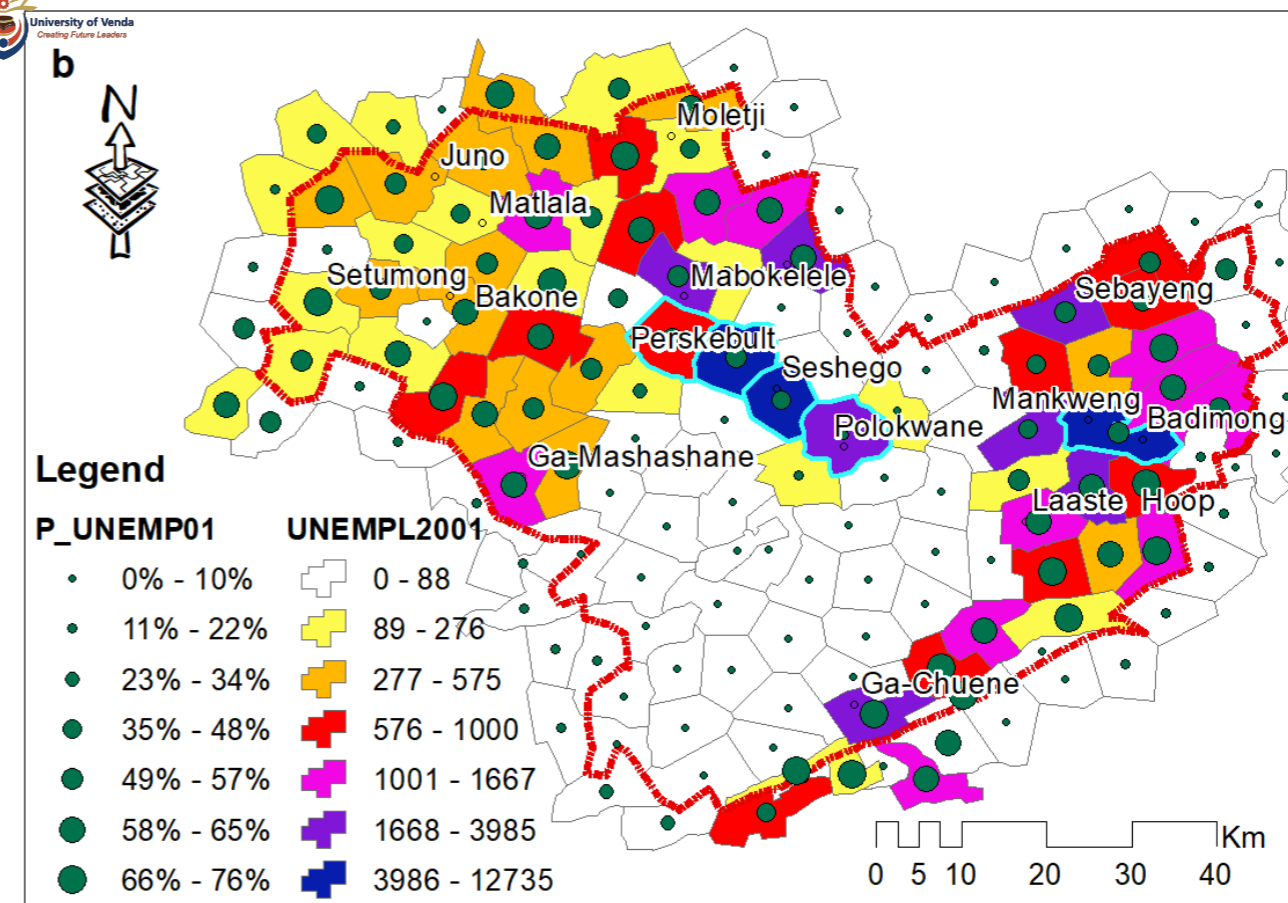
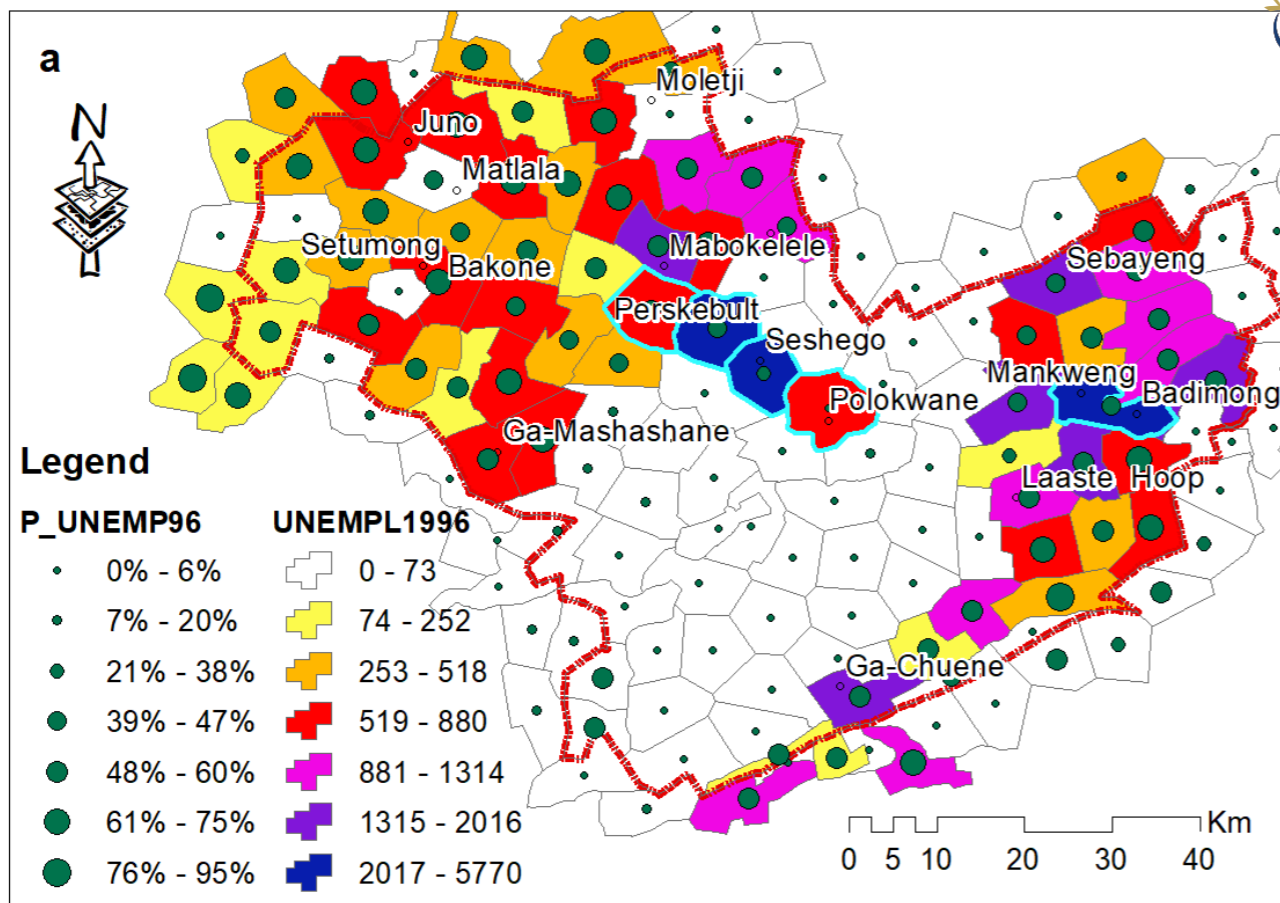
The settlement clusters Seshego, Polokwane and Mankweng/ Badimong show a significant concentration share of the elderly population (aged 65 and above) within the range 2918 to 5836 people presented in figure 7.5b. However, a comparison to the ages composition 15-64years of 37038 – 74104, as presented in figure 7.6d, it is evident that the elderly population is significantly lower in these areas. This painted picture, shows that as the population transition from the middle age group to the elderly, they migrate back to rural areas causing

population rebound in these areas. There is the exception of only a few affluent elderly people that might be owning properties who remain in these core areas to enjoy their retirement and pensions.

7.2.3 Unemployment changes

Measuring the spatial distribution of unemployment is essential in providing spatial based evidence required to make informed decisions on areas to concentrate resources for economic growth. This is an effort that is intended to assist in redressing the apartheid legacy and manifestations of its spatial injustices and social insecurities. To add on CSIR BE (2015f p.1), reiterates that one of the key yardsticks used to measure the health of an economy is unemployment/ employment. Similarly, unemployment/ employment plays a crucial role in influencing socio-spatial transformation in cities. In essence the major pull factor that influence people within the working age group to migrate to certain areas is opportunities for employment. This in turn, factors the spatial distribution of unemployment in cities over time.

To deepen the understanding on this, figure 7.7 shows the intensity and geographical distribution of unemployment in the City of Polokwane between the years 1996 to 2016. The mathematical model (equation 5.5), was employed in computing the percentage unemployment presented in figure 7.7. In another perspective, reliance on unemployment percentages alone exaggerates the social reality on the ground. In particular mesozone 2017_01717, recorded unemployment of 50% in 2016, which paints a picture that a reasonable number of people were working. However, further analysis of this mesozone reveals this exaggeration, in that the actual number of working age group recorded was 2 people, meaning 1 person is working and the other is not. Thus, in this study both the unemployment actual numbers i.e. choropleth thematic maps with an overlay of percentage unemployment for each mesozone as presented in figure 7.7 and figure 7.8.



*P_UNEMP96: Percent unemployed year 1996; UNEMP: Unemployed

Figure 7.7: Spatial distribution of unemployment 1996_2016.

Source: Author, 2020

Figure 7.7a, shows that in 1996 Polokwane central had an unemployment range of 519 to 880 people (range 0-6%). Polokwane (2007a p.38) supports this stating that Polokwane urban core trading area had low unemployment rates compared to other areas. The settlement clusters with highest concentration of unemployment within the range of 2017 - 5770 people, are Seshego (21-38%); Perskebult, and Mankweng/Badimong are within the same range of 42-52% as indicated in the details from table 7.1. These emergent differential spatial distributions of unemployment paints a picture which evidences the manifestations of apartheid legacy of spatial injustices and its manifestation of uneven distribution of employment opportunities in the City of Polokwane.

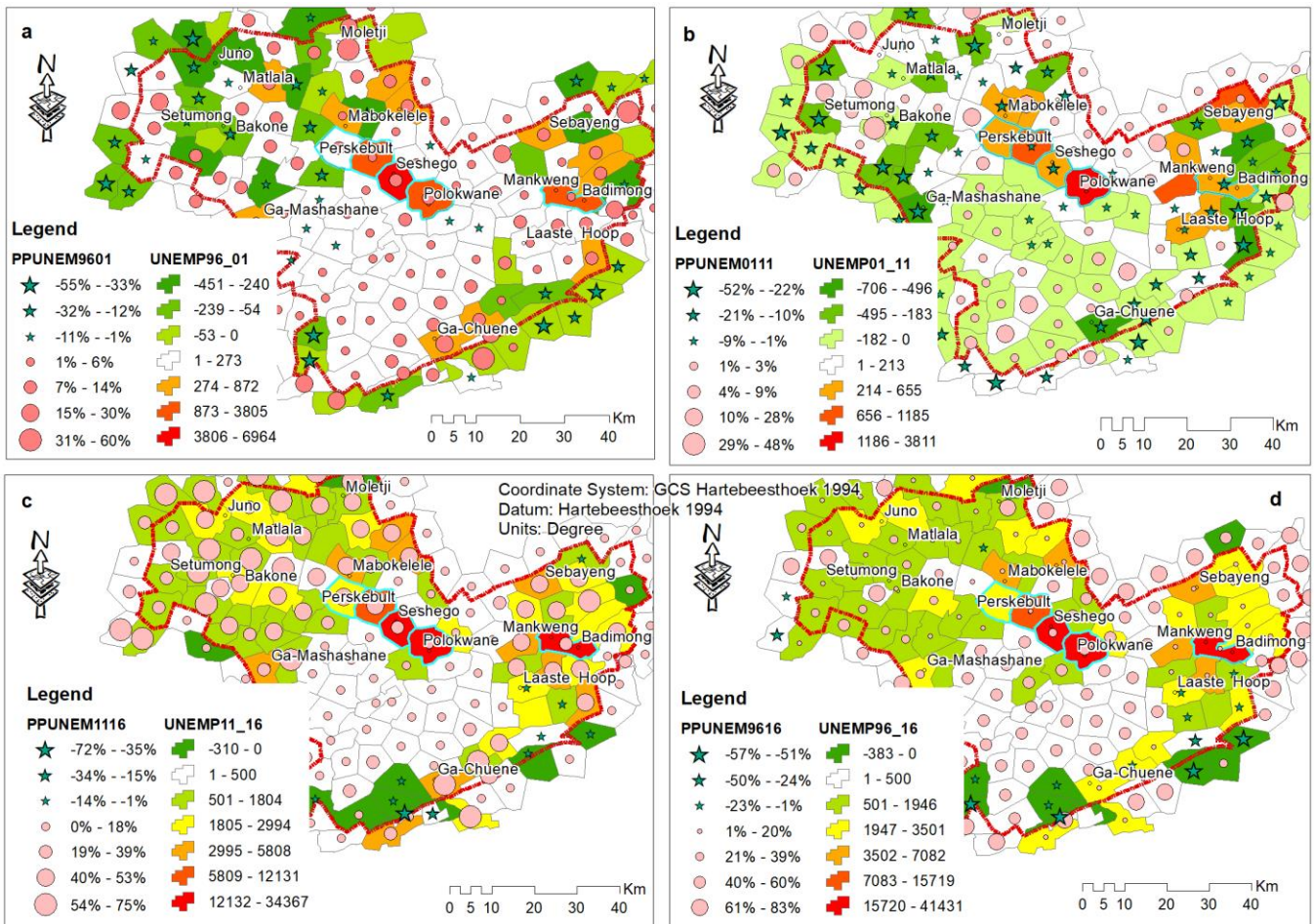
Table 7.1: Unemployment changes 1996_2016

Description	Year	Polygon mesozone ID				
		2017_01248 Mabokelele	2017_01285 Perskebult	2017_01331 Seshego	2017_01375 Polokwane central	2017_01391 Mankweng/Badimong
Labour force	1996	1308	11595	19833	15115	11506
	2001	1615	15628	30438	30111	18256
	2011	2808	21026	44778	55226	9242
	2016	6123	37037	67063	74104	60353
Unemployment	1996	591	5354	5770	732	5157
	2001	841	7918	12735	3985	8961
	2011	1242	8942	13255	47430	15713
	2016	3484	21073	38157	42163	34340
Percentage Unemployment	1996	45%	46%	29%	5%	45%
	2001	52%	51%	42%	13%	49%
	2011	44%	43%	30%	14%	37%
	2016	57%	57%	57%	57%	57%
Unemployment changes	1996- 2001	250	2564	6964	3253	3805
	2001- 2011	401	1024	520	3811	281
	2011- 2016	2242	12131	24902	34367	25098
	1996- 2016	2893	15719	32387	41431	29183
Percent Point Unemployment Changes	1996- 2001	7%	5%	13%	8%	4%
	2001- 2011	-8%	-8%	-12%	1%	-12%
	2011- 2016	13%	14%	27%	43%	20%
	1996- 2016	12%	11%	28%	52%	12%

Source: Adopted from CSIR Mesozone 2018

Polokwane central being the primary activity node and Limpopo provincial government hub, increases its opportunities for employment, a migration pull factor. This also factors the unemployment concentration of adjacent settlement clusters, as substantiated by the unemployment spatial distributions evidenced in figure 7.7d and figure 7.8d.

Mathematical models 5.6 and 5.7, were employed to compute actual numbers of unemployment changes and percent point unemployment changes as presented in figure 7.8 and table 7.1. This approach assists in deepening the understanding on spatial disparities of unemployment changes in the City of Polokwane between 1996 and 2016, compared to figure 7.7 which shows the percentage unemployment rates and actual figure for each year provided.



*PPUNEM9601: Percent Point Change Unemployment 1996 to 2001; UNEMP: Unemployment

Figure 7.8: Unemployment changes 1996_2016

Source: Author, 2020

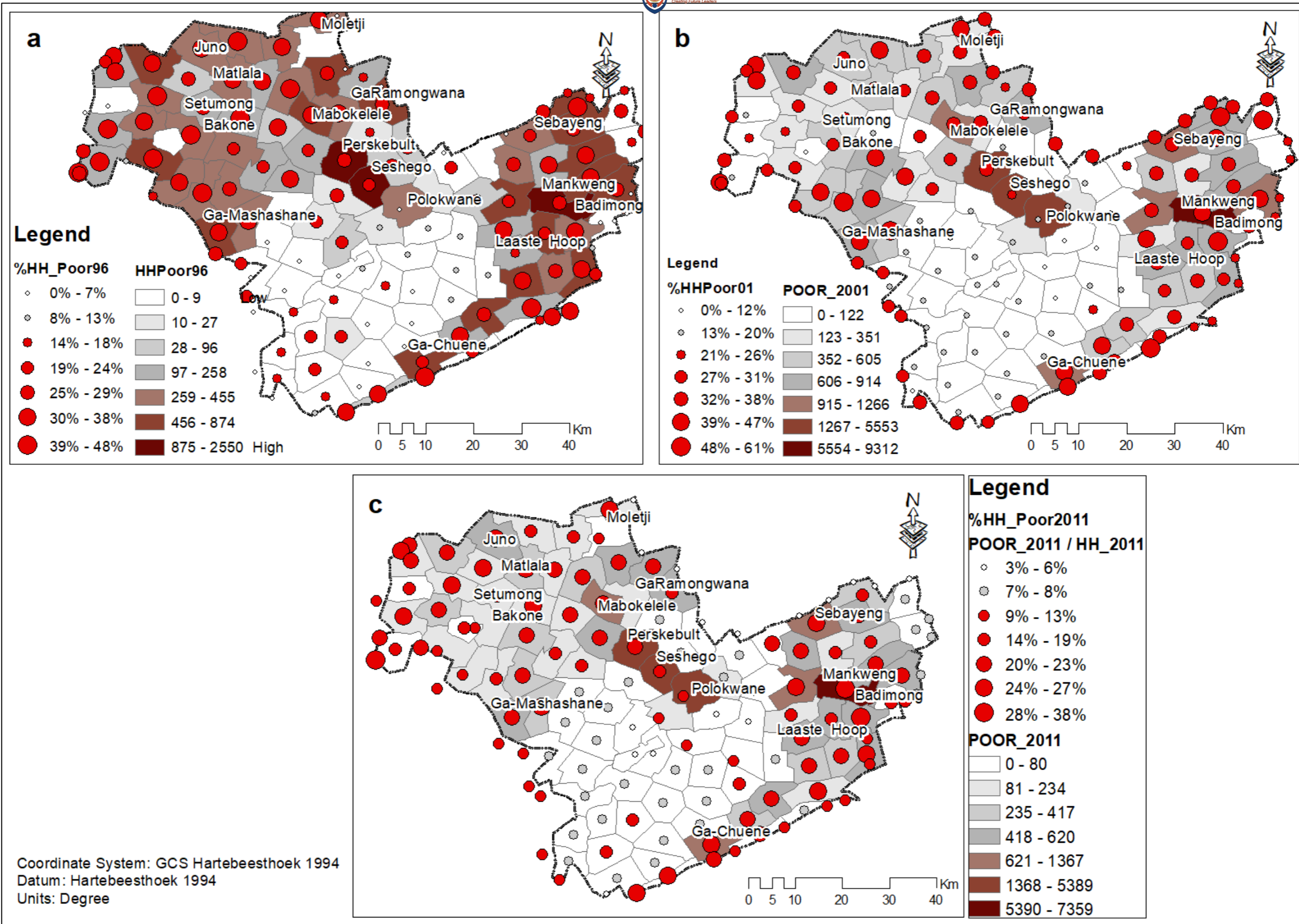
The spatial transformations between 1996 and 2016 presented in figure 7.8d, shows the unemployment changes and spatial disparities in the City of Polokwane. de Villas and Kalema (2005 p.87) echoes that there are disparities in unemployment amongst other issues in Polokwane. This denotes that unemployment spatial disparities have always been a persistent issue that the municipality is still grappling with it. The areas Seshego, Polokwane central and Mankweng Badimong experienced the highest unemployment increase range of 15720 – 41431 people in the city. Most farm areas, in the middle area of Polokwane shows unemployment increase range of 1-500 people. The other rural areas both in the north west i.e. Setumong, Bakone, Matlala, Moletji with shades of green evidences relative increase in unemployment range of 501-1946 people between 1996 and 2016. This implies that there are geographical differences in distribution of opportunities across all spatial scales. Polokwane acknowledges high unemployment rates, and is regarded as one of the local constraints affecting the economic health of the city and communities are urging the municipality to support their development projects to create employment opportunities (Polokwane IDP 2008 p. 77; p.145).

In the point view of spatial dialectics and didactics theory (Halvorsen 2019 p.448), the socio spatial transformations of unemployment between 1996 and 2016 in the City of Polokwane exposes tensions developing in the city against the backdrop of redressing apartheid legacy of uneven distribution of opportunities. In particular the post apartheid progressive policy frameworks and development plans are intended to redistribute employment opportunities. However the spatial transformation trajectories evidenced in this section shows that in 1996 unemployment was barely 5% in Polokwane central an indication that the area is highly concentrated with employment opportunities and in 2016, the unemployment for this area had increased by 52%, or 41431 people. Comparatively, the unemployment rate of this urban core is higher than that of Polokwane (2016 p.106) 32.4%, and approximately double than of the South African nation 26.5% recorded in 2016 (StatsSA, 2016).

Despite the concerted efforts by government, the social reality is that opportunities are still unevenly distributed and concentrated in Polokwane central, as such people are continuously migrating to this area hoping to find employment. Thus, Polokwane (2010a p.163), “spatial concentration model combined with a selective cluster approach” guiding spatial transformation is also aiding in this uneven distribution of opportunities given that the urban core is receiving more investments than any other areas. Ultimately, this results in high unemployment rates in Polokwane central settlement cluster and surrounding areas. In another perspective, it shows that redressing the apartheid legacy a result of approximately four decades of planning, exacerbated by rapid urbanization is a daunting challenge that requires more time.

7.2.4 Change in Poverty

Poverty is a prevalent issue in the City of Polokwane just like any other city in the world, with 40% of the population having no form of any income (Polokwane 2016 p.114). Household poverty is an essential spatial indicator with policy implications on understanding the progress of spatial transformation towards improving living standards and peoples well being. It is an annual income measure that combines all forms of income for all members of a house residing together. This spatial indicator also helps understand the spatial injustices inherent in cities manifesting in forms of income inequality, as expressed using the proxy household poverty income of R0-54344 per annum (CSIR BE (2015j p.2). The interoperability of the mesozone geospatial data permitted the computation of data to map spatial transformation in household poverty between the years 1996 to 2011 as presented in figures 7.9 and 7.10. The mathematical model 5.8 was employed to compute the percent household poverty for each mesozone polygon as presented in figure 7.9a-c.



*%HH_Poor: Percentage household poor; HHPoor: Household poor

Figure 7.9: Spatial distribution of household poverty

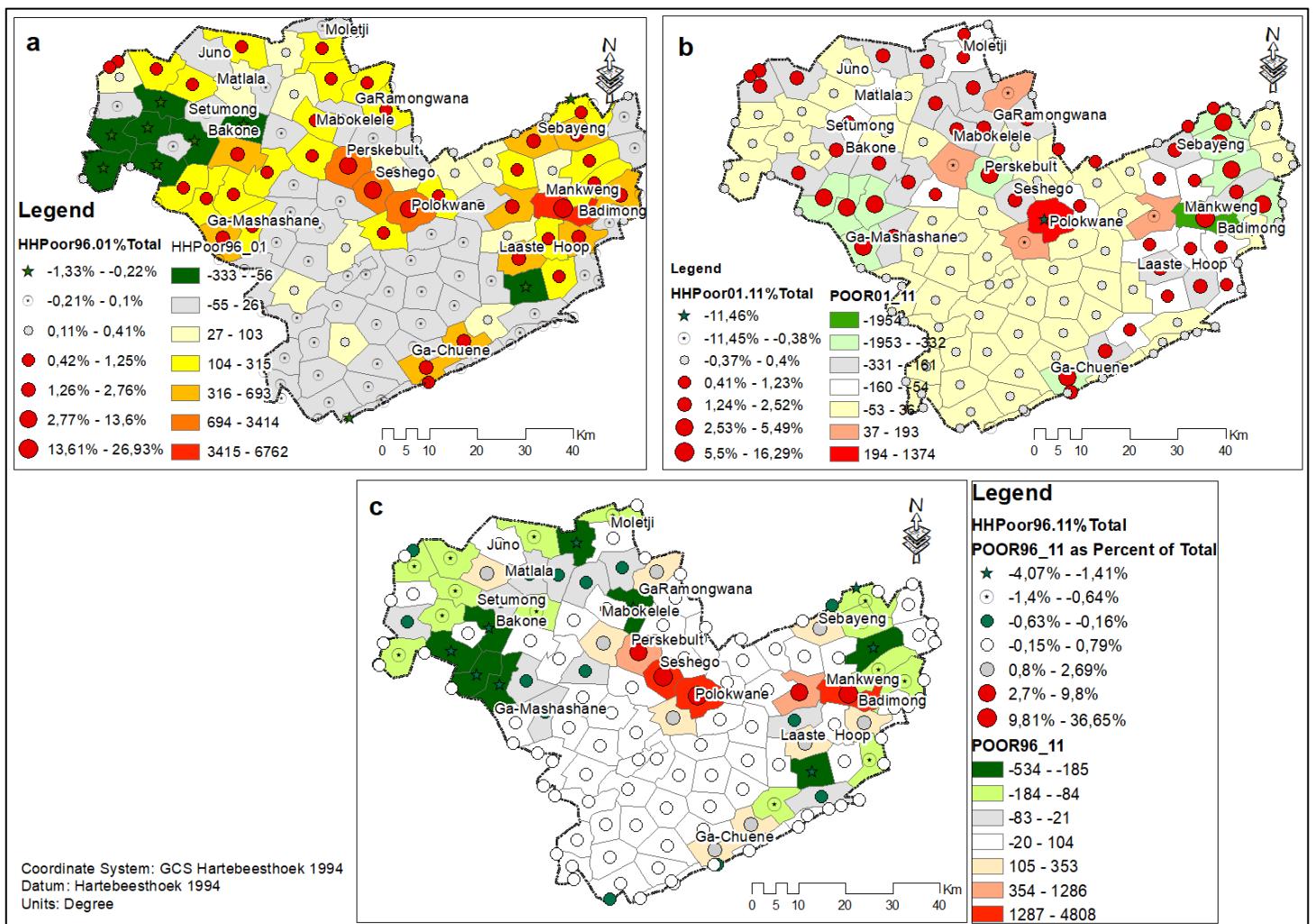
Source: Author, 2020

Spatial patterns presented in figure 7.9, shows that from 1996 to 2011 household poverty is predominantly widespread in rural areas, covering a wide geographical area in both the north west and eastern areas, which are former Lebowa homeland areas (Donaldson 2001 p.209). On the other hand, the urban core, Polokwane central had a lower proportion of 259 – 455 (0-7%) households that are poor. This evidences income inequality and disparities, in that the combined income of most people residing in rural households is below set poverty lines of R0-54344 per annum in South Africa. de Villers and Kalema (2005 p.87) concurs with this, citing that most traditional rural areas in Polokwane are depressed. This denotes that the rural agricultural lands in the homeland areas for blacks have poor conditions and are not productive for any reasonable agrarian activities leading to lower household incomes and large proportion of household poverty. Comparatively, the geographical areas occupied by the white owned farms in the middle of Polokwane shows a record of 0-9 poor households in 1996 figure 7.9a, 0-122 in 2001 and 0-80 in 2011. These low figures of poor households substantiates that, agricultural land with good soil is highly productive, which increases the income of farmers and in turn reduces household poverty. In support of this, Polokwane (2013d p.33) encourages commonage farming on its identified public land, leveraging on the potential of productive land in alleviating poverty. This demonstrates the spatial injustices of apartheid engineered planning which forcefully concentrated blacks in unproductive homeland areas entrenching the blacks in poverty.

It is apparent that, rural household poverty in previously colonized developing countries, is not entirely attributed to globalization. The sad reality is that, despite the advent of post apartheid era and its spatial transformation progressive policy frameworks, this does not change the soil conditions and agricultural productivity of the so called former homeland tribal areas. In particular, the rural areas of the disbanded Aganang LM that were incorporated forming the north west of Polokwane are classified as having low agricultural potential (RSA DRDLR and DAFF 2015 p.3). This denotes economic insecurity, as there are no meaningful agricultural activities taking place in these areas contributing to the emerging patterns on spatial distribution of household poverty. Furthermore, Donaldson (2005 p.357) argues that, risks of natural disasters such as the 1990's seven year drought, a harsh natural environment reminds the traditionally rural homeland people of being pushed off the boundaries into poverty. This denotes that in generational narration, imagination and anticipation on the repeat of these natural disasters of drought exacerbated by climate change, the poor rural household are always pushed to migrate to urban areas of Polokwane in search for better living conditions.

Figure 7.10, provides a better picture in deepening the understanding on spatial transformation of household poverty in the City of Polokwane. The mathematical models 5.9 and 5.10, were employed to measure the changes in poor household per mesozone and percentage

contribution of such to the overall household change for the specified period. The spatial transformation between 1996 and 2011 presented in figure 7.10c, shows that most rural areas experienced relative decline in household poverty as indicated in the north western and eastern sides of City of Polokwane. This relative decline does not need to be confused with improved living conditions and or better income in these areas, rather it's a sign of rural urban migration because of economic insecurity. This attest that cities are rapidly urbanizing, in these previously colonized areas spatial loosening abolished the colonial laws that restricted movement of people from homeland areas to urban areas unnecessarily. In view of the complexity theory, households as agents of change, self-organize and in turn result in the emergent landscape from spatial transformation. The implication of this is the inherent migration of people from the unproductive homeland areas with poor living conditions into urban areas that are perceived as having greater opportunities for improving the household income and well being of everyone.



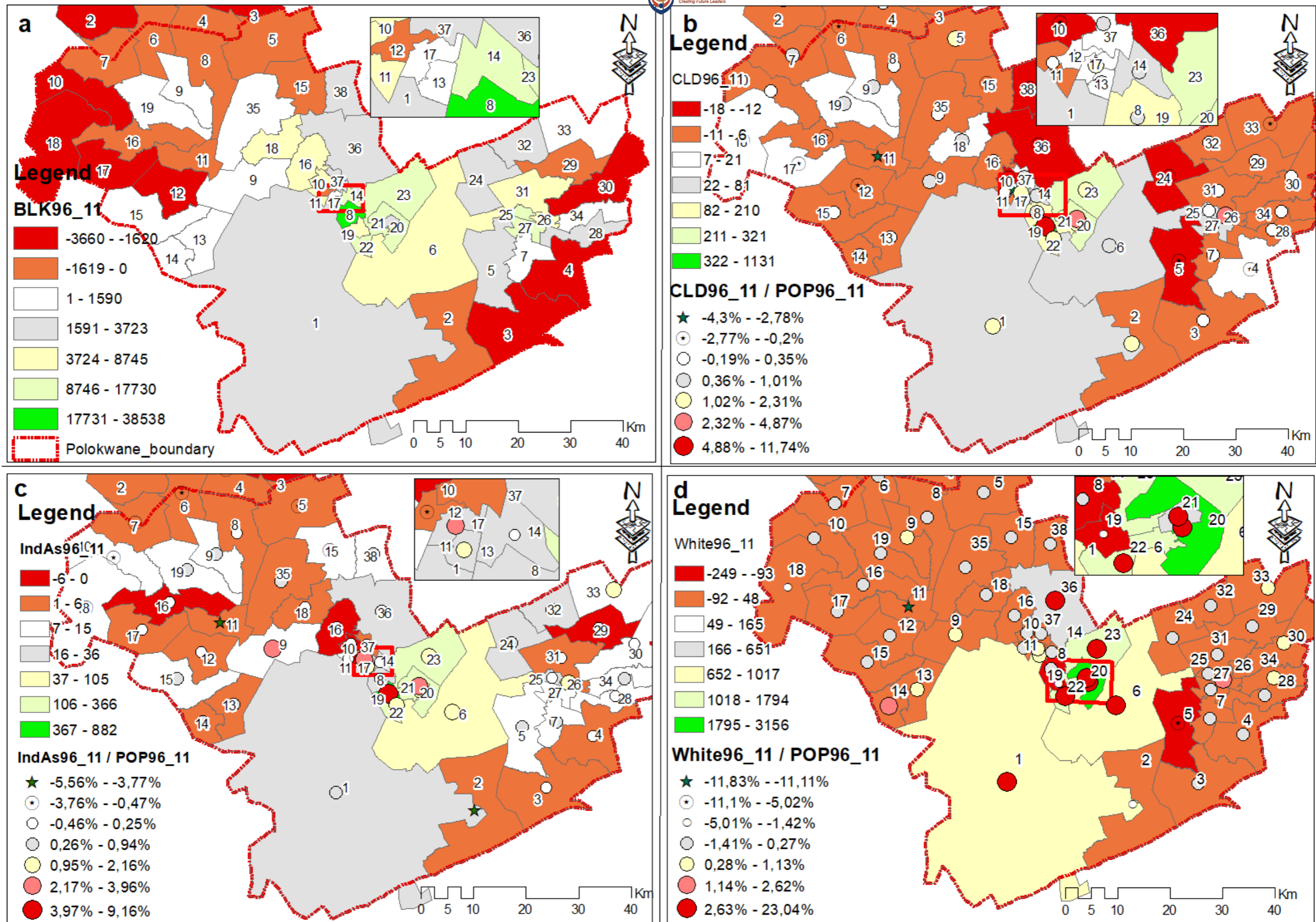
*HHPoor_%Total; Household poor as percent of total
Figure 7.10: Changes in household poverty 1996_2011

Source: Author, 2020

Comparatively, Polokwane-Seshego and Mankweng/ Badimong settlement clusters experienced significant increase of household poverty range of 1287 – 4808 as presented in figure 7.10c. Gildenhuys (2015 p.13); Polokwane (2007a p.38) supports this stating that household poverty in the urban areas is still a concern. These areas account for the largest share and concentration of poor households a percent increase range of 9.81%-36.65% in relation to the overall growth of household poverty recorded between 1996 and 2011. Interestingly, the spatial patterns emerging shows that areas adjacent to these 1st and the 2nd order nodes, have also experienced relative increase in the number of households that are poor. Thus, the face of declining poverty in rural areas is an indication of fuelled migration patterns from rural areas to the urban core. This portrays what SACN (SoCR 2016 p.74) viewed as urbanisation of poverty, considering it in the context of City of Polokwane, is a result of household poverty shifting from being primarily a rural phenomena into an urban phenomenon. The urban areas have become the hotspots for poverty as evidenced by spatial transformation patterns, showing that these areas contributed the largest increase in share of household poverty changes between 1996 and 2011. Thus, the Polokwane (IDP 2008 p.56) local economic development strategies are not yielding the expected spatial transformation outcomes that would reduce this rapid urbanization of poverty. To add on, the concentrated poverty in urban areas is also attributed to the lack of income by 40% of the population and that low income earned by majority of the unskilled migrants to the city (Polokwane IDP's 2016 p.114; Polokwane 2008a p.22).

7.2.5 Desegregation of race

The apartheid planning ideology resulted in spatial segregation of people in relation to their races. Similarly, City of Polokwane was established embedded with principles of spatial segregation along different races. Thus, it is important to also measure the racial composition changes as a spatial indicator for understanding spatial transformation in South African cities (CSIR BE 2015e p.1; Donaldson and Kotze 2006 p.567). Interoperability of available geospatial data permitted tracking of racial spatial distribution changes in the City of Polokwane using ward boundaries linked to 1996 to 2011 census data as presented in figures 7.11 and 7.12.



***BLK**: Black Africans; **CLD**: Coloureds; **IndAs**: Indians and Asians

Figure 7.11: Spatial distribution of race between 1996 and 2011

Source: Author, 2020

The spatial distribution changes in race groupings presented are; Black African (figure 7.11a), Coloured (figure 7.11b), Indian/ Asian (figure 7.11c) and Whites (figure 7.11.d). The picture painted in figure 7.11 shows that socio-spatial transformation reflected is that then native areas of Lebowa, in the north western and eastern areas of City of Polokwane experienced a decline in population of the Black African race. In particular, wards 30, 4, 3 in the eastern area and 10, 18, 17, 12 in the north western area recorded the highest decrease range of -3660 - -1620 Black Africans as presented in figure 7.11a. This portrays that the implications of racial legislations i.e. Natives Land Act; Bantu Authorities Act, resulted in forced dispossession and concentration of Black Africans in the homeland areas. In light of this, the abolishment of these restrictive measures on property ownership, residential areas which ensured race segregation, have necessitated the noted racial spatial distribution changes being experienced in the City of Polokwane. Comparatively, figure 7.11d, shows that the Whites moved from wards 8, 15, and 19 a decrease range of -249 - - 93 people, attributed to the post-apartheid initiative of land claims. In support of this, ward 15, forms part of the eastern land indicated to be part of areas under land claims (Polokwane 2016 p.86; Polokwane 2010a p.150). Similarly wards 8 and 19, which form part of then white farm areas where blacks and other races were forcefully removed from the New Pietersburg in 1966 to pave way for exclusive white occupation, have also been proclaimed. To add on, RSA DRDLR (2019), substantiates that the land claims lodged before 1998 for New Pietersburg which was bulldozed to the ground, were to receive 497 serviced stands which is restoration of urban rights, in the adjacent Polokwane Ext. 40 within ward 19.

Interestingly, spatial transformations painted in figure 7.11 shows a landscape of normalized society where the urban core of Polokwane significantly gained population of all the different races. The eradication of the race spatial divide did not occur overnight in Polokwane (Donaldson and van de Merwe 1999 p.237). Thus, these socio-spatial transformations are a symbolism of the long victory of the liberation struggle that was actively fought for in South Africa, to eradicate apartheid ideology of spatial injustices, oppression, conservatism and racial segregation that was deeply rooted in the social fabrics of the city. Thus, to understand the dynamics, nature, extent and degree on racial desegregation and diversity further analysis was done as presented in figure 7.12 and table 7.2. It is evident that in 1996 wards 8, 20, 22 and 23 were predominantly white race, 74%, 55.1%, 70.4% and 76,1% respectively. However,

spatial transformation experienced in these wards between 1996 and 2011 have resulted in the switch of the dominant race from being white to dominantly being black people.

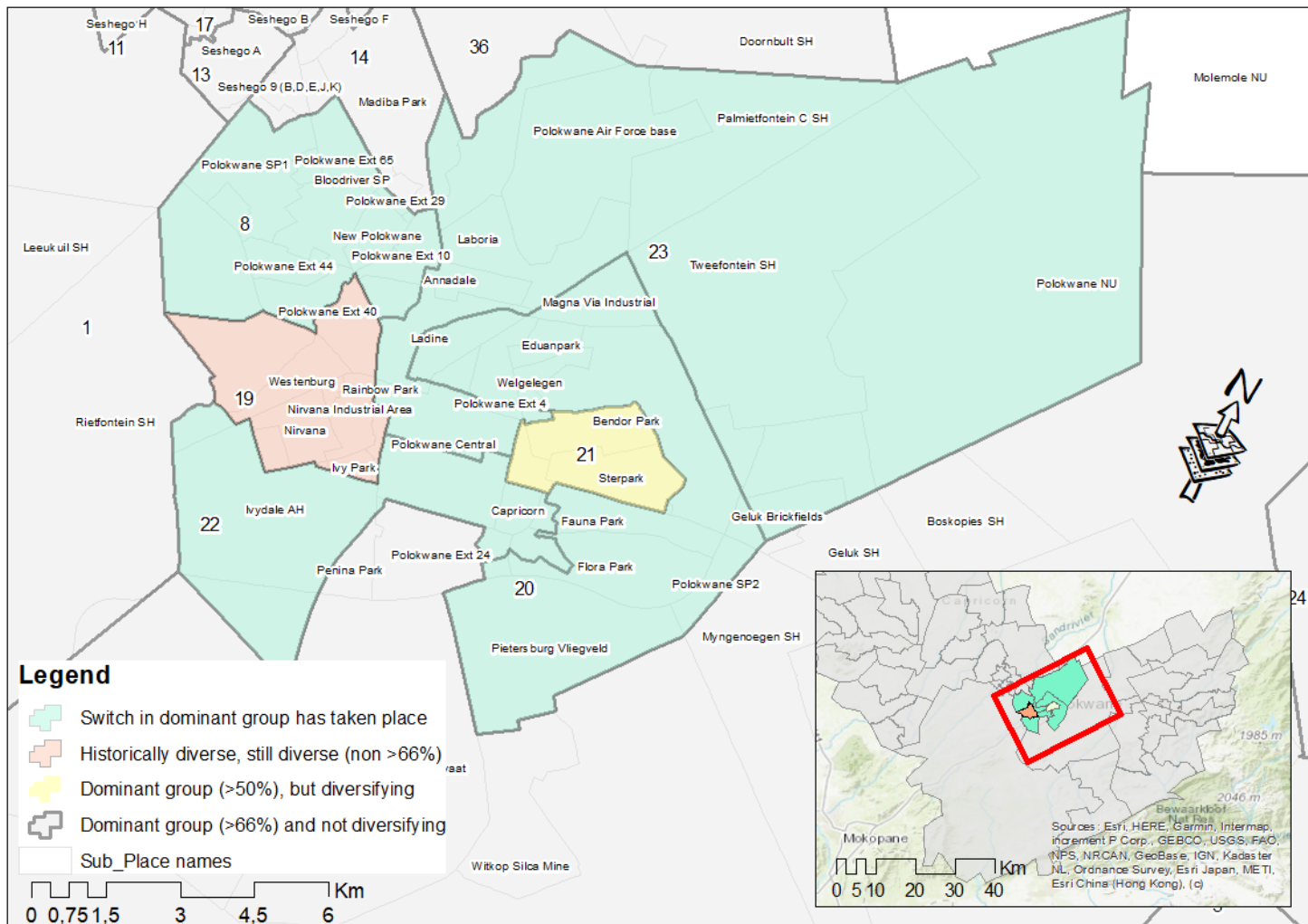


Figure 7.12: Racial diversity 1996_2011



Source: Author, 2020

Figure 7.12 shows that ward 19 is still historically diverse, there is no dominant race group with population above 66%. In essence, table 7.2 shows that this ward in 1996 population for the following race groups was; blacks 38%, coloured 28%, Indian/ Asian 25% and white 8%. The spatial transformations between 1996 and 2011 resulted in the following racial composition changes; black 60.5%, coloured 19.6%, Indian/ Asians 16.4% and white 2.3%. These findings echoes de Villiers and Kalema (2005 p.83) point of view that Polokwane portrays a non racial divided community because of racial mixing in suburbs, properties and businesses. This racial diversity in this ward as portrayed in figure 7.12 is attributed to the fact that it's composed of different former segregated racial suburbs namely Westenburg for coloured people, Nirvana for Indians, Ivy Park a former white suburb (Donaldson and Kotze 2006 p.572; de Villiers and Kalema 2005 p.82; Donaldson 2001 p.210) and Polokwane Ext 40 for blacks. The noticeable increase in black race group is also linked to spatial transformation

initiatives such as the low income social housing infill developments Cloete and Massey (2017 p.156) including the Polokwane Ext 40, 497 serviced stands as restoration of urban rights to land claimants evicted from New Pietersburg (RSA DRDLR 2019).

Socio-spatial transformations in ward 21 shows the dominant group remained the white race with 54.2% in 2011 from 80.1% in 1996. This changing landscape, evidences that the ward is racially diversifying with blacks increasing from 16.7% in 1996 to 41,2% in 2011. This increase in black race in this former white suburbs is attributed to the increasing property ownership by blacks in Bendor Park and Ster Park suburbs in this ward. In support of this, Donaldson and Kotze (2006 p.572) pointed the changes in black owned properties between 1995 and 2003; Ster Park suburb had 12.6% (32) and increased to 24% (106); the affluent suburb Bendor Park had only 9.2% (82) and increased to 27.3% (339). This emergent, and spatially transforming landscape provides a learning curve that the affluent blacks have been increasingly buying properties in these previously white dominant and restricted areas, ultimately reversing the socially engineered and entrenched inhuman spatial injustices of racial segregation.

Table 7.2: Racial desegregation

Race	Year	93504008: Ward 8	93504019: Ward 19	93504020: Ward 20	93504021: Ward 21	93504022: Ward 22	93504023: Ward 23
Total Population	1996	846	8628	11214	3912	4791	5355
	2001	6879	13413	18036	5922	11337	10308
	2011	39501	18258	28152	6561	17439	18972
Black African 	1996	111 (13%)	3300 (38%)	4815 (42,9%)	654 (16,7%)	1242 (25,9%)	1128 (21%)
	2001	5778	7299	9216	1755	5412	4464
	2011	38649(97.8%)	11052(60.5%)	17931(63,7%)	2700(41,2%)	12063(69,2%)	12384(65,3%)
Coloured	1996	-	2439 (28%)	78 (0,7%)	3 (0.08%)	30 (0,6%)	27 (0,5%)
	2001	30	3030	207	39	99	57
	2011	162 (0.4%)	3570 (19.6)	399 (1,4%)	132 (2%)	219	342 (1.8%)
Indian or Asian	1996	15 (2%)	2115 (25%)	36 (0,3%)	33 (0.8%)	48 (1%)	39 (0.7%)
	2001	24	2547	117	111	141	102
	2011	42 (0.1%)	2997 (16.4)	402 (1.4%)	138 (2.1%)	243 (1.4%)	231 (1,2%)
White 	1996	624 (74%)	666 (8%)	6186 (55,1%)	3132 (80,1%)	3372 (70,4%)	4074 (76.1%)
	2001	1047	537	8493	4017	5688	5682
	2011	531(1,3%)	417 (2,3%)	9342 (33,2%)	3555 (54,2%)	4854 (27,8%)	5868 (30,9%)
*Population race: others and unspecified are included in total population and account for the remaining percentages.							

Source: Author, 2020 (from StatsSA Supercross)

Table 7.2 shows significantly low percentages of other races. Polokwane (IDP 2016 p.107); de Villiers and Kalema (2005 p.84) concurs with these findings citing that in general Limpopo province including City of Polokwane has a low population of other racial groups such as coloureds, Indians/Asians (1% each race). That being said, spatial transformation between 1996 and 2011 depicts that most of the wards in traditional rural areas as presented in figure

7.12 remained dominated by a single group of race, the blacks. In support of this, de Villiers and Kalema (2005 p.87), also alluded that in the previous homeland areas the population remained predominantly black. This implies that despite the development of the post apartheid progressive policy frameworks, the situation has remained the same in the previous native reserve areas of Lebowa. This is attributed to the fact that the homeland areas suffer from economic insecurities, poor agricultural lands which pushes the native blacks away to other areas, certainly this won't attract any other races and in turn these areas will not diversify in the near future.

In another perspective, this high aggregate ward level representation paints a picture of post apartheid desegregation, however the reality on the ground is resurgence of neo-apartheid in the form of social class segregation. This implies that further analysis does reveal that the high income social classes are located in their own affluent suburbs segregated from the low income earners, social class giving birth to a new form of post apartheid social class segregation. Donaldson (2005 p.361) also noted similar characteristics of spatial and social exclusions based on class in Polokwane. Thus, physical segregation is still persistent manifesting in different forms regardless of several decades after attaining democracy.

7.3 City Structure

This section discusses the spatial transformations of Polokwane city structure between 1996 and 2016. The spatial indicators employed in this section are; city boundary changes, changes in built up area, changes in road transport networks and changes in industry contribution to gross value added (GVA).

7.3.1 City boundary changes

City of Polokwane, was established embedded with principles of spatial segregation along racial lines, just like any other city in South Africa. Figure 7.13, shows that Seshego township, was established segregated by a buffer of agricultural farm land where blacks and other races were forcefully removed in the 1960s-70s. This township was strategically established predominantly as a dormitory for black labourers working in Pietersburg. Despite its proximity to Pietersburg, the 1989-2010 development structure plan for the town council excluded Seshego (Donaldson 2001 p.209). This clearly demonstrates how deep rooted spatial injustices were being socially engineered, ensuring that black communities remain underdeveloped. The advent of post apartheid era, beginning with transition phase initiated the arduous journey on spatial transformation of nearly a century's (since 1886) of spatially engineered segregation in then Pietersburg local council. RSA DMB (2018 p.100); Donaldson (2001 p.211) posit that spatial transformation, or re-determination of municipal boundaries is regarded as a significant component on the process of redressing the spatial injustices echoed

in the various post apartheid progressive policy frameworks i.e. RSA RDP 1994, to NSDFP 2020.

Municipal Demarcation Board (RSA MDB 2020) classifies its municipal boundary redetermination into three broad categories namely; Type A - redeterminations which are minor and technical in nature; Type B - redeterminations that are medium scale which includes consolidations and annexations; and lastly Type C – major and large scale municipal boundary redeterminations such as amalgamation and categorisation. This denotes that all the municipal boundary redeterminations for City of Polokwane as presented in figure 7.13 fall within the category of type C.

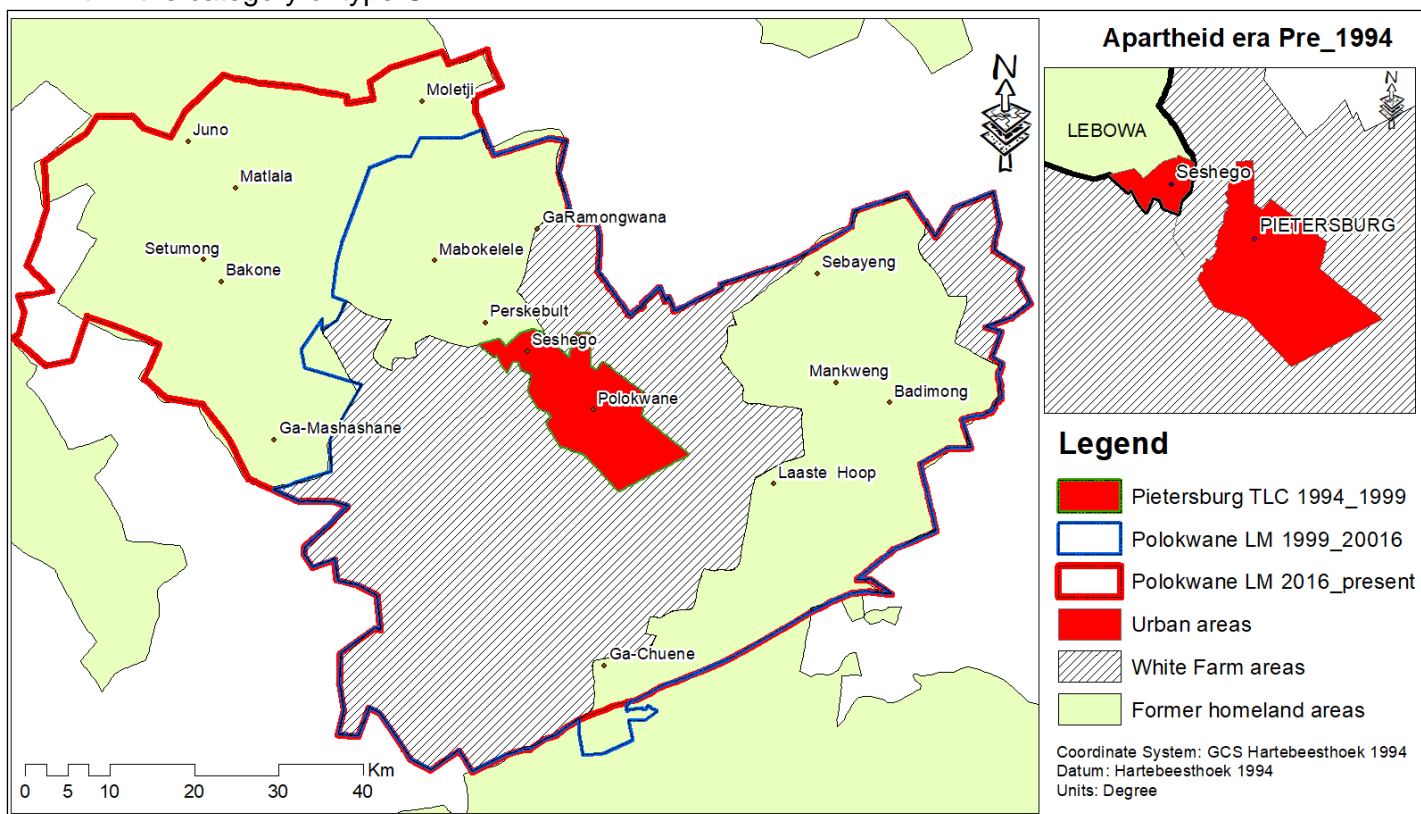


Figure 7.13: City of Polokwane boundary changes

Source: Author, 2020

Table 7.3 provides a summary on the spatial transformation of Polokwane boundary as presented in map 7.12.

Table 7.3: Spatial transformation of City of Polokwane area coverage

Time	Area: km ²	Type of boundary spatial transformation
Pietersburg TLC 1994-1999	175	Type C: Incorporation of the segregated Seshego township for establishment of Pietersburg TLC
Polokwane LIM354 1999-2016	3 775	Type C: Redetermination of Polokwane boundary to incorporated the former Lebowa homeland areas and townships i.e. Mankweng, Sebayeng
Polokwane LIM354 2016-present	5 054	Type C: Merging with part of the disestablishment Aganang LM which include Juno, Setumong, Bakone and other rural settlements

*Type C: Amalgamation and Categorisation

Source Author, 2020

The structural spatial transformation evidenced in 1994 was the establishment of the Pietersburg Transitional Local Council (TLC) boundary measuring 175km² which remained operational until 1999 (see table 7.13). This established boundary, a reorganization of then conservatives territorial space incorporated Seshego township only and excluded other homeland townships such as Mankweng. This was not achieved without resistance across the nation, it was a tension ridden process straddled with reality that other conservative parties were refusing restructuring and spatial transformation of local authorities. This merger was facilitated by the directions of the Local Government Transition Act 209 of 1993 (RSA 1993). A Government Negotiation Forum was established encompassing Pietersburg, Seshego and other areas functional to the city. Several stakeholders were invited, and reached a consensus by two-third majority after nearly 18 meetings leading to signing of the transition agreement in 1994.

Although there was a set criteria for deciding boundary demarcation for transitional local councils, the territorial mindset of the conservatives changed the basis of decision making. This led to boundary decision based on strategic exclusion of traditional areas from being incorporated into being part of the Pietersburg/Polokwane TLC in fear of black domination and citation that property values will degrade. This marked a symbolic and unimaginable historic change from predominantly white conservative council through spatial integration with Seshego township. Donaldson (2001 p.2011), adds that provincial government representatives of the forum cited that the agreement was only reached to pave way for the democratic local government elections that had to underway in 1995. The only meaningful municipal boundary re-demarcation process is said to have started in 1999, which resulted in establishment of new local authorities as they are currently known in South Africa.

The year 1999, marked a post-transitional period when the MDB guided by the RSA Municipal Demarcation Act 27 of 1998 engaged in the process of re-determining municipal boundaries. In line with sec 25 of the Act, the following factors were also considered by the MDB in this boundary rationalization process; geographical contiguity, to redress the fragmented local municipalities that hampered viable and sustainable service delivery; capacity development: some of the transitional councils were considered to be under capacitated, vulnerable and weak to drive the spatial transformation developmental mandate; resource sharing: some of the councils that existed had no fiscal capacity to carry their mandates which required combining the councils and share the available financial resources (RSA MDB 1999 p.13-14). The output of this municipal boundary rationalisation was the spatial transformation of local councils from approximately 843 into 284 municipalities across South Africa. These are further grouped into six; Category A: Metropolitan municipalities, 231 Category B: local municipalities and 47 Category C: District Municipalities (RSA MDB 1999 p.22). This process resulted in the

re-establishment of Category B Polokwane LIM354 (then NP354) boundary that was functional from 1999 to 2016 as presented in figure 7.13.

The spatial transformation of the municipal boundary in 1999 resulted in the increase of land coverage for Polokwane to 3775km², a size slightly deviating from the category B coverage size norm of 3 500km² (RSA MDB 1999 p.14). It was highlighted that deviations from the norms on coverage size and population are expected because of uneven relationships between population, size of coverage and distribution of settlement patterns. Thus, the deviation of Polokwane from the land coverage norm is attributed incorporation of spatially disjointed settlements in the former rural homeland areas of Lebowa. These settlements include Sebayeng, Mankweng, and Perskebult which were part of Traditional Rural Councils (TRC's) that were disestablished during rationalisation as alluded earlier in the discussion. Donaldson (2001 p.111) pointed out that the 1990s local authorities for Pietersburg did not want rural areas to be incorporated in the municipality citing that, it will take approximately five years to plan and develop the necessary basic infrastructure required for the fully functioning of Seshego only. This denotes an acknowledgement of spatial injustices which resulted in unequal distribution of basic infrastructure needs in the black homeland areas. They knew that incorporation of impoverished rural areas affects the local tax revenue base for the municipality and also increase the municipal burden to provide basic services in such underdeveloped rural areas. Thus, it is evident that redressing of spatial injustice is not an overnight exercise, it will take more time and requires huge investments.

Although the rationalisation of municipal boundaries in 1999, makes an impression that then established municipalities were financially viable and had the capacity to raise revenue to effect their mandates. Moffat (2014 p.75) argued that the reality on the ground is that other rural municipalities are fiscally distressed with own revenue generation of approximately 10-12%, largely relying on government bailout and other transfers for expenditures. However, The Local Government Budgets and Expenditure Review (2011 p.11) was oblivious to this fact citing that regarding certain municipalities as never being financially viable is a misrepresentation of the local economies and the careful consideration that went into rationalising municipalities in South Africa. It was high time that in 2016, the government came to the realization that de-establishment of several municipalities is required to facilitate the attainment of the post apartheid spatial transformation agenda of redressing apartheid legacy of spatial injustices.

It is apparent that the reality and grave concern on the ground is that apartheid socially engineered spatial injustices and disparities are still inherent and manifesting in negative implications on people's living conditions. Thus, to address this, the MDB embarked on

another process of redetermining municipal boundaries in 2016 which culminated in disestablishment of Aganang and part of it was merged with Polokwane LIM354 as presented in figure 7.13. The reasons that were cited for the 2016, merging across the Republic include the following poor governance, lack of economic base, low revenue tax base, poor service delivery, depopulation i.e. Aganang experienced -10,70% growth rate between 2001 and 2011 and also had 1% urbanization, sparsely populated with low densities, RSA MDB (2018 p.94-112).

This spatial transformation for Polokwane resulted in the increase of; land coverage to 5 054km²; population i.e. on bases of 2011 census the population for Polokwane increased from 628 999 to 728 468 which indicates an increase by an approximate mark of 100 000 people. To add on, Aganang had a poor economic base, low taxable income base, high unemployment, and experienced low economic growth rate. This burden negatively affected Polokwane. In addition, table 7.4 shows that part of Aganang merged with Polokwane is largely zoned as agricultural rural areas 1575.5km² (95%), this largely affects revenue generation and sustainable service delivery. RSA MDB (2018 p.103) substantiates this stating that disestablished Aganang generated revenue rates of 8 824 000 compared to Polokwane rates of 256 187 000, this clearly shows transfer of fiscal pressure to Polokwane. Furthermore, the disestablishment of Aganang resulted in transfer of 98% of its workforce to Polokwane, putting the local authority under pressure on this transitioning process to adjust its structures and accommodate the workers accordingly.

Table 7.4: Land use zoning for part of Aganang merged with Polokwane

Zoning		Polygon Count	Areakm2	Percentage
Residential	Formal	3017	2,93	0,17697394
	Rural	27556	67,36	4,06858858
Business	Formal	484	1,65	0,09966109
	Informal	249	0,84	0,05073656
Industrial		4	0,02	0,00120801
Community Services	Education	226	3,46	0,20898629
	Institution	1	0,01	0,00060401
	Place of worship	279	1,35	0,08154089
Municipal	Municipal	43	0,72	0,04348848
	Cemetery	3	0,001	0,00006040
	Open space	37	0,74	0,04469649
Government		24	0,34	0,02053622
Agricultural		516	1575,50	95,16124259
Others	Undetermined	2	0,69	0,04167646
Total		32441	1655,60	100%

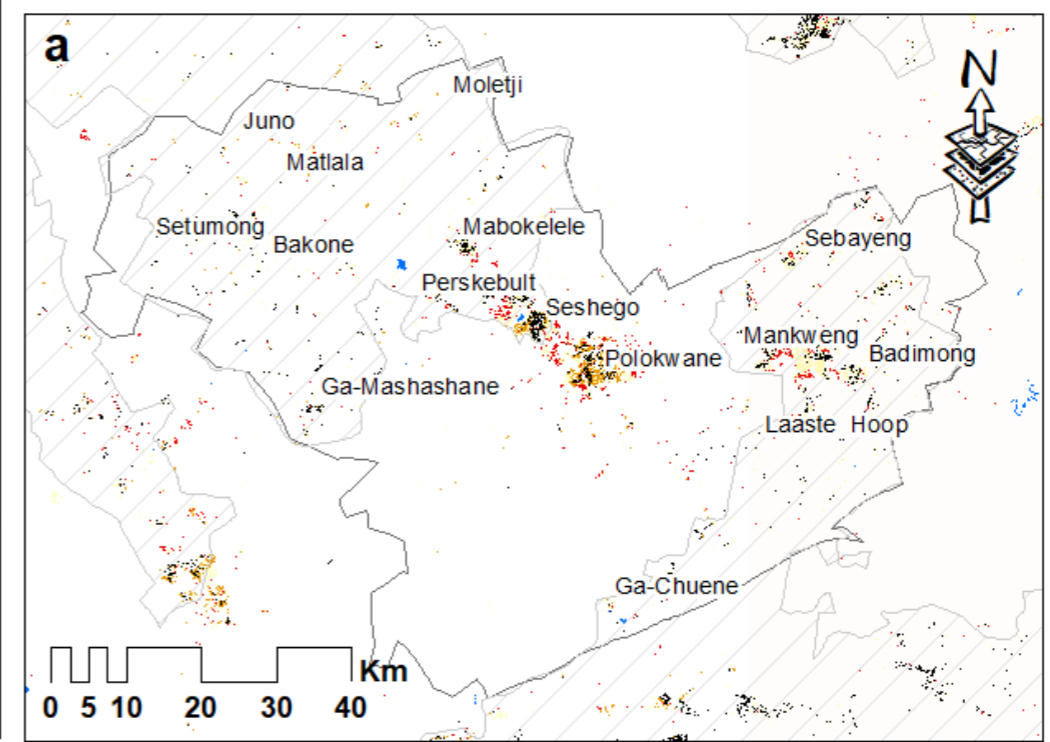
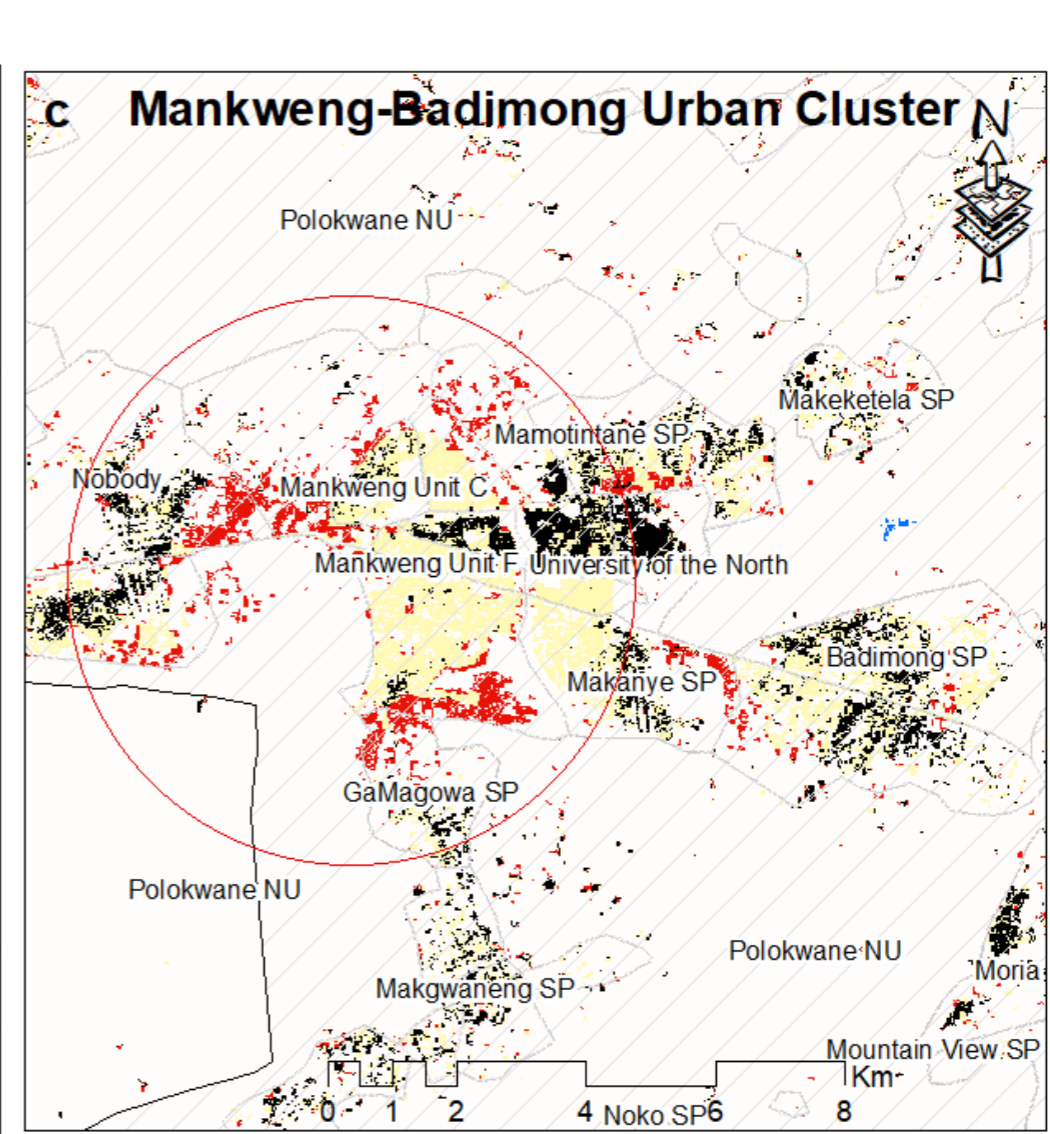
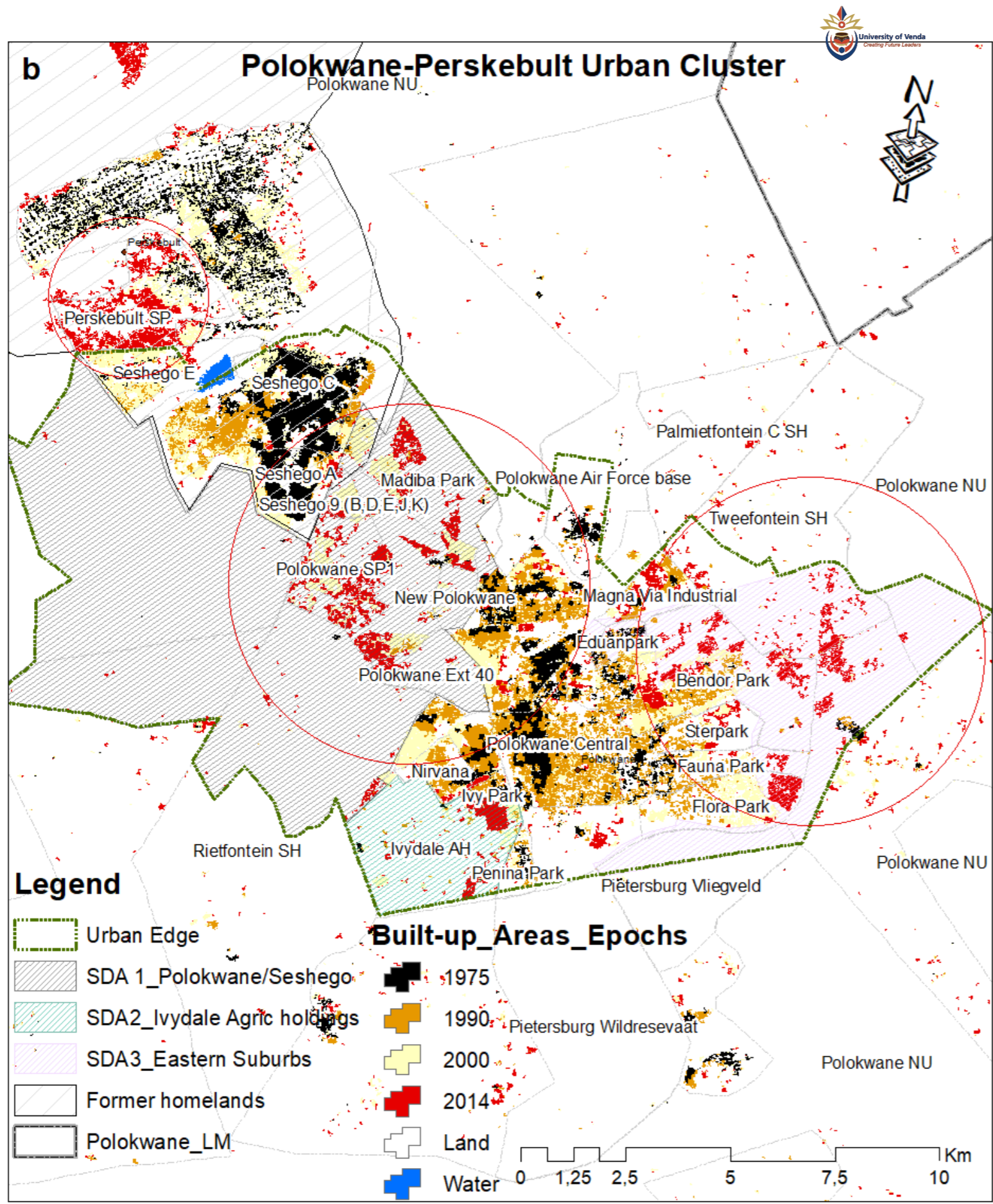
Source Author, 2020, computed from ArcMap

The spatial transformation municipal boundary is viewed as a redistribution opportunity to redress the implications of the distorted spatial patterns of apartheid (RSA MDB 2018 p.100).

These hopes pinned on and principles of municipal boundary redetermination are still the same as those that guided rationalisation of local authorities in 1999, merging the economic bases; reducing operational costs associated with having multiple management structures and municipalities are fiscally distressed. This denotes that resolving the apartheid legacy on spatial injustices, uneven distribution of opportunities requires more than redetermination of municipal boundaries as hoped to create financially viable local authorities. The reality on the ground shows otherwise, increasing coverage by merging with rural homeland areas that are unproductive and have economic insecurities does not increase the revenue base, rather it increases the indigent households which strains the municipality.

7.3.2 Changes in Built up area

The view point prevailing in the world is that spatial transformation is a constant i.e. the built up areas are increasingly growing. Illustration of this is presented in the case studies chapter, for example in 2011, Toronto's built-up areas had increased by 64% (1 189km²) compared to the pre-1971 (Stats Canada 2016 p.31). While this is true, the nature, extent and intensity on spatial transformation of the built-up areas differs between cities. Thus, to have a nuanced understanding of these, there is need to analyse the land use land cover change of the built-up areas over time. Organization for Economic Cooperation and Development (OECD) (2020); Haščič, and Mackie (2018 p.45) define built-up areas as buildings with roof structures as employed in the Global Human Settlements Layer datasets (GHSL). This definition is different from other alternative definitions of the built environment, in that it excludes other human infrastructure such as public open green spaces, industrial and commercial sites i.e. landfills, and paved surfaces: parking areas, roads. The implication of this strict and narrow definition is that the outcomes of the quantifications on built-up area land coverage derived from the dataset that uses this definition greatly differs from alternative land cover change analysis methods that incorporate the excluded urban fabric. Overall, regardless of the definition employed, there is congruence in relation to the main outcome on this spatial-temporal indicator which is the visual depiction on spatial transformation of the built environment. Thus, figure 7,14 provides land cover change of the built-up areas landscape, an outcome of the anthropogenic activities in the City of Polokwane between the epoch 1975 to 2014.



* Dataset: GHS_BUILT_LDSMT_GLOBE_R2018A_3857_30_V2_0 (Corbane et al., 2018); SDA Strategic Development Areas,

Figure 7.14: Built-up area changes

Source: Author, 2020

Figure 7.14a, provides a municipal wide area spatial transformation of the built-up areas. In broad sense, it is evident that settlements in the City of Polokwane are spatially fragmented across the former homeland areas in the western and eastern divide of the city. To add on, table 7.5 provides detailed quantifications on spatial transformation of the built-up areas derived from the computations of pixel count for City of Polokwane. It reveals that in 1975 the built-up area was only 44,2km² (0.73%), this has exceedingly changed in approximately 4 decades as more anthropogenic developments took place which increased the built-up area. In particular, 26,9km² built-up area was added as of 1990, further 67km² which is the largest extensive increase that was recorded in 2000 and by 2014 additional 33,4km² was further built resulting in the cumulative increase of built-up area to 2,83% which is higher compared to 1,29% that of South Africa. Therefore, these results depicts that the urban footprint is growing attributed to the considerable spatial transformation of the built-up areas. The pace, magnitude of changes in built-up areas is significantly different between the establishment of the City in 1886 to 1975 (0.73%), compared to that of 1975 to 2014 (2.83%). Furthermore, the rate of spatial transformation of the built environment is higher in the City of Polokwane in comparison to that for Capricorn DM, Limpopo Province and South Africa.

Table 7.5: Built-up area changes

Description	Pixel count (size 30 by 30m)	Built-up area km ²	Percentage of total land area			
			Polokwane	Capricorn DM	Limpopo Province	South Africa
1. Water bodies	2581	2,3	-	-	-	-
2. Land	6553978	5898,6	97,2%	-	-	-
3. Builtup Area 1975	49091	44,2	0,73%	-	-	-
4. Builtup Area 1990	29857	26,9	1,17%	0.81%	0,51%	0,72%
5. Builtup Area 2000	74336	67	2,28%	1.30%	0,86%	0,93%
6. Builtup Area 2014	37074	33,4	2,83%	1.71%	1.42%	1,29%

Source Author, 2020

In view of the spatial turn theory, making a retrospection on representation of spatial transformation, it is evident that the nature of changes in built-up areas differs across the city's geographical space as presented in figure 7.14. The pockets of settlement clusters that experienced extensive spatial transformation of the built-up areas are 1st order node Polokwane-Perskebult and 2nd order node Mankweng-Badimong. The detailed geography on the extent of changes in the built-up areas of these nodes is illustrated vividly in figure 7.14, b and c. The apartheid legacy of spatial segregation is clearly marked by the 1975 built-up environment landscape presented in figure 7.14. It clearly shows the prevailing view that City of Polokwane was developed embedded with principles of spatial segregation. Seshego, a dormitory township was developed for the frontier commuters working in white dominated then Pietersburg. The results of land cover changes shows that by 1990 the built environment had

spatially transformed considerably, a clear indication of urbanization but segregation still prevailed between these settlements. The growth in the built-up areas for the 2000 epoch shows infill, compact development for the 1st order node, compared to the 2nd order node which experienced extensive outward growth leading to spatial expansion of Mankweng-Badimong settlements. This extensive growth can be viewed as part of the contributory factors to the overall highest built-up area increase recorded in 2000. In line with Turok (2014 p.76) these highly concentrated built-up areas clearly provide insights on the city's structure in relation to sites experiencing intensive housing development.

In addition the epoch 2014, reveals further expansion of the built-up areas across all settlement clusters. To add on, spatial extent of the built-up areas in 2014, reinforces Abrahams (2017 p.19) view that traditional areas in close proximity to the urban nodes are spatially transforming i.e. Pietersburg and Mankweng-Badimong settlement clusters. Interestingly, infill developments on previously farm areas indicates a remarkable success pattern of spatial integration between the formerly segregated Seshego township and then Pietersburg (Polokwane) centre. Therefore, the results suggest that, the nature of spatial transformation of the built-up areas within the urban edge is both compact, integrated infill development and outward expansion. Chapter 6, provides an overview on the policy directions that account for part of this nature on spatial transformation of the built-up areas in the SDA's 1, 2 and 3. Interesting to note is that even in the traditional areas that have been previously excluded in the planning policy frameworks such as the Town Planning Scheme the expansion of the built-up areas does not resemble the discouraged spontaneous and spatial splintering of settlements. In particular, Perskebult settlement shows the intensity of development integrating Seshego, similarly Mankweng shows integration with Nobody on the west, GaMagowa on the south side and Badimong settlement.

7.3.3 Changes in road transport networks

RSA Department of Transport (DoT) (2020) vision entails that transport is South Africa's heartbeat for social development and economic growth. Its proper functioning relies on transport networks as essential veins that defines the structure and linkages between human settlements. Chakwizira and Mashiri (2009 p.2) reinforces this citing that the prevailing view point is that transport, economic growth, better income are inextricably linked. Bearing this in its social engineering, apartheid government made excessive infrastructure investments in white communities ensuring spatial injustice and imbalances in infrastructure development (RSA The Presidency 2014 p.104). This led to the inheritance by post-apartheid government a spatial structure, which deprived the homeland areas of meaningful forms of social and economic development opportunities. Along similar lines, figure 7.15 clearly demonstrates spatial evidence that in 2000 then Pietersburg previously white privileged city, was

concentrated with road networks, resulting in the marginalization of settlements in the homeland areas. Furthermore, there are road networks weaving through the farm areas linked to the city as the central market area, compared to rural homeland areas with poor accessibility index and excluded from economic advancement opportunities.

Dismantling the harm-strung of apartheid legacy does not happen overnight, but tracking the spatial transformation of the spatial structure of cities provides empirical evidence, that paints a better picture on the stride of progress made in post-apartheid era. The results from the preceding section points the growth of built-up areas, which excluded road transport networks in its operational definition. Consequently, this section is essential as it unravels the dynamics on structural transformation of the road networks in the rapidly growing built-up areas in the City of Polokwane.

The overview of policy directions for spatial transformation in the City of Polokwane, discussed in chapter 6, shows the city's acknowledgement that road networks are of cardinal importance, in unlocking the development potential of an area. In line with this view, figure 7.15 provides an understanding of the structural spatial transformation of transport road networks in City of Polokwane.

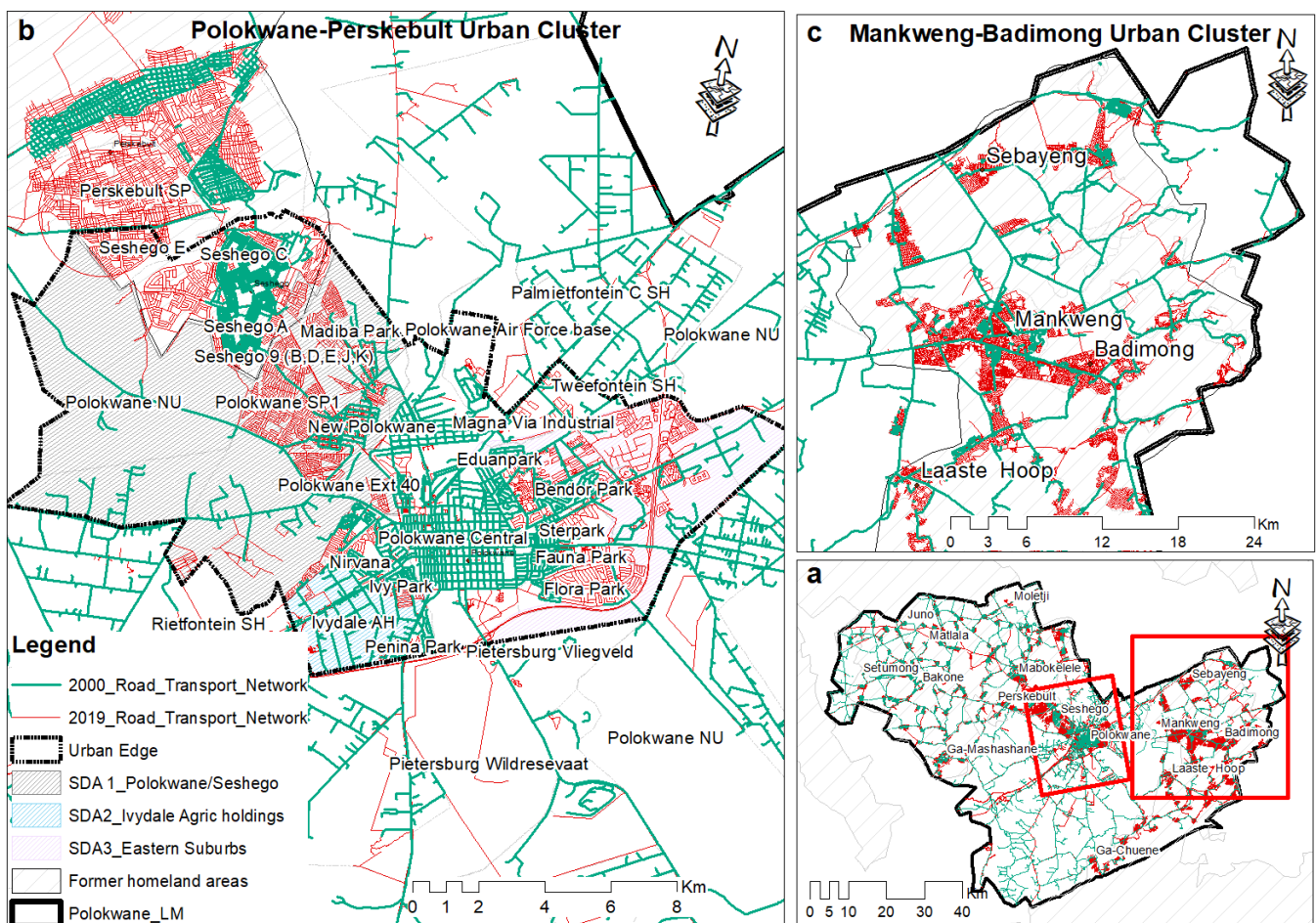


Figure 7.15: Spatial transformation of road transport networks

Source: Author, 2020

The picture painted in figure 7.15a, shows the broader structural spatial transformation of road transport networks in the City of Polokwane between 2000 and 2019. This evidence concurs with results presented in relation to built-up area changes, an indication of considerable spatial transformation across the city. The computed results presented in figure 7.16, support this pointing out that in the year 2000 the city had road network length of 4 794km, and it increased to 9 216km as of 2019. These results reveal that the pace at which the road network has increased is greater than that at which the city was established until 2000. Although the conventional wisdom is that spatial data is not readily available, inadequate, and accuracy issues are raised, the available data provides a model representation of reality on the ground. Polokwane (2016 p.173) reiterates that its recent inventory pointed an increase in road network length attributed to new developments such as township establishments. Although there are concerns about degrading road conditions in rural area, the empirical evidence presented suggests a positive contribution towards the redress of apartheid spatial injustices and imbalances by improving the rural accessibility index (RAI).

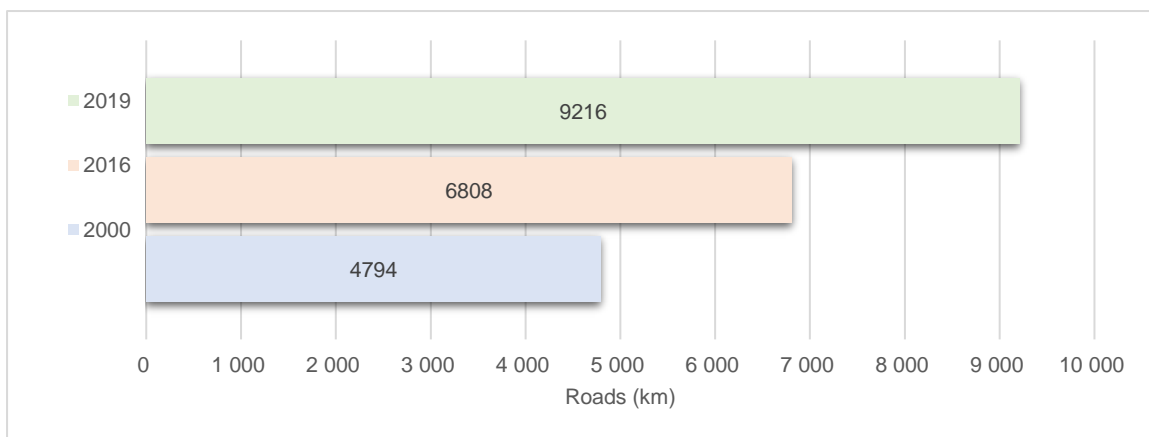


Figure 7.16: Spatial transformation of road transport network

Source: Author, 2020

The results presented, shows that the central 1st order Polokwane-Perskebult cluster and the eastern parts of the city, which include 2nd order Mankweng-Badimong cluster, Sebayeng-Dikgale cluster, Laaste Hoop experienced huge transformation of the road transport networks. With regards to Polokwane-Perskebult cluster, figure 7.15b, reveals that the spatial transformation of road networks is contained in the demarcated urban edge. In this urban edge, the SDA1 an area between Seshego and Polokwane central, and SDA3 in the eastern areas, evidences integration and concentrated structural spatial transformation of the road transport networks. Not only the urban edge is witnessing spatial transformation but, Pietersburg a rural settlement outside the urban edge is also showing spatial transformation integrating with Seshego. These results suggest that this Perskebult-Seshego cluster

experienced residential developments leading to this emerging spatial landscape patterns of road networks.

The eastern areas of Polokwane evidences that post apartheid era ushered an opportunity that triggered massive developments since 2000, leading the witnessed patterns of road networks. In support of this, Polokwane (2016 p.174) adds that each year there is an increasing backlog of paved roads attributed to developments taking place in rural areas. Thus, the spatial transformation of the road transport networks signify improved rural-urban mobility patterns and increased access to areas of opportunities in the City of Polokwane. The trickle down effect of this is not only increased income and development in the urban core, but also the evidenced spatial transformation in then homeland areas. Polokwane CITP (Transport plan 2013 p.38), substantiates that the noticeable improved access in Mankweng, Badimong, Sebayeng settlement clusters ensures improved economic transactions, transfer of resources and movement of people.

In support of empirical evidence discussed in this section on structural spatial transformation of road networks in Polokwane, other major transport infrastructure developments important to note as intended from representations in figures 6.13 and 6.14 (see chapter 6) are the BRT network along Nelson Mandela Drive and the N1 eastern ring road or by-pass respectively. These key infrastructural spatial transformations are presented in plates 7.1 and 7.2.



Plate 7.1: Polokwane N1 Eastern by-pass road structural spatial transformation

Source: RSA DoT 2020b (<https://twitter.com/Dotransport/status/1334419110902554626/photo/3>)



Plate 7.2: Nelson Mandela Drive spatial transformation to Leeto la Polokwane BRT system

Source: City of Polokwane 2018 (<https://twitter.com/LeetolaPLK/status/1008644280494313473/photo/3>)

7.3.4 Changes in industry contribution to Gross Value Added (GVA)

Wang and Liu (2017 p.5); Harrison *et al.*, (2014 p.118); Turok (2014 p.76), highlights that the geography of economic development sites and diversity of industries is crucial in unravelling spatial transformation dynamics of an area. This is based on the premise that such a spatial indicator helps in reflecting the socio-spatial changes at different developmental phases of any city over time. In line with this view, the interoperability of available data permitted the use of gross value added (GVA) as a proxy measure for spatial transformation at mesozone level. The assumption is that GVA contribution of any given area is accounted for by diverse economic activities grouped using the Standard Industrial Classification (SIC), which in turn correlates to the number of people employed in such economic activities. In simple terms, a higher GVA contributed by different sectors, entails that there is diversity of economic activities, occupations and opportunities, as well more people are also employed in such sectors that are contributing to the total GVA. Thus, any changes or deviation in GVA contribution reflects changes in industry diversity and people employed in such. In another perspective, the notion of spatial transformation as discussed in chapter 2, entails redressing apartheid injustices and imbalances through creation of economic opportunities. Therefore, analysing changes in GVA contribution for each area helps to understand if any progress has been made in facilitating equitable redistribution of economic opportunities to the previously marginalized in post apartheid era.

CSIR (2018) employed Quantec GVA data, to compute GVA values for the mesozone polygons. In assessing suitability of the Quantec estimate values, StatsSA (2012 p.29) employed a t-test to check for similarity in the GVA estimates in comparison to StatsSA values and that of South African Reserve Bank (SARB). StatsSA (2018 p.29) concluded that Quantec, StatsSA and SARB, estimate values are statistically the same, citing that t-test value 0.004145 and probability value of 0.9967 which implies that there is no statically significant difference for the different GVA estimates. These results suggest that the GVA estimate values can be used with confidence, as a proxy measure on understanding not only economic activities contribution, but also their spatial distribution linked to the mesozone polygons and changes over time. In line with this perspective, figure 7.17 presents the changes in GVA in the City of Polokwane between 1996 and 2013.

The Standard Industrial Classification (SIC) for the dataset is as follows **S1**: Agriculture, forestry and fishing; **S2**: Mining and quarrying; **S3**: Manufacturing; **S4**: Electricity, gas and water; **S6**: Wholesale and retail trade, catering and accommodation; **S7**: Transport, storage and communication; **S8**: Finance, insurance, real estate and business services; **S9**: General government [QSIC 91] + Community, social and personal services [QSIC 92-96, 99]. To add on **S5**: Construction is excluded from the mesozone dataset.

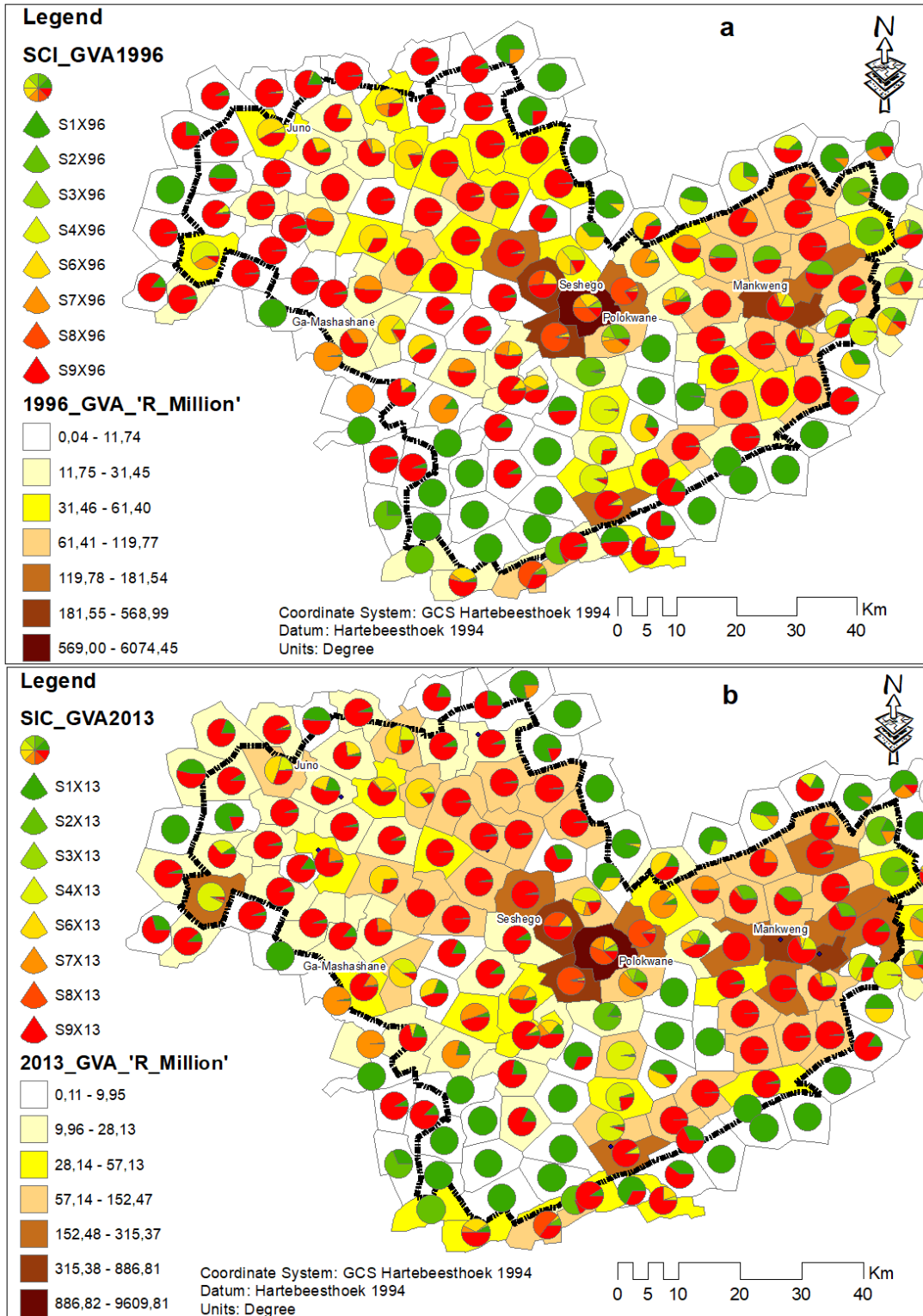


Figure 7.17: Changes in GVA contribution

Source: Author, 2020

Figure 7.17 shows pie-charts representing the socio-spatial changes in GVA contribution of different industries per mesozone, with an overlay of total GVA for each mesozone in 'million' Rand. The pattern in this figure shows that in both 1996 and 2013, the dominant economic

sector across most mesozones is the category S9, which in this case is composed of general government, community, social and personal services. Despite being dominant, the low employment figures and low incomes in these economic sectors accounts for lower overall mesozone GVA estimates evidenced in figure 7.17. In addition to this, the large share of the pie-chart represented by a single sector also suggests lack of socio-spatial diversity in economic activities between 1996 and 2013. Overall, the pattern of spatial transformation in figure 7.17 a, and b, shows that there is evidence of socio-spatial transformation in relation to redistribution of economic sectors. Only a few selected settlement clusters have remained significantly concentrated with diverse economic sectors which include, Polokwane central, Seshego, Perskebult, Ivydale farm holdings, Eastern Suburbs, Mankweng-Badimong as detailed in figure 7.18.

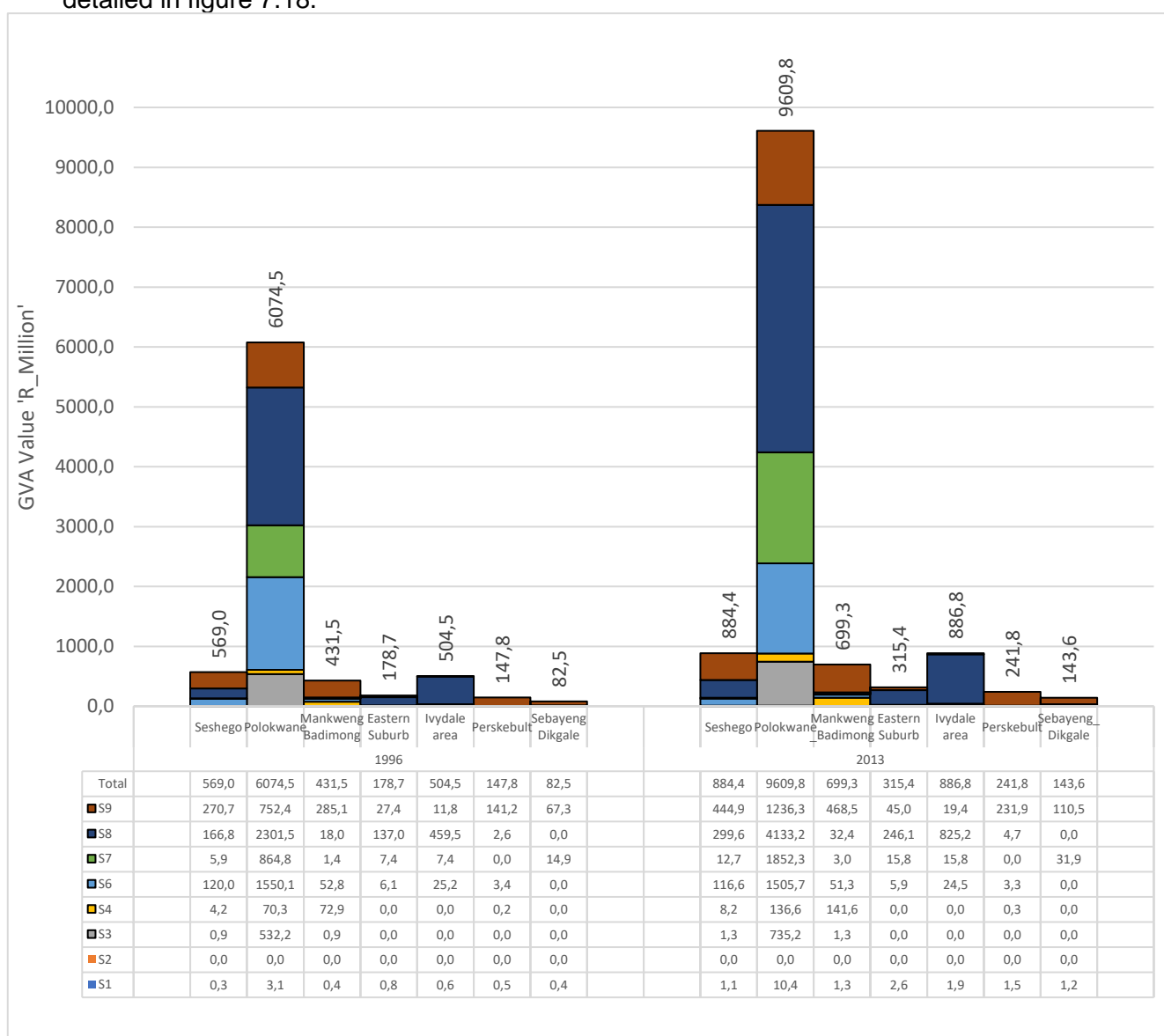


Figure 7.18: Mesozone socio-spatial transformation of GVA values_1996_2013

Source: Author, 2020

It is important to note that tracking spatial transformation using GVA values allows spatio-temporal analysis between the individual mesozone to find if there are changes in its overall GVA value contributions. In line with this view, GVA values presented in figure 7.18 evidences that Polokwane central has the largest values in both years 1996 and 2013. In particular there are 2 economic sectors with GVA values above the Billion Rand mark in 1996, namely S6 with approximately R1.55Billion, and S8 with 2,3Billion. Comparatively, the socio-spatial transformation until 2013, resulted in 4 economic sectors passing the Billion Rand mark in GVA value contribution. These economic sectors are S6 with R1.5Billion a drop of R50 million; S7 with R1.85Billion; S8 with R4,13Billion; S9 with R1,24Billion GVA value contribution. These results, denotes that economic activity S8, has remained the dominant sector over the years, Cloete and Massey (2017 p.155); SACN (2017a p.37); SACN (2017b p.6); Donaldson (2001 p.209) supports this stating that since 1990s Polokwane central has developed to be a major functional service centre for Limpopo region with location quotient above 10.

To add on, the three areas that evidences diversity of economic activities are Seshego, Polokwane central and Mankweng-Badimong settlement clusters, with exclusion of S2 economic cluster which is mining because there are no mines in these nodal areas. Sebayeng-Dikgale settlement cluster lacks economic diversity and S9 is its significant economic with changes from 67million in 1996 to 110million in 2013. These results suggest that economic opportunities, are still concentrated in Polokwane Central node which is the provincial hub of Limpopo. In view of Turok (2014 p.76) these result align with the spatial transformation principles of limiting spatial splintering of cities and fragmentation. However, the detriment of this, is that economic activities become concentrated in a single nodal area, which denotes reinforcement of apartheid legacy on inequality and imbalances in distribution of economic opportunities.

In another perspective, to get a better understanding on areas that experienced significant socio-spatial transformation in GVA changes, the research employed spatial statistics, Hot Spot Analysis Gertis-Ord G_i^* in ArcMap. The results suggested a statistically significant positive Z score of 99% confidence that settlements that are intensively clustered together with high GVA changes are part of the 1st order node Perskebult-Polokwane settlement cluster, an area within the urban edge of City of Polokwane. This denotes reality that the 1st order settlement cluster is the most significant economic node in the municipality that is concentrated with economic opportunities. In the perspective of critical urban theory (Brenner 2009 p.198); spatial dialectics and didactics (Halvorsen 2019 p.448), these results suggests the dilemma associated with existing spatial transformation policy frameworks and strategies. Despite several years of resource investments aimed at redressing the spatial legacy of apartheid, imbalances, inequitable distribution and spatial divide of economic opportunities

still prevails in the city. In support of this, there is no evidence of economic diversity in Sebayeng-Dikgale between 1996 and 2013, S9 has remained the dominant economic activity.

7.4 City texture

The previous sections on demographic distribution and city structure, unravelled spatial transformation at a mesozone level. This section focuses on city texture, which brings the analysis of patterns on spatial transformation to a fine grained micro-scale. Cities are complex systems, and interactions between agents within this complex system result in emergent socio-spatial transformation in city texture. It requires the adoption of complex earth observation algorithms aided with GIS to decode, analyse and map the nuanced changes of human settlements fabric at granular scales. In line with this perspective the spatial indicators adopted in this study are; Changes in density (Spatial transformation settlement model 1km grid cell); Population density changes 250m grid cell); Urban space integration changes and Changes in building structure developments.

7.4.1 Changes in density

Tracking changes in density is a crucial spatial indicator on spatial transformation of human settlements (RSA MDB 2018 p.12; Turok 2014 p.79). The historic apartheid legislative ideologies on forced dispossession of blacks to the homeland areas, residential controls and restrictive movement policies resulted in de-urbanization of the urban core, for occupation by the privileged and minority white group. This alteration in population distribution contributed to socio-spatial city texture imbalances on population and physical structure dimensions of density. The implication of this, is the inherent spatially fragmented settlement patterns, which are inefficient and unsustainable. However, towards the end of apartheid, disestablishment and spatial loosening of the apartheid legislative policy frameworks resulted in the resurgence of urbanization across South African cities. A scenario raised by Bakker *et al.*, (2016 p.2) that what would happen if the population is exogenously increased in any city? Thus, in line with this perspective tracking density changes in post-apartheid era, assists in answering this question, and to get a better understanding on the progress of redressing apartheid legacy. Consequently, the empirical evidence of new growth trajectory assist in measuring the effectiveness of post-apartheid progressive policy framework and normative spatial planning principles in changing the city texture in developing integrated, compact, efficient and sustainable cities.

The study employed Global Human Settlements Layer (GHSL) pre-processed and ready to use geospatial digital image datasets to track spatial transformation of city texture by detecting the fine grained spatial variability of pixels and spatial distribution of population densities. The advantage of this dataset is its critical global application in tracking the progress towards

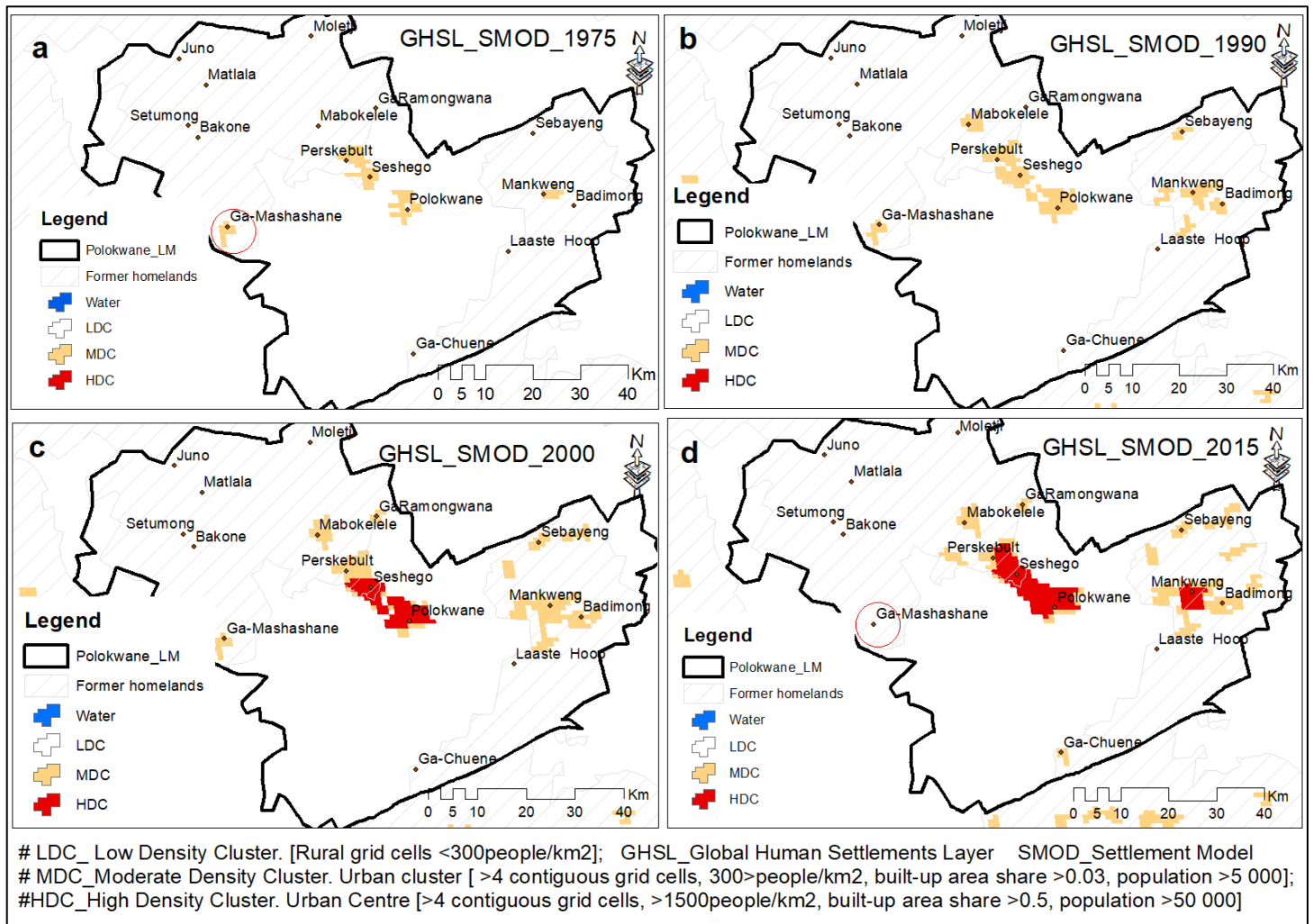
attainment of the New Urban Agenda III, SDG's, and mitigating the vagaries of climate change (Pesaresi *et al.*, 2016 p.20). In fact, its application is also essential in tracking the progress of post-apartheid spatial transformation progressive policy frameworks in redressing the inherited spatial injustices and inefficient city texture. The datasets employed provide nuanced understanding on density changes at 2 micro-scales namely; 1km grid cell for the settlement model and 250m grid cell for population density changes.

7.4.1.1 Spatial transformation settlement model (1km² grid cell)

The GHS settlement model (GHS_SMOD) employs a 1km² grid cell size, to assist in understanding the spatial transformation of urban texture on a global urban-rural classification continuum. The model computes density using total population within the grid cell and the spatial coverage share of built-up area within the same grid cell. Therefore, the spatial variability of these parameters in the grid cells gives the image different textures or shades of pixels, which are then used to distinguish an area as urban or rural over time. In another perspective the changes in settlement density and classification also helps understand what the European Statistics (EUROSTAT) perceived as degree of urbanization (DEGURBA) (Pesaresi *et al.*, 2016 p.24). This denotes that the settlement model is two fold, it provides for the understanding on changes in city's settlement density texture, spatial distribution, extent and rate of urbanization. In line with this perspective the figure 7.19 present the settlement model changes in the City of Polokwane between 1975 and 2015.

The empirical evidence presented in figure 7.19a suggests that by 1975, the apartheid government had achieved its desired spatial segregation pattern. The blacks had been successfully confined to townships in the homeland of Lebowa as frontier commuters working for whites in then Pietersburg. This de-urbanization contributed to the noticeable fragmented and unsustainable settlement patterns, characterised by moderate density clustering (MDC) of more than 300people/km², built-up area (buildings with roofs) coverage of 0.03 and population threshold of greater than 5 000 people. The forceful removal of blacks from New Pietersburg an area they could easily walk to work place into Seshego, caused spatial mismatch and imbalances in access to opportunities. This spatial pattern had implications on the environment and the frontier workers who endured commuting long distances daily, and spending much of their wages on transport costs leaving them in abject poverty. To add on, the low population densities and fragmentation is still noticed in 1990, but the settlement clusters show patterns of spatial growth, a bearing mark of apartheid restrictive legislative and policy frameworks. The noticeable additional settlement clusters having reached moderate population and settlement densities of 300people/km² are; Badimong, Laaste Hoop, Sebayeng, and Mabokelele as presented in figure 7.19b. These results concurs with the view

that population density across South Africa is low in comparison to that of other countries (SACN 2011 p.51). In addition to this, most of the land area remain classified as low density cluster rural areas with population density of less than 300people/km². MDB (2018 p.13) concurs with this stating that 91.6% of the land area in the City of Polokwane is characterised by low density rural areas, medium density 3.9% and the high density areas only covers 4.5% of the city.



*Dataset: GHS_SMOD_POP(1975, 1990, 2000, 2015)_GLOBE_R2019A_54009_1K_V2_0

Figure 7.19: Spatial transformation settlement model (1975_2015)

Source: Author, 2020

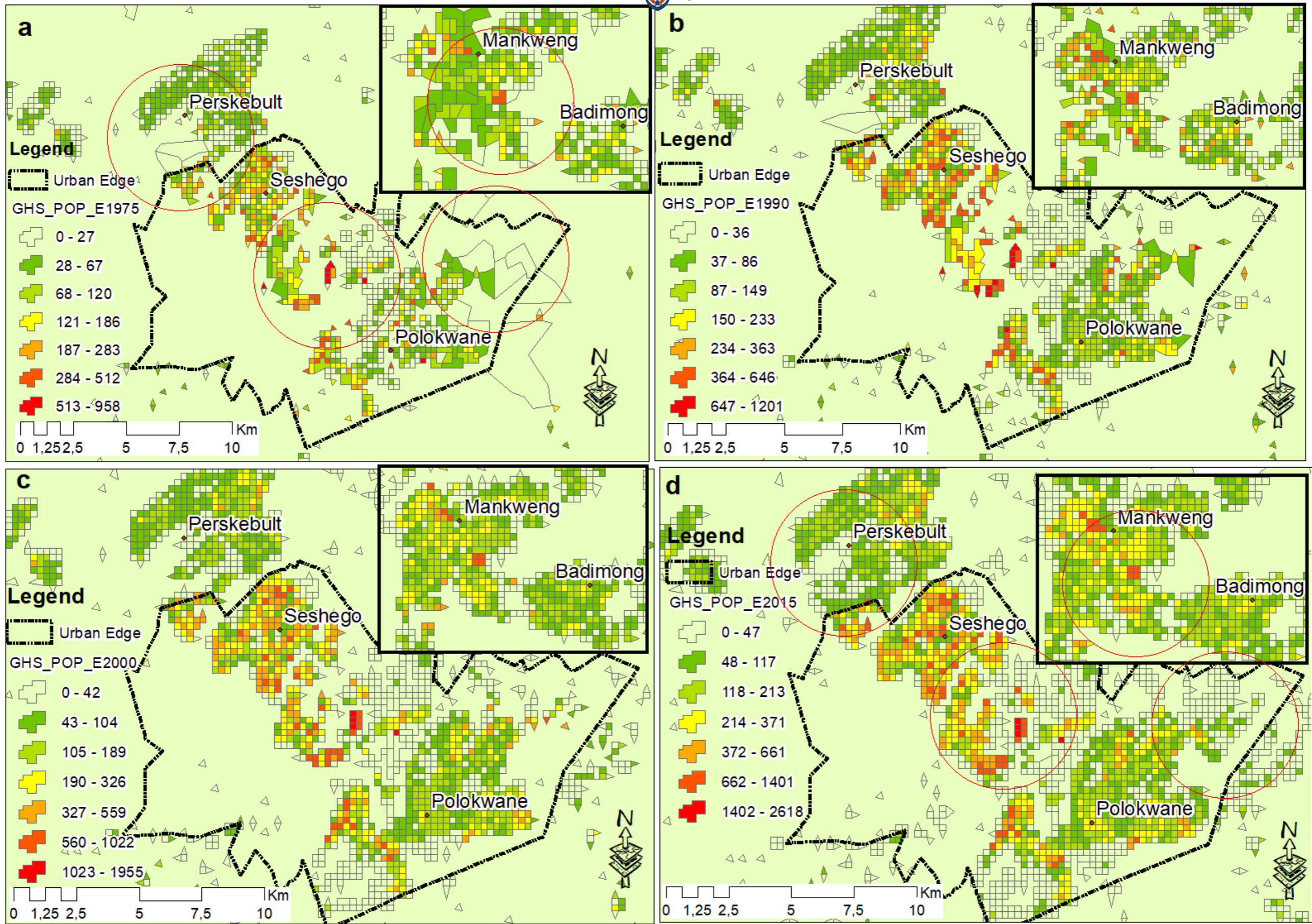
Figure 7.19c and d, present a different, changing perspective of the narrative on variation of density characteristics and contiguity of the 1km² grid cells within the City of Polokwane in post-apartheid era. In particular, the general understanding is that in the aftermath of apartheid, spatial patterns of densities in cities are characterized by high densities at the urban core followed by low densities in the buffer areas that ensured segregation and then high densities in the black dormitory townships (SACN 2011 p.59). On one hand this character is still persistent between Polokwane and Mankweng, partly attributed to the moratorium issued

on new developments because of lack of bulk infrastructure services in this area (Abrahams 2017 p,20; Polokwane 2013d p.47). On the other hand the picture painted in figure 7.19 shows that in the past, Seshego and Polokwane were characterized as such, but this has changed in the post-apartheid era, starting with the noticeable spatial integration and high density settlement clustering from 2000 and 2015. In addition, the picture portrayed in figures 7.19c and d, substantiates Turok (2014 p.80) view that there are extreme variations of densities in cities with high densities in certain area and low densities in others. Similarly, the degree of urbanization indicated in these figures marks these extreme differences in densities across the human settlements in the City of Polokwane.

In the perspective of the complexity theory Alberti (2018 p.47) points out that cities are complex systems containing agents whose action affects spatial transformation in a city. This denotes that increasing population, entails an increase in agents of change within the City of Polokwane. Their interactions and actions resulted in the emergent spatial transformation of settlement density to 1 500people/km², the built-up area of buildings with roofs increased to >0.5 and the population of the area is also above 50 000 people. The results also suggests that both areas Polokwane-Seshego and Mankweng-Badimong settlement clusters are rapidly urbanizing having increased population density, built-up areas and population exceeding 50 000.

7.4.1.2 Population density changes 250m grid cell

The previous section discussed the changes in settlement model classes and densities generalised at 1km² grid cell. This approach misses the nuanced granular population density differences within the city. SACN (2011 p.59) adds that cities fragmentation in South Africa is discussed portraying a similar spatial configuration, overlooking the unique differences in the city textures such as population distribution. In line with this perspective, the study adopted the 250m grid cell to unravel the fine grained differences, spatial distribution and socio-spatial transformation of population density in the City of Polokwane. The analysis was focused on the major settlement nodes that evidenced highest degree of urbanization namely 1st order node Seshego-Polokwane and 2nd order node Mankweng-Badimong as presented in figure 7.20.



*Dataset: GHS_POP_E(1975, 1990, 2000, 2015)_GLOBE_R2019A_54009_250_V1_0

Figure 7.20: Changes in population distribution and density at 250m² granular grid cell

Source: Author, 2020

Figure 7.20 shows the spatial distribution of population densities in the City of Polokwane. Figure 7.20a, portrays that the spatial variations in population densities with areas such as Seshego township witnessing higher densities as blacks were concentrated within this area with maximum population density range of 513 to 958 people per 250m grid cell. There are pockets of land characterized by very low densities such as the buffer area between Seshego and Polokwane, the eastern suburbs of Polokwane, Perskebult and also areas between Mankweng and Badimong. This spatial variability evidences general low population densities across the city. The different interactions between the agents of change, and directions for spatial transformation as discussed in chapter 6, resulted in the emergent increased densities, spatial integration between Seshego and Polokwane as noted in 2015 (see figure 7.20d).

The highest density range per 250m grid cell has increased to 1402 – 2618 people compared to the highest density range of 513-958 people for 1975. Abrahams (2017 p.8); Polokwane (2017 p.102) concurs with these results indicating that Seshego township has the highest population density compared to any other settlement clusters in the city. These results also suggests a key element of success in spatial transformation through increased population density in a well located area, and integration between Polokwane-Seshego settlement cluster. Thus, the development and spatial transformation trajectories witnessed are in line with the legislative policy frameworks from the RDP 1994 through to NSDF 2019. In particular, NSDF (DRDLR 2019 p.114) supports this citing that spatial transformation must promote settlement integration to foster high densities in facilitating economic development potential. This entails that the noticeable increased densities and spatial integration gives hope in support of public transport such as the planned BRT system Leeto La Polokwane through this area to Moletji as outlined in chapter 6 on transport directions for spatial transformation. Similarly, Abrahams (2017 p.40); Polokwane (2013c p.8) substantiate that densification is being encouraged in the urban edge to promote public transport, efficient and sustainable cities.

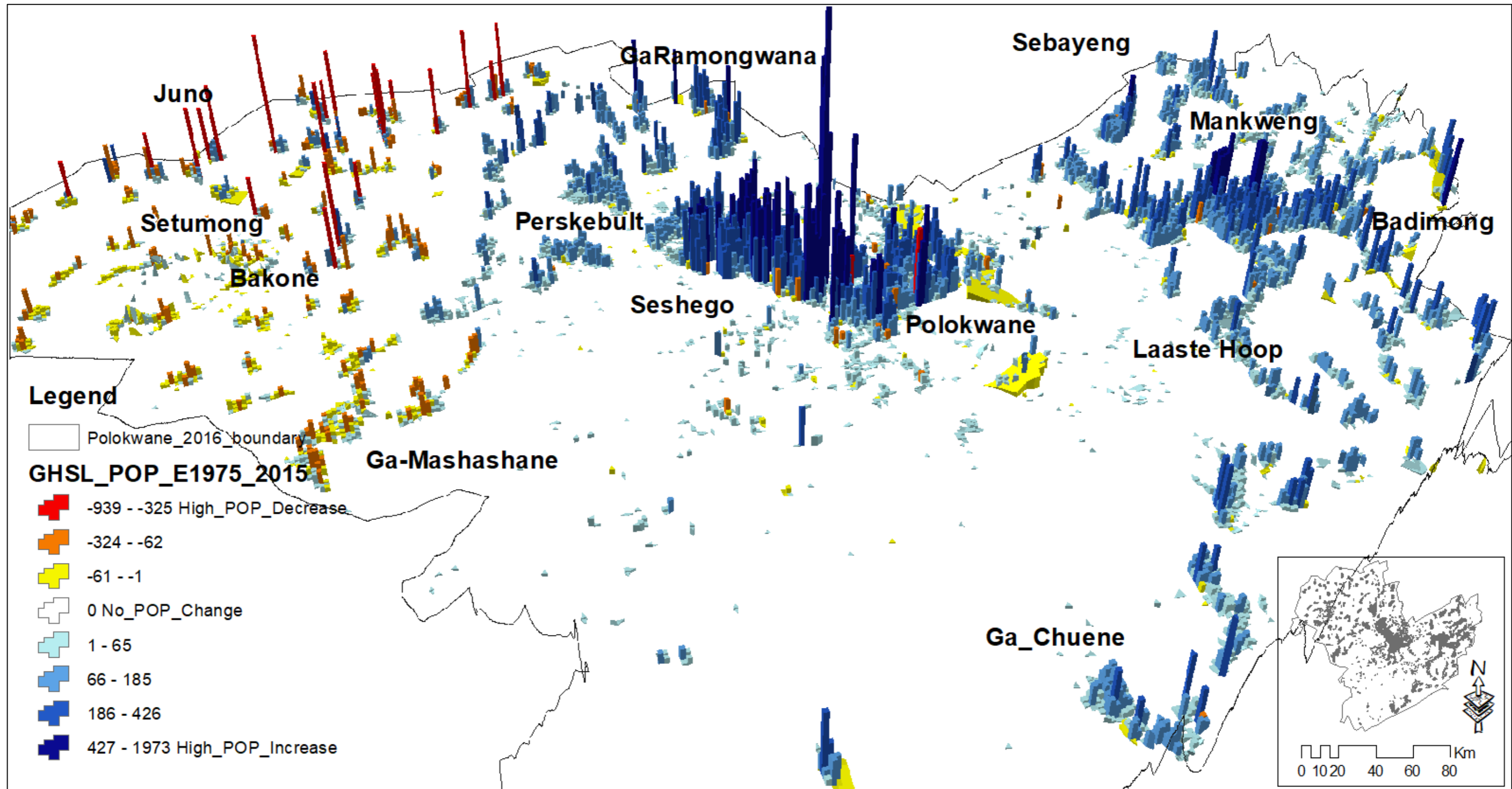


Figure 7.21: 3D Visualization of population density changes at 250m granular grid cell 1975_2015

Source: Author, 2020

SACN (2011 p.60) argues that the novel way of portraying the density differences within the city is to employ three-dimensional mapping. In line with this perspective, this study embraced the power of 3D visualization of changes in population density using the 250m grid cell as presented in figure 7.21. Thus, to visualise the spatial transformation of population densities between the years 1975 to 2015, different shades of colors were employed with yellow to red representing population density decrease and blue shade representing population density increase. The height of the bars represents the population density changes per 250m grid cell, with highest bars representing high density values.

The visualisation, presented in figure 7.21, shows that, the previously homeland areas in the north west part of then Aganang LM experienced population density decrease between 1975 and 2015. On the other hand, areas in the east and Polokwane central shows varied intensity of population density increase. Seshego-Polokwane settlement cluster demonstrated compact, efficient and sustainable development in the city. Figures 7.19-21, provides the empirical evidence answering Bakker *et al.*, (2016 p.2) quasi-experiment question on what will happen if population increases in a city. It is evident that with increasing population density and the city became more urbanized. In addition, the city also evidences substantial integration, compact and more sustainable developments within the urban edge.

7.4.2 Urban space integration changes

Connectedness of places relative to other parts of the city is viewed as one of the key features of urban texture (Turok 2014 p.79). However, in the context of complexity theory, Alberti *et al.*, (2018 p.53), cities are viewed as complex systems that are always experiencing spatial transformation over time. The nature, extent and ideologies of agents behind the spatial transformation impact on the level of connectedness, rather spatial integration of the settlements in the city. The complex nature of the urban systems including transport networks poses the difficult challenge on assessing the level of connectedness or spatial integration of spaces in the city.

Thanks to Hillier and Hanson (1984 p.108), theorisation that, the complex nature of urban systems can be represented cartographically as axial or convex spaces portraying the syntactic properties of the city. Such properties facilitates the description of a city's relational spaces, as either distributional, non-distributional, symmetric or asymmetric to the whole system. This is done by employing an analytical power of space syntax software which offers the possibility to concisely decipher the city's complex relational system using numerical syntactical and graphical representations. This implies analysing texture of the city as an expression on the extent of spatial integration (depth) for each individual axial space relative to the global whole complex city's network system. University College of London (UCL 2020);

Hillier and Hanson (1984 p.108-109) defines integration as, "...a normalised measure of distance from any space of origin to all others in a system. In general, it calculates how close the original space is to all other spaces, and can be seen as the measure of relative asymmetry (or relative depth)." To add on, Teklenburg *et al.*, (1993 p.348) pointed out that spatial integration analysis in space syntax is also viewed as a proxy measure on quality of the built environment. This denotes that good quality built environments are highly integrated in the city's system and that poor quality built environments are segregated, fragmented from the city's global system.

This study employed the capabilities of space syntax analytical techniques with the intention of examining whether spatial transformation in the City of Polokwane has maintained the apartheid status quo of spatial segregation or there has been improvement in spatial integration of the city. This software offers the ability to reliably narrate and represent the reality, quality of life in the past cartographically as presented in figure 7.22.

Figure 7.22a, provides ground to the analytical, and critical perspective on understanding spatial transformation of city texture in the City of Polokwane. It provides the historic syntactical spatial pattern of the city, using road transport networks for the year 2000. In the lens of critical urban theory (Marcuse 2012 p.20; Brenner 2009 p.198), the critique of spatial configuration in figure 7.22a, reveals that it portrays a spatial syntax (grammar), which suggests that most human settlement clusters were not properly integrated in the city's system. In support of this, figure 7.18a, shows that distribution of values in the histogram is skewed to the left, mean 615.0068; SD 403.3047; CV 0.6558, which are huge deviations from the mean a representation of low depth, demonstrating lower levels of spatial integration. This denotes, that most settlements Seshego, Perskebult and Mankweng were spatially segregated, compared to then Pietersburg which evidenced high levels of spatial integration. In another perspective, this evidences that in the year 2000 when South African local governments were established, they inherited built environments characterized by fragmentation, poor quality and inefficiency. To address this, post-apartheid policy frameworks provided spatial transformation directions for the concerted efforts to eradicate spatial segregation, fragmentation and inefficiency inherent in the city's system.

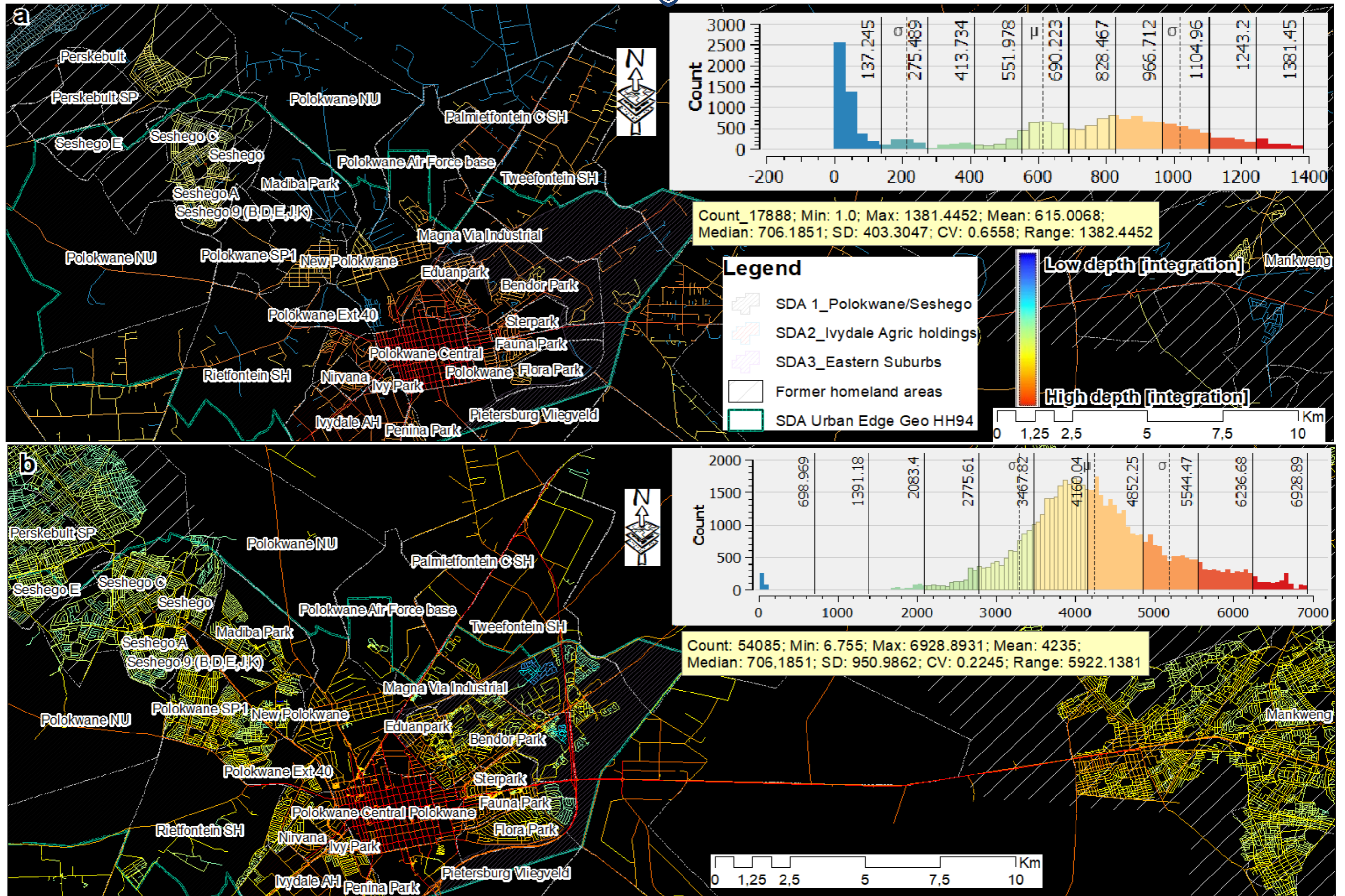


Figure 7.22: Urban space integration changes

Source: Author, 2020

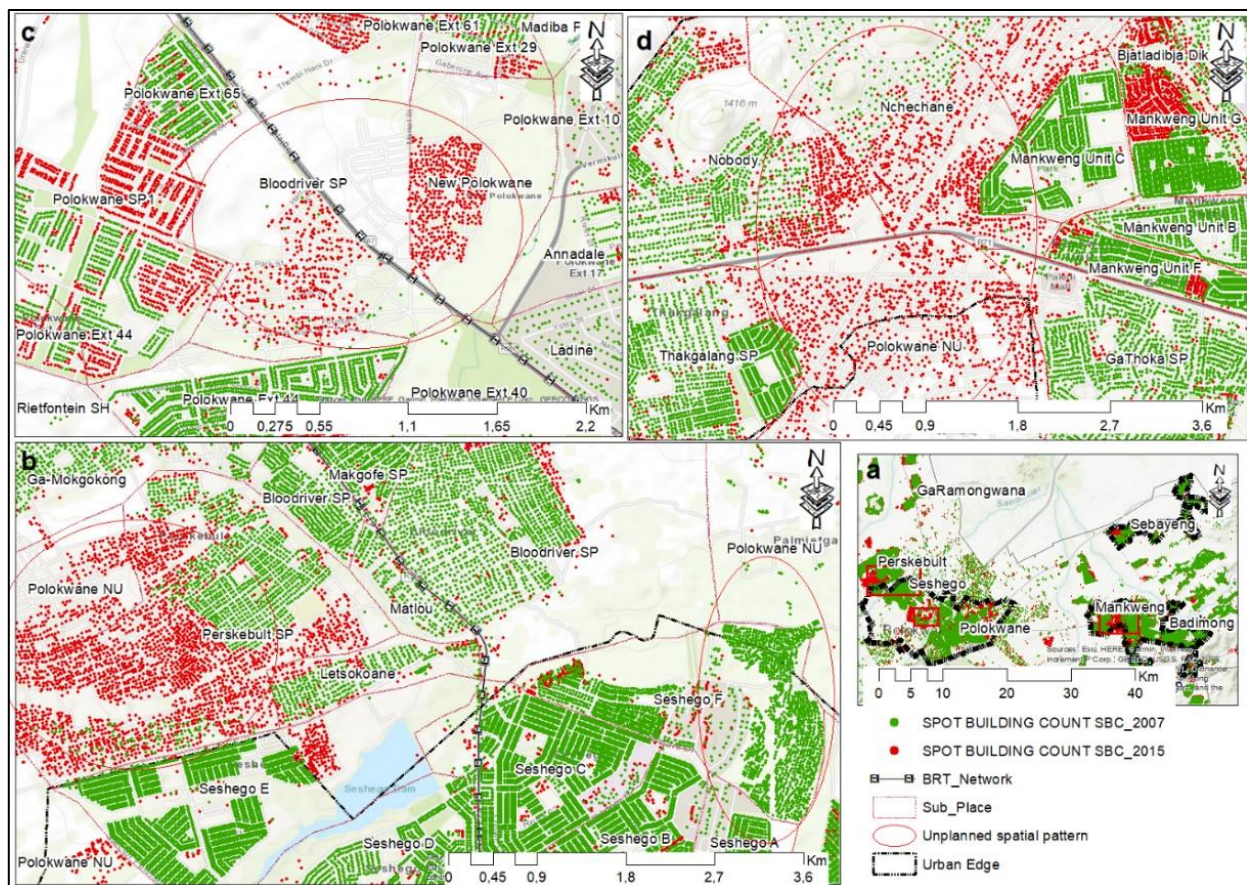
In another perspective, the histogram in figure 7.22b, shows normal distribution of values, mean: 4235; SD: 950; CV: 0.2245, which implies there is no huge variation from the mean. This indicates moderate depth level, which implies improved levels of spatial integration in the city's system in 2015, compared to low spatial integration levels in 2000. This concurs with Hillier and Hanson (1984 p.108) that addition of spaces in the system increases the level of depth in the city. Therefore, there is correlation between the level of spatial integration and spatial transformation of transport networks. In line with this view, the spatial transformation of transport network in the City of Polokwane has contributed significantly to the increase in spatial integration, and efficiency in some areas of the city. For instance the development of the eastern N1 by-pass road and the Nelson Mandela Drive which links Polokwane-Seshego and Perskebult settlement clusters has significantly increased spatial integration of these areas to the global city's complex transport network system. These results suggest that spatial transformation directions discussed in chapter 6, in particular leveraging on the development of transport networks in SDA's 1, 2 and 3, have contributed significantly in intensification of spatial integration between Seshego and Polokwane settlement cluster. To add on, this concurs with the policy framework plans of the City that there are opportunities for integration of settlements in the city (Abrahams 2017 p.22; Polokwane 2010a p.155). Furthermore, Cloete and Massey (2017 p.160) supports these results citing the city through funding such as the Neighbourhood Development Partnership Grant, has facilitated development of roads and other infrastructure facilities promoting integrated spatial transformation. However, Abrahams and Marais (2019 p.197) contends that there is need for spatial interventions targeted at integrated residential developments before making strong claims on spatial integration in the city. Although, spatial transformation does not happen overnight, the empirical evidence shows that policy framework directions or discourses contribute greatly to the creation of spatially just, integrated and good quality built environments.

7.4.3 Changes in building structure developments

SBC, is derived from the satellite imagery SPOT 5, at a micro scale of 2,5m and the building structures are manually digitized, mapped as points using the rule, "1 point per cadastre" (Mudau 2010 p.50). This implies this data is highly accurate and essential in descriptive analysis of fine grained city texture using the points of building structure developments, given that buildings are fundamental elements of urban morphology and can also indicate the nature and extent of spatial transformation. de la Rey (2008 p.33), points out that the development of this geospatial dataset was attributed to the inadequacy of census data in providing meaningful and detailed micro level data required to support strategic planning of electrification programmes. These programmes as echoed by the post-apartheid legislative policy frameworks are meant to redress the apartheid legacy of spatial injustices and

disparities which left many people across the country without services such as electricity among others. In light of this, Eskom tasked one of its divisions to come up with technical innovation that provide up-to-date empirical evidence pin-pointing the exact geographic location of physical building structures and the maintenance of such a geographical database.

In another perspective, census data does not provide this fine-grained building structure level data which is useful, for mapping spatial transformation in city texture attributed to ethical considerations such as protecting citizens' sensitive data privacy. Thus, the advantage of this dataset can also be viewed from its alternative name, Eskom Dwelling layer, which implies places or house where people reside. This provides empirical evidence for the nuanced understanding of city texture changes in relation to the resultant urban form, from residential and other building structure developments are taking place. This information is essential in evaluating the attainment of post-apartheid progressive policy directions on spatial transformation such as compact city, corridor developments, densification, infill developments and spatial integration of segregated human settlements. The interoperability of the available datasets permitted the analysis of building structure developments between 2007 and 2015 as presented in figure 7.23.



*Dataset: ESKOM SPOT BUILDING COUNT SBC

Figure 7.23: Changes in building structure developments 2007_2015

Source: Author, 2020

Figure 7.23a, shows the urban edges for the three major settlement clusters in the city namely; Polokwane-Seshego, Mankweng-Badimong and Sebayeng-Dikgale. The urban edge of Polokwane-Seshego as presented in table 7.6, evidences highest level of building structure developments an increase from 38 443 in 2007 to a total of 50 369 in 2015. Table 7.6 also highlights that significant spatial transformations took place between 2007 and 2015 amounting to 16 physical developments of key commercial building structures or nodal areas in the City of Polokwane which include; Mall of the North, Seshego Circle Centre, Paledi Mall and the singled significant resort nodal area Peter Mokaba Stadium (see plates 7.3 to 7..6 respectively).

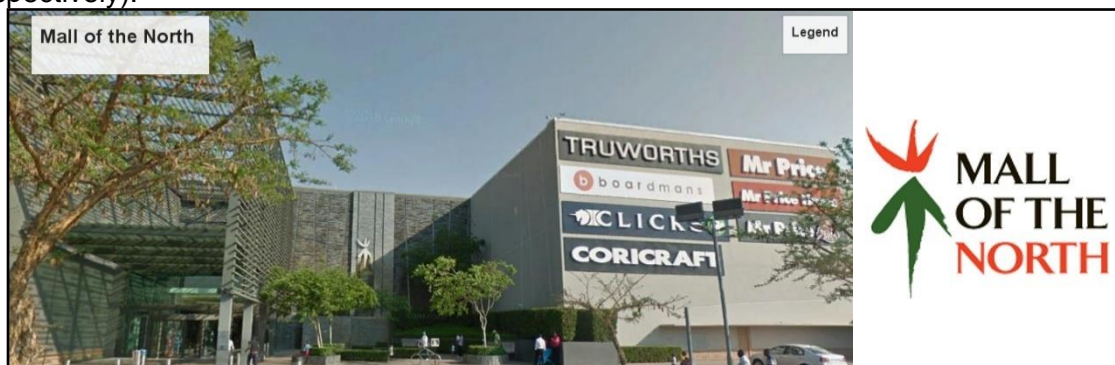


Plate 7.3: Mall of the North commercial node
Source: Author, 2020



Plate 7.4: Seshego Circle Centre commercial node
Source: Moloto 2021



Plate 7.5: Commercial node Paledi Mall in Mankweng
Source: Author 2021



Plate 7.6: Peter Mokaba sports complex recreation node

Source: FIFA, 2010

Comparatively, the urban edge for Mankweng-Badimong settlement cluster had a total of 29 806 building structures (2007) and increased to 38 362 (2015) and Sebayeng-Dikgale had 7 459 in 2007 which slightly increased to 9 603 in 2015. These increasing figures on dwelling and other building structure developments suggests that these settlement clusters are experiencing spatial transformation and are urbanizing at different rates and scales. This also, concurs with the findings discussed in the section on built-up area changes, presented in figure 7.14.

Table 7.6: Building structure developments

Type of building structure	Polokwane urban edge		Mankweng-Badimong Urban edge		Sebayeng-Dikgale urban edge	
	2007	2015	2007	2015	2007	2015
Dwellings	38 321	45 028	29 771	35 407	7441	8 906
Complex/Hostel	88	142	-	-	-	-
Dense informal	-	801	-	427	-	72
Commercial and industrial	-	15	-	1	-	-
Airport	-	1	-	-	-	-
Resort	-	1	-	-	-	-
Schools	33	38	35	36	18	18
Mine/Quarry	1	8	-	-	-	-
Other built-up	-	4 335	-	2 491	-	607
Total	38 443	50 369	29 806	38 362	7 459	9 603
Informal Dwellings	520	1218	4	740	-	72

Source: Author, 2020 compilation from SBC Count 2007 and 2015

Despite the advantage of SBC Count on showing the specific geographic location of building structures, the classification of the building structures gives a wrong impression about the distribution of functions such as commercial and industrial, airport among others which are regarded as not being in existence in the City as of 2007. In particular, table 7.6, shows that in 2007 there are no building structures classified as commercial and industrial, on the contrary the reality on the ground is that City has a functional CBD, polycentric shopping centres, and industrial areas in the urban edge. However, the spatial pattern that emerge from the mapped building structures provides for nuanced understanding of city texture through analysing the morphological spatial patterns formed by the landscape of point data as presented in figure 7.23. The comparative advantage of using this geospatial data is that to understand spatial transformation of city texture relying on cadastral data is a drawback because it

portrays a physical spatial structure resulting from approved layout plans. This excludes other city texture giving elements such as informal dense settlements and other settlement developments in areas under traditional authorities. Thus, inline with this perspective, the spatial transformation of city texture in strategically selected areas is presented in figure 7.23. The base geospatial dataset, dwelling layer for 2007 (green points) presents an urban texture, characterized by spatial configurations that are dense, detached building structures forming compact, continuous and connected urban blocks. In the perspective of complexity theory (Alberti *et al.*, 2018 p.47), this noticeable historical morphological pattern in 2007, is attributed largely to the essential role played by the local government in governing township development layout plans ensuring that the City is developing in an orderly manner with respect to legislative policy frameworks. This is also supported by Abrahams (2017 p.40), pointing out that the former R293 township Mankweng, and Seshego and the urban core Polokwane central are planned, zoned and serviced by the municipality influencing the nature of city's morphological spatial pattern. Ahmad and Pienaar (2014 p.101) reverberates that local municipalities as agents change, are the primary arbiter of spatial transformation with a mandate to direct and manage spatial developments in the city.

The emergent evolution, physical growth, and spatial transformations in city texture, has resulted in the morphological patterns witnessed in 2015, which resemble the required integrated human settlements in post-apartheid era. This shows the force of urbanization and interactions between other agents of change and effects of such in giving birth to a different physical form of city texture. In particular, informal settlements north of Seshego-A, New Polokwane (Disteneng or Extension 78), and Perskebult a rural settlement under the traditional authority presents a dense city texture. Polokwane (2020 p.120); Gildenhuys (2015 p.14); Polokwane IDP (2008 p.15); Polokwane (2007a p.29) supports this stating that there is inadequate housing and informal settlements in the urban areas. Informal settlements have long been developing in the city with New Polokwane (Disteneng) dating back to 1990s after the end of apartheid regime (Donaldson and Kotze 2006 p.567). However, the morphological pattern resulting from spatial transformation in this area, is similar to that of Mankweng-Badimong showing unplanned, discontinuous settlement physical structure. The settlement patterns emerging shows lack of planned streetways and the unplanned mushrooming of building structures clustering together. This morphological urban form evidences lack of proper planning, as the primary arbiter has shifted from being the local municipality to the traditional authorities who allocate land without following any layout development plans. These results, suggests that the city's evolutionary process in redressing the apartheid legacy, and response to rapid urbanization has failed to keep up with housing demand. This result in people developing informal settlements or opting for buying and developing dwelling structures in the areas under traditional authorities closer to the city centres where there is

access to employment opportunities. Polokwane (2020 p.772); Abrahams (2017 p.39-40) echoes the same, citing that the inability of the municipality to intervene in planning and management of residential developments in traditional rural areas is resulting in unplanned dense settlements, which affects the morphological spatial pattern of the city.

7.5 An integrated spatial transformation tracking framework

There is dearth of literature focusing on framework for tracking spatial transformation. Available scholarly writings by Surya *et al.*, (2020); Landman and Badenhorst (2014; 2012); Christmann (2014); Roitman *et al.*, (2010); Landman (2006); are inadequate and limited in scope to investigating the process of spatial transformation. Roitman *et al.*, (2010, p.21) also highlights that researchers investigating urban issues including spatial transformation must develop or improve existing frameworks. In line with this perspective, this section discusses the conceptualized integrated spatial transformation tracking framework for small and intermediate cities in South Africa. This, study provides foundational building blocks that are essential in development and application of the integrated spatial transformation tracking framework as proposed and advanced in figure 7.24.

7.5.1 Assumptions for the integrated spatial transformation tracking framework

This study assumes that to track spatial transformation of cities, there is need to understand the complex and interrelated factors driving change. Cities are in the process of experiencing continuous growth, hence the generic assumption that spatial transformation is a constant factor critical in the successful functioning of human settlement. Thus, expressions of spatial transformation demand is positively associated with space (re)production supply side. This denotes that drivers/needs/demand expressions for spatial transformation give rise to supply ideas on (re)production of space through (re)construction and development of urban space by a range of players or actors. Hence the assumption that with change happening in cities, interoperable longitudinal geospatial data is also available to track such spatial transformation. This study also assumes that necessary GIS technologies and capacitated personnel are in place to facilitate the tracking of spatial transformation in a city or urban area.

7.5.2 Defining features of the integrated spatial transformation tracking framework

The key features for this framework are; spatial transformation legislative and policy frameworks, expressions of spatial transformation drivers/demand characteristics, space (re)production-spatial transformation supply and management, integrated spatial transformation tracking plan, and implementation plan and feedback. It is important to note that tracking spatial transformation does not follow a simple linear process. This section expounds the relevance of these key defining features of the integrated framework for tracking spatial transformation in small and intermediate cities in South Africa.

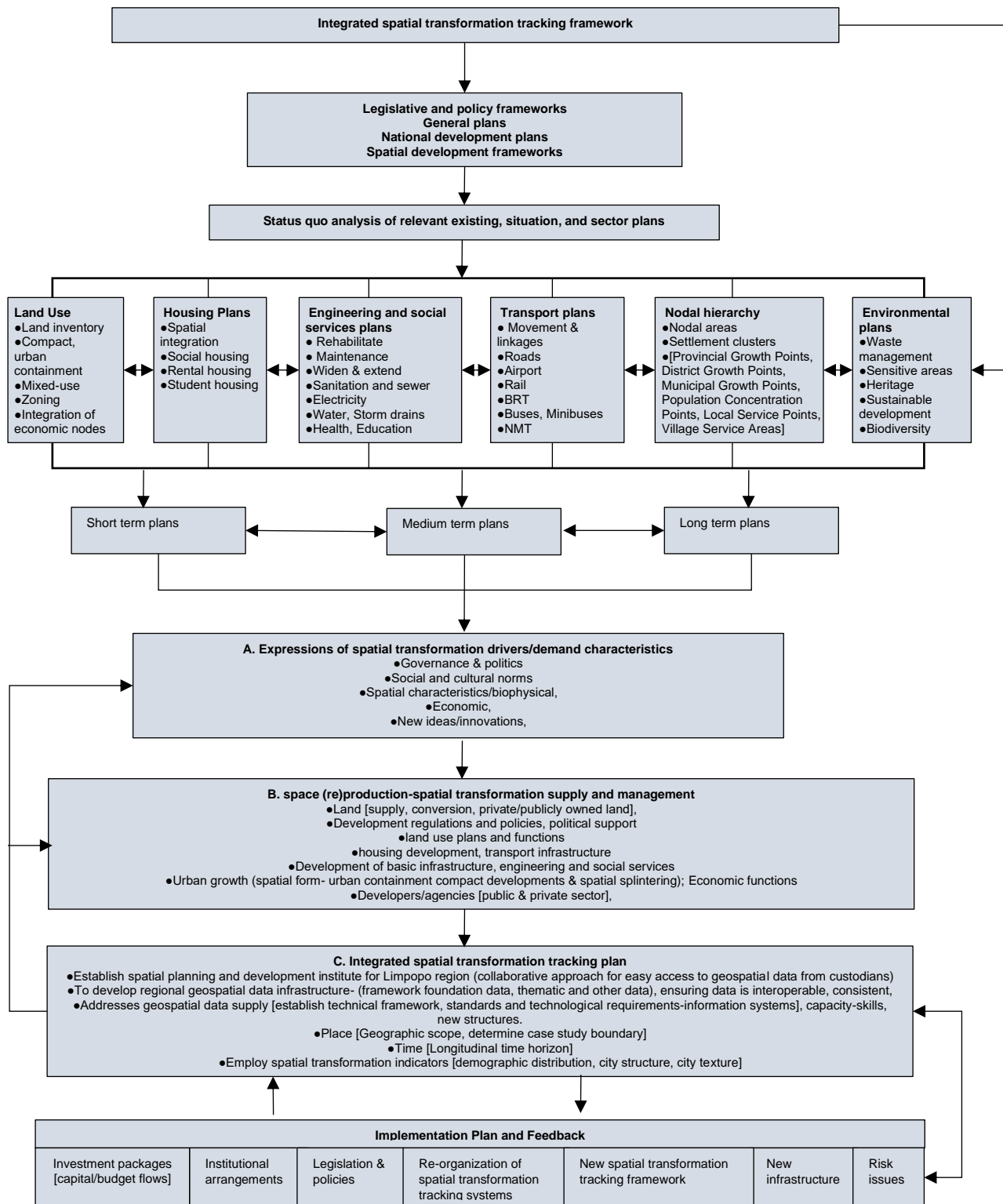


Figure 7.24: Integrated spatial transformation tracking framework

Source: Author, 2020

Figure 7.24 provides a simplified and integrated framework for tracking spatial transformation in small and intermediate cities in South Africa. The key defining features for this framework are as follows;

7.5.2.1 Spatial transformation legislative and policy frameworks

The critical analysis of notions and theories of spatial transformation (see chapter 2) depicts that this concept is a complex and multidimensional phenomenon. As such to decipher it, literature review on international case studies (see chapter 3) corroborate that structuralist analysis i.e. critical analysis of legislations and policy frameworks is a key defining feature as proposed and advanced by the framework. The discourses that emerge from such frameworks, provide a better way to elucidate dynamics of spatial transformation in cities, than the classical norm on quasi-biological metaphor analysis of organic growth, invasion and succession (Bruyns 2018 p.53; Muhammed and Onuche 2017 p.168; Thorns 2002 p.8). In view of Thornberg (2012 p.12) the logic of abduction and theory of change (ToC). Paina *et al.*, (2017 p.31) as employed in this study entails that legislative and policy framework discourses are a heuristic tool, for critical reflection and evaluation on progress of spatial transformation in cities. This implies a spatial turn, a retrospection to identify the planned initiatives, providing baseline conditions against which the experienced spatial transformations is evaluated.

The approach to this process that can be adopted by small and intermediate cities in South Africa as employed in this thesis, involved identification and analysis of crucial legislative and policy frameworks which provides communicative action that direct spatial transformation in a city or urban area (see Chapter 6). In particular the key legislative and policy frameworks analysed in this study include; RSA Constitution 1996, White Paper on Reconstruction and Development Programme 1994, Development Facilitation Act 67 of 1995 (Repealed by SPLUMA 16 of 2013), Urban Development Framework 1997, Limpopo Spatial Rationale 1999 (reviewed 2002), National Spatial Development Perspective 2003 (reviewed 2006), Breaking New Ground (BNG) 2004, National Development Plan (NDP) 2030 (2012); Spatial Development Framework (Polokwane 2010); and Local Spatial Development Framework Plans (Polokwane 2007a,b, and 2009). The communicative action weaving through these frameworks are; policy objectives, normative principles, vision, spatial transformation concepts and tools. Overall, critical discourse analysis of the legislative and policy frameworks from all scales assist in determining the baseline status quo/situation. This analysis must uncover details of intended spatial transformation plans on several key aspects inclusive of; land use, transportation, engineering and social services, nodal hierarchy and the environment. This strategic analysis of instructive plans and policy documents points to intended implementable and evaluable short, medium and long term plans for spatial transformation in cities. The legislative and policy frameworks are also informed by spatial transformation drivers/demand characteristics.

7.5.2.2 Expressions of spatial transformation drivers/demand characteristics

Expressions on complex spatial transformation drivers/demand characteristics is also another key defining feature for the proposed framework. Various studies by Coetzee *et al.*, (2014 p.1); Landman and Badenhorst (2014 p.215); Mubiwa and Annegarn (2013 p.4); Wray *et al.*, (2013 p.6), Lauf, *et al.*, (2011 p.71), Landman (2006 p.2); Sadiki and Rmutsindenla (2002, p.57) highlight that understanding the dynamic and complex socio-spatial transformation pressures, needs, forces, drivers/demand characteristics is important in establishing strategies to monitoring change in cities. The general expressions of these spatial transformation drivers/demand characteristics as discussed by key experts and corroborated with literature are presented in table 3.2, Appendix C and further discussed in the context of Polokwane intermediate city in chapter 8. These drivers are broadly categorized as governance and political; spatial characteristics/biophysical factors, social cultural norms and economic drivers. The extent to which these drivers influence spatial transformation differs from one place to the other. Reflecting on these drivers, it is opined that part of the demand characteristics also act as identifiable spatial indicators of transformation in cities. The interpretation this highlights that part of the complex, multidimensional socio-spatial transformation characteristics act as both drivers and indicators of space changes in cities. For example social characteristics such as population increase drives spatial transformation, and in turn population spatial distribution changes also act as a key indicator on spatial changes happening in cities (see section 7.2.1 chapter 7). These drivers/demand characteristics of spatial transformation also give rise to ideas on space (re)production supply and management.

7.5.2.3 Space (re)production-spatial transformation supply and management,

Spatial transformation in cities is a result of interaction between the complex needs/demand and space (re)production-spatial transformation supply characteristics. However, the rate, extent, and intensity of spatial transformation varies between one city and the other, attributed to compounding differences in means of supply and management. This entails that for each particular small and intermediate city there is need to identify the specific supply and management characteristics, which in some cases translates into spatial intervention tools or concepts that facilitate spatial transformation (as reflected in section 6.6 in chapter 6). The key supply and management characteristics emerged in this study as highlighted by key experts and in literature are directly linked to space users (citizens) and producers (Surya *et al.*, 2020 p.2; Landman and Badenhorst 2014 p.215; Christmann 2014 p.236; Landman and Badenhorst 2012 p.22; Landman 2006 p.9). The characteristics are not limited to the following; land (ownership and allocation, conversion), development regulations and policies, political

support, devolution of powers, land use plans and functions, housing development, transport infrastructure, basic infrastructure, engineering and social services developments, urban growth, changing economic functions and initiatives by developers/agencies. Users of this framework must also understand, that these space (re)production supply characteristics, also directly translate into measurable spatial indicators that depict spatial transformations occurring in cities. This entails that to make use of the notable spatial indicators there is need to establish an integrated spatial transformation tracking plan.

7.5.2.4 Integrated spatial transformation tracking plan

The discussion on spatial transformation legislative and policy frameworks, expressions of drivers/demand characteristics, and space (re)production supply and management, pointed to both possible indicators and baseline objectives against which evaluation for spatial changes in cities can be done. The plan to operationalize these possibilities crucial to users of this framework, as applied in this study, involved analysis of available geospatial data infrastructure and datasets (see chapter 5). The findings concur with literature that access to readily available, complete, comparable, from the same source; captured with consistent methodologies, at similar fine grained scales, and interoperable geospatial data is a huge challenge (Maritz *et al.*, 2017 p.3; Maritz *et al.*, 2016 p.3; Amindarbari and Sevtsuk, 2012 p.2). In another perspective, it is also important for small and intermediate cities as users of this framework to bear in mind that the established SASDI does not store geospatial data required by users, corroborating with findings by Mabuza (2003 p.2319). Some of the existing desirable geospatial datasets that are fine grained small scale areas are only limited to metro-cities across South Africa i.e. Easy Quantec datasets and census data from Statistics South Africa. This denotes small and intermediate cities in South Africa as possible users of this framework need to adopt a differentiated approach or plan towards tracking spatial transformation. In particular, developing their own regional geospatial data infrastructure, a typical characteristic of most metro cities around the world i.e. Gauteng City Region Observatory (GCRO) in South Africa, IPPUC- Instituto de Pesquisa e Planejamento Urbano de Curitiba and Urbanizacao de Curitiba SA in Brazil.

The plan users need to adopt as followed in this study involves gathering existing and accessible longitudinal geospatial datasets to build an integrated geodatabase. The selected datasets must also cover space of interest i.e. City of Polokwane and also be interoperable permitting the tracking of spatial transformation. Users of this framework must take advantage of the advancements in technological innovation in geographic information systems (GIS) and its functions i.e. spatial analysis capabilities as employed in this study. This permitted the reconstruction, extraction of existing geospatial data sources for building the indicators, and

data manipulation processes (see mathematical models for data manipulation in chapter 5) to generate desired maps tracking spatial changes (see maps in chapter 7) as also done in respective studies by Maritz *et al.*, (2017; 2016) and Amindarbari and Sevtsuk, (2012). Maritz *et al.*, (2017 p.12) highlighted that, it is important to understand that no single indicator alone can depict all necessary spatial transformations experienced in cities. Thus, the solution to this as employed in this study was built on the work by Turok (2014), leading to adoption of a revised spatial transformation mapping triad (see figure 2.6 and relevant spatial indicators in table 2.2 in chapter 2). The application of this framework in practice requires development of an implementation plan and getting feedback.

7.5.2.5 Implementation plan and feedback

The discussion in chapter five on analysis of geospatial mapping methodology expressed that most available data sets are inadequate, their interoperability is mostly limited to a particular project scope. The broader interpretation to this facilitating a wider application of this framework is that there is need to develop an implementation plan, set aside budget, make possible institutional arrangement, necessary infrastructure among others and provide feedback to improve the integrated spatial transformation tracking framework.

7.5.3 Testing the framework

The integrated spatial transformation tracking framework proved useful as theoretically tested through out this study leading to findings presented in this chapter . However, as part of finalizing the testing process, the researcher engaged key experts and the municipality in assessing, the readiness of this conceptualized integrated spatial transformation tracking framework for implementation. They indicated that from a theoretical stand point they agreed with the framework, however the next stage requires politicization, and radical practical testing, making use of any identifiable concrete and scalable pilot project running over five years. Thus, based on results that emerge from the pilot test, revisions and modifications would be made to the framework. This ensures that critical inputs from various sectors and plans such as Integrated Development Plans (IDP), Integrated Transport Plans (ITP), Local Spatial Development Frameworks (SDF), among others are incorporated. This assists in identifying necessary potential modifications that can be cast back in improving the proposed framework.

7.6 Critic and value addition of the framework

The critic of this framework originates from its assumptions. In particular, interoperable longitudinal geospatial data is not readily available. Such big data is acquired from different sources, in different formats, thus it requires pre-processing so that it becomes interoperable for easy of tracking spatial transformation. Furthermore, the necessary GIS technologies

required such as ArcGIS are expensive and cannot be afforded by many, however open source software's can be employed. It is also important not to assume that the personnel are capacitated, trainings are needed so that the personnel gains the skills set required to effectively facilitate tracking of spatial transformation using the advanced framework. Literature surveyed in this study indicated that there is lack of clearer frameworks for tracking spatial transformation. Thus the value addition of this framework is that it fills this gap. The framework provides a functional approach and process flow of activities in tracking spatial transformation. This thesis details the processes followed and is also accessible from the university repository. Thus, potential users of this framework can assesses what worked and how decisions on approaches employed were arrived at.

7.7 Chapter summary

This chapter presented maps of spatial transformations in the City of Polokwane for the time frame 1996 to 2016. The main focus was on these three major dimensions of spatial transformation namely; demographic distribution, city structure and city texture. The spatial transformation indicators employed for the dimension demographic distribution are; population changes, changes in spatial distribution of age structure, unemployment changes, changes in poverty and changes in race. For city structure, the spatial indicators employed include; city boundary changes, changes in built-up areas, changes in road transport networks, and changes in industry contribution to GVA. Lastly, city texture spatial indicators for spatial transformation employed are; changes in density- settlement model changes, population density changes; urban space integration changes and changes in building structure developments. These different dimensions and spatial indicators indicated that there is no single spatial indicator or methodology that can measure and provide nuanced understanding of spatial transformation in any given locality. To add on, this chapter demonstrated the advantage of using mesozone, and micro-scale size in understanding the spatial transformation dynamics in a city rather than the aggregation of data generalized at the municipal macro level. In addition, multiple geospatial datasets were employed in this chapter, which denotes that there is no single geospatial dataset that is adequate to provide for the dynamic understanding of spatial transformation. In any case, it is apparent that there be a functional national spatial data infrastructure, to ensure easy access to the multiple geospatial datasets without facing any hurdles.

CHAPTER 8: DRIVERS OF SPATIAL TRANSFORMATION IN THE CITY OF POLOKWANE

8.1 Introduction

This chapter discusses the drivers of spatial transformation in the City of Polokwane and it is divided into 6 sections as presented in figure 8.1. Section 1 introduces this chapter and its overview. Sections 2 to 5, discuss the expressions of governance and policy, spatial characteristics/biophysical, social and cultural and economic drivers of spatial transformation in Polokwane respectively. Section 6, is a summary of this chapter.

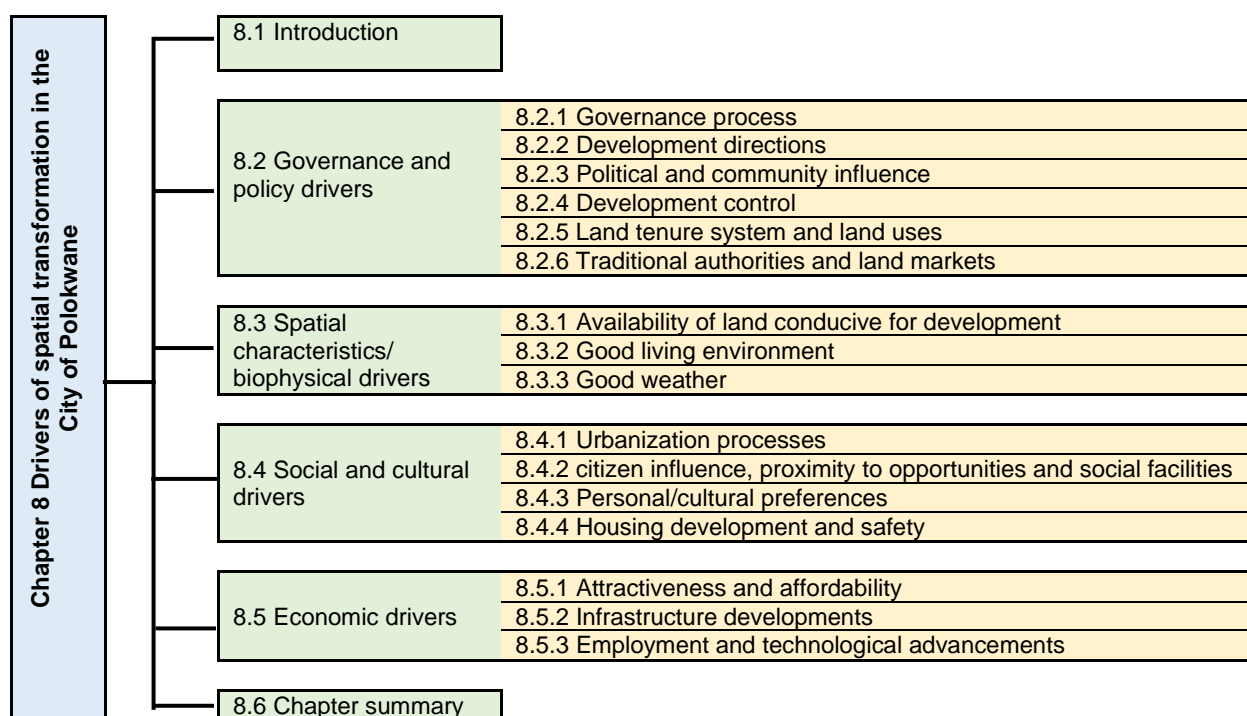


Figure 8.1: Chapter 8 Orientation

Source: Author, 2020

It is evident from the previous chapter that spatial restructuring is taking place as presented by the spatial transformation indicators. However, the key question raised is, what are the drivers of spatial transformation in the City of Polokwane? The critical urban theory lens, provides that theory is an attempt to understand and explain spatial reality. Thus, in line with this theory to deepen the understanding of the evidenced spatial transformations in the City of Polokwane, requires critique, deciphering of socio-spatial reality in order to identify, expose the drivers and agents shaping society. Similarly, the spatial turn theory and spatial triad, on production of space provides for moving beyond mere observation of spatial transformation as shown by the maps. It reiterates the need for understanding the factors driving spatial transformation as a social product of both representation and representational spaces. To add on, spatial turn entails a retrospection, glancing backwards at the spatial transformation reality

and probe for the drivers of such noticeable urban changes. In another perspective, there are spatial dialectics and didactics; differing notions about drivers of spatial transformation in cities as they are complex systems. In support of this, the complexity theory points out that urban systems are linked to various components, by extension spatial transformation is also a complex concept linked to various drivers or factors. Therefore, this provides an analytical lens to expose and explain the governance and political; spatial characteristics/biophysical factors; social and cultural norms, and economic drivers of spatial transformation a social product as rooted in the ideologies, power and practices in the City of Polokwane.

8.2 Governance and policy drivers

To determine governance and policy drivers of spatial transformation in the City of Polokwane, exploratory factor analysis (EFA) was employed. The results for the correlation coefficient matrix for the 17 items that were used in the questionnaire measurement instrument are presented in table 8.1.

Table 8.1: Correlation matrix on variables of governance and policy drivers of spatial transformation

Correlation Matrix ^a																	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
Drivers.ST-GP1.	1.000																
Drivers.ST-GP2.	.504	1.000															
Drivers.ST-GP3.	.302	.192	1.000														
Drivers.ST-GP4.	.148	.259	.305	1.000													
Drivers.ST-GP5.	.168	.134	.162	.210	1.000												
Drivers.ST-GP6.	.154	.152	.031	.165	.372	1.000											
Drivers.ST-GP7.	.067	.177	.085	.138	.319	.525	1.000										
Drivers.ST-GP8.	.178	.144	.061	.057	.287	.432	.525	1.000									
Drivers.ST-GP9.	.200	.136	.108	.124	.239	.282	.411	.525	1.000								
Drivers.ST-GP10.	.147	.136	.056	.099	.190	.312	.327	.337	.490	1.000							
Drivers.ST-GP11.	.200	.079	.068	-.011	.143	.312	.275	.364	.426	.521	1.000						
Drivers.ST-GP12.	.136	.031	.161	.113	.157	.110	.241	.225	.364	.396	.403	1.000					
Drivers.ST-GP13.	.211	.178	.152	.140	.060	.202	.144	.197	.197	.305	.302	.463	1.000				
Drivers.ST-GP14.	.100	.236	.076	-.003	.102	.199	.228	.252	.178	.210	.204	.271	.475	1.000			
Drivers.ST-GP15.	.111	.117	.111	-.045	.060	.145	.123	.114	.124	.167	.166	.148	.229	.451	1.000		
Drivers.ST-GP16.	-.015	-.022	.115	-.071	.037	.141	.029	.173	.084	.105	.115	.074	.108	.241	.544	1.000	
Drivers.ST-GP17.	.038	-.044	.010	-.107	-.022	.060	-.015	.081	.037	.103	.089	.009	.067	.116	.285	.474	1.000

a. Determinant = .009

Source: Author, 2019

In assessing the problems of multicollinearity, the study followed rules highlighted in a study by Ashehri (2012) and augmented by checking the computed determinant score i.e. rule of thumb for absence of multicollinearity >0.00001 . Table 8.1 shows that the determinant score is 0.009, which is greater than the suggested rule of thumb score. Therefore, the variables seems to have a patterned relationship and there is the absence of multicollinearity problem.

The factorability of output matrix, was scrutinized using the statistical procedures, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity as highlighted in a study by Bai, Hira and Deshpande (2016). The results for these two statistical procedures are presented in table 8.2.

Table 8.2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy (MSA).		.755
Bartlett's Test of Sphericity	Approx. Chi-Square	1868.527
	df	136
	Sig.	.000

Source: Author, 2019

The results presented in table 8.2 shows that, computed KMO statistic 0.755, is greater than 0.50 recommended in a study by Lin and Wu (2016), indicating sampling adequacy. The computed statistic for Bartlett's test of sphericity, Approx. Chi-square $\chi^2 = 1868.527$, (df) 136, Sig. value is statistically significant (less than 0.05) at $p < 0.001$, demonstrating that R-matrix is not an identity matrix. In view of Field (2009; 2013), these results indicate that variables included in this analysis have adequate relationships for EFA as distinct and reliable factors can be yielded that are useful in determining governance and policy drivers of spatial transformation in the City of Polokwane. The computed factor analysis output for variables of governance and policy drivers of spatial transformation is presented in table 8.3.

Table 8.3: Rotated Factor Matrix^a governance and policy drivers

Variables for governance and policy drivers of spatial transformation	Factor					
	1	2	3	4	5	6
Drivers.ST-GP1.Government control on land ownership					.796	
Drivers.ST-GP2.Control by municipality on how land is used					.578	
Drivers.ST-GP3.Traditional authorities allowing unplanned land development						.486
Drivers.ST-GP4.Land markets favour the rich						.587
Drivers.ST-GP5.Uncontrolled movement of people in to the area after apartheid	.438					
Drivers.ST-GP6.Government spending on construction of roads	.646					
Drivers.ST-GP7.Government spending on housing construction	.729					
Drivers.ST-GP8.Municipality decision making processes	.627					
Drivers.ST-GP9.National government development directives		.516				
Drivers.ST-GP10.Provincial government development directives		.597				
Drivers.ST-GP11.Polokwane municipality development directives		.634				
Drivers.ST-GP12.Uncontrolled allocation of land		.644				
Drivers.ST-GP13.Government authority to direct development				.506		
Drivers.ST-GP14.Implementation of land use policies				.790		
Drivers.ST-GP15.Political organizations giving people land to build			.554			
Drivers.ST-GP16.Community based organizations controlling land development			.924			
Drivers.ST-GP17.Land restitution			.515			
Eigenvalues	4.220	1.969	1.650	1.363	1.055	1.031
% of variance	24.82	11.58	9.70	8.02	6.20	6.06
Cumulative %						66.40

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations. Factor loading less than 0.40 are not shown*

Source: Author, 2019

Table 8.3 presents the factor loadings of the 17 variables from the measurement instrument on governance and policy drivers of spatial transformation in the City of Polokwane. These results show that all 17 variables included in the measurement instrument are of practical significance, because the factor loading values for all the variables exceeded 0.40 as recommended by Field (2009; 2013).

This study adopted multiple approaches in determining the number of factors to retain namely; percentage (%) of variance i.e. above 50% Williams *et al.*, (2010 p.6), Kaiser criterion i.e. retain latent factors with eigenvalues above 1.0 (Azevedo *et al.*, 2019; Yong and Pearce 2013), and scree test (Yong and Pearce 2013). The scree tests results for variables from the measurement instrument on governance and policy drivers of spatial transformation in the City of Polokwane are shown in figure 8.2.

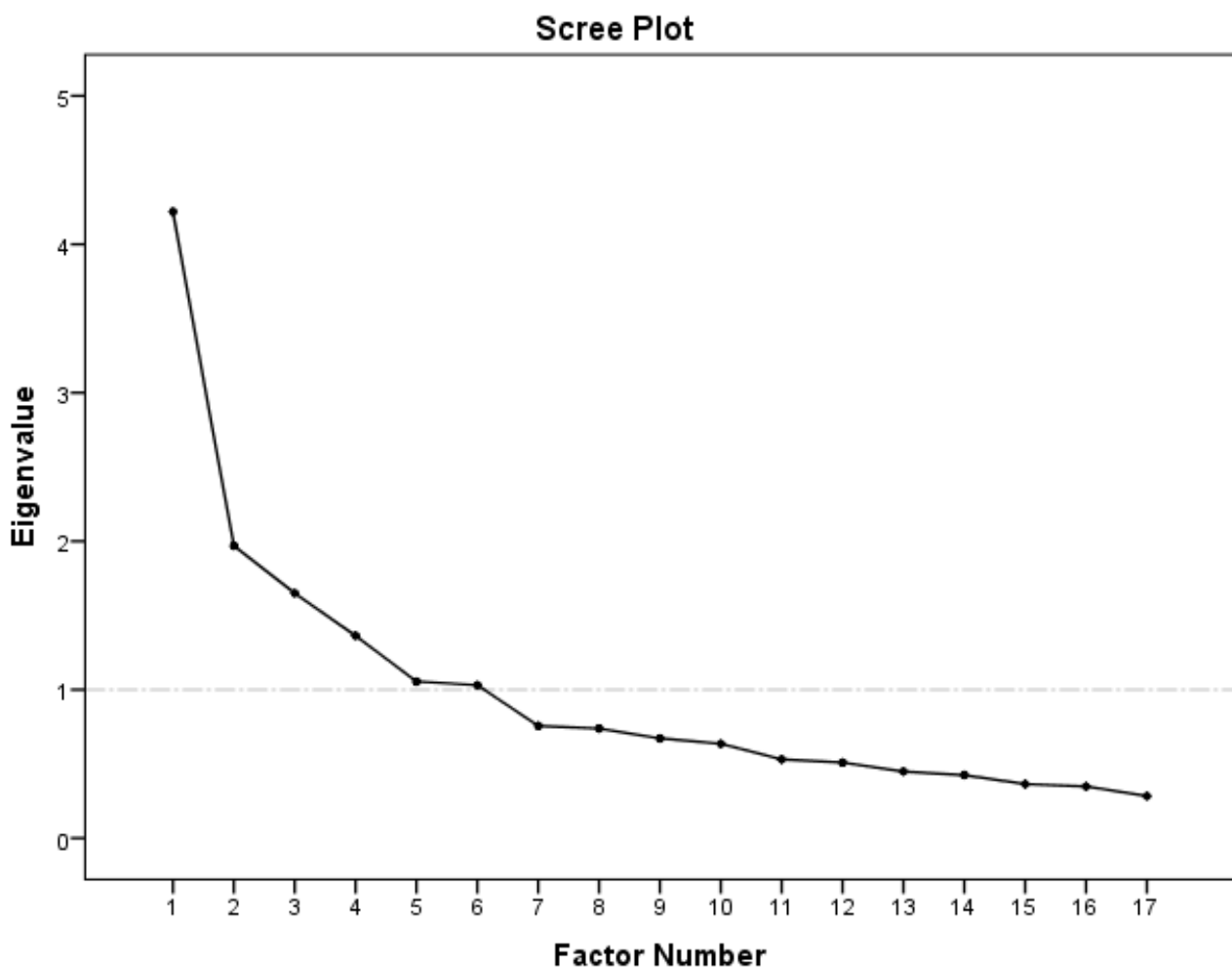


Figure 8.2: Scree plot variables on governance and policy drivers of spatial transformation

Source: Author, 2019

Figure 8.2 depicts supporting evidence that the measurement scale used has a six-factor solution that explain the analysis of the problem on governance and policy drivers of spatial transformation in the City of Polokwane. These underlying six factors are summarised in table 8.4.

Table 8.4: Categorizing governance and policy factors driving spatial transformation

Factor no.	Factor name	% of variance	Related variables
1	Governance processes	24.82	Drivers.ST-GP5.Uncontrolled movement of people in to the area after apartheid Drivers.ST-GP6.Government spending on construction of roads Drivers.ST-GP7.Government spending on housing construction Drivers.ST-GP8.Municipality decision making processes
2	Development directions	11.58	Drivers.ST-GP9.National government development directives Drivers.ST-GP10.Provincial government development directives Drivers.ST-GP11.Polokwane municipality development directives Drivers.ST-GP12.Uncontrolled allocation of land
3	Political and community Influence	9.70	Drivers.ST-GP15.Political organizations giving people land to build Drivers.ST-GP16.Community based organizations controlling land development Drivers.ST-GP17.Land restitution
4	Development control	8.02	Drivers.ST-GP13.Government authority to direct development Drivers.ST-GP14.Implementation of land use policies
5	Land tenure system, and land use	6.20	Drivers.ST-GP1.Government control on land ownership Drivers.ST-GP2.Control by municipality on how land is used
6	Traditional authorities and land markets	6.06	Drivers.ST-GP3.Traditional authorities allowing unplanned land development Drivers.ST-GP4.Land markets favour the rich

Source: Author, 2019

Table 8.4 shows that the 17 variables were reduced into 6 latent factors namely: governance processes; development directions; political and community influence; development control; land tenure system and land use; traditional authorities and land markets. These extracted latent factors are presented using the mathematical model (4.1) in relation to measured variables as follows;

$$Y_i = b_1X_{1i} + b_2X_{2i} + \dots + b_nX_{ni} + \varepsilon_i \quad 8.1$$

$$1. \text{Governance processes}_i = 0.438\text{Drivers.STGP5}_i + 0.646\text{Drivers.STGP6}_i + 0.729\text{Drivers.STGP7}_i + 0.627\text{Drivers.STGP8}_i + \varepsilon_i$$

$$2. \text{Development directions}_i = 0.516\text{Drivers.STGP9}_i + 0.597\text{Drivers.STGP10}_i + 0.634\text{Drivers.STGP11}_i + 0.644\text{Drivers.STGP12}_i + \varepsilon_i$$

$$3. \text{Political and community influence}_i = 0.554\text{Drivers.STGP15}_i + 0.924\text{Drivers.STGP16}_i + 0.515\text{Drivers.STGP17}_i + \varepsilon_i$$

$$4. \text{Development control}_i = 0.506\text{Drivers.STGP13}_i + 0.790\text{Drivers.STGP14}_i + \varepsilon_i$$

$$5. \text{Land tenure system, and land use}_i = 0.796\text{Drivers.STGP1}_i + 0.578\text{Drivers.STGP2}_i + \varepsilon_i$$

$$6. \text{Traditional authorities \& land markets}_i = 0.486 \text{Drivers.STGP3}_i + 0.587 \text{Drivers.STGP4}_i + \varepsilon_i$$

8.2.1 Governance processes

The notion of spatial justice theory as pointed out by (Dikec's 2001 p.1792), provides a theoretical lens substantiating that governance systems, processes are responsible for driving spatial transformation whether just or unjust. This implies that government processes on planning, financing and management matters underpinned by political ideologies drives spatial transformation in cities. In support of this, a case study reviewed shows the government's annexation of surrounding areas, suburbs, industrial sites, and its support for the Hobrecht's master plan, drove spatial transformation of the city structure of Berlin (Arandelovic and Bogunovich 2014 p.2). In addition to this, lack of political support arising from the differing views from spheres of government influenced the path of spatial transformation in Auckland New Zealand. The central government had differing views on the Auckland Plan that favoured compact cities in favour of the citizen preferences of suburban developments leading to sprawling of the city.

Similarly, spatial transformation governance processes in cities is intertwined with the various spheres of government in South Africa. In particular, decisions made by the central government also drives spatial transformation in the City of Polokwane. This, can be witnessed from the post-apartheid government decision on municipal boundary redetermination through the MDB, to redress the spatial injustices on segregation of homeland areas as presented in figure 7.13. To add on, Polokwane (IRPTSO P 2014 p.x) cites that the South African Cabinet approved the Public Transport Strategy in 2007, with Polokwane selected as one of the cities mandated to develop the IRPTNs. Furthermore, then Department of Local Government and Housing, development plans on eradication of all informal settlements in South African cities also contributed to spatial transformation. Funds are being continuously made available through different government programmes to develop housing units in order to facilitate spatial transformation in the city. For example, in 2005/06 a budget was made available to the City for the development of 1000 BNG housing units among other social housing programmes (Polokwane 2006). In addition other funding at the disposal of the municipality for social housing development to facilitate spatial transformation from other spheres of government include Restructuring Capital Grant (RCG) administered by Social Housing Regulatory Authority (SHRA) for social housing development (Polokwane 2020 p.117).

Putting all these together, these findings suggest that spatial transformation in the City of Polokwane is also attributed to governance processes influencing planning, financing and

management of the City. This effort is aimed at addressing apartheid spatial planning legacies of injustices, spatial segregation among others. To ensure this, the various initiatives involving other spheres of government identified include, boundary redetermination, land development objectives, corridor developments, housing funding, development of BRT system among others and most recently piloting of the 2016 Integrated Urban Development Framework.

8.2.2 Development directions.

In the lens of spatial justice theory (Pirie 1983 p.470), spatial triad on production of space (Lefebvre 1991 p.38), and theory of change (ToC) Paina *et al.*, (2017 p.31), it is viewed that social conditions which are undesired in space warrants the formulation of development directions to address the undesired societal issues. The case study reviews on Curitiba Brazil and Hangzhou China demonstrated how development directions led to successful spatial transformation in these cities. Similarly, just like any other city in South Africa, the City of Polokwane was planned embedded in apartheid unjust spatial segregation ideologies. Hence, the post-apartheid political and democratic governance system in South Africa, by extension City of Polokwane put forward normative principles and development directions to address entrenched spatial injustices from apartheid planning ideologies.

Abrahams (2017 p.5) reiterates that policy development directions are key drivers of spatial transformation. In support of this, Chapter 6 provides a broader narrative on the legislative policy development directions on spatial transformation in the City of Polokwane. Furthermore, a key informant supported this stating that,

“the city has been transforming following the available policies,” (Key informant: Municipal Official).

In view of theory of change (ToC) and representation of space, development directions presented in chapter 6, provides visualizations on typical examples of conceptualized desired spatial transformation plans, maps for the City of Polokwane. Particular examples of the legislative policy development directions for the city are evidenced in; figure 6.5 which presents the identified 8 strategic development areas (SDA's) and 4 potential development areas (PDA's); figure 6.7 showing the urban edge, fringe and future development areas and figure 6.10 presents the development corridors (DC's) and functional development areas (FDA's). A key informant reiterated that Polokwane is one of the municipalities in Limpopo province, amongst other provinces in South Africa;

“that embraced DFA to facilitate redress of apartheid spatial segregation legacy” (Key informant: Consultant).

Abrahams (2017 p.23) concurs with this, reiterating that Polokwane municipality embraced the development directions of DFA and its LDO's. This implies that the development directions are strong drivers of spatial transformation of the built-up areas within the City of Polokwane as presented in figure 7.14. This suggests that development directions plays a pivotal role in driving spatial transformation and development trajectory across all scales of cities.

8.2.3 Political and community influence

According to Anderson and Holloway (2020 p.190) discourse analysis theory, refers to 'action' taken, particularly spatial transformation as a motivation by political interests, ideologies and other power relations. Similarly, the case study of Harare Zimbabwe, substantiates that political and community organizations play a pivotal role in driving spatial transformation. In particular, the political programs in the 2000s that disregarded planning systems by influencing spatial transformation include Fast Track Land Reform Programme (FTLRP), and various housing cooperatives that mushroomed (Muchadenyika and Williams 2017 p.34).

However in the case of Polokwane, the level at which community organizations drive spatial transformation does not compare to that experienced in Harare, Zimbabwe. The DRDLR (2019 p.2) in its media statement pointed out that Seshego Land Claims Committee was granted Jansenpark 1136 LS portion 20 and 21 (42ha) of housing development land in 2013 through the programme called Pro-Active Land Acquisition Strategy (PLAS). They got the land despite missing the 1998 cut-off date, attributed to the government commitment to reduce spatial injustices and its manifestation in housing backlog. This implies that the level at which political and community influences spatial transformation differs with city's development context.

In another perspective the politics influences RDP policy document on spatial transformation. Leadership ideology positively drive spatial transformation pattern, for instance the pattern of spatial segregation evidenced in SA cities, including Polokwane in particular was an apartheid engineered vision of the then leadership. Similarly, the resultant post-apartheid spatial transformation in the City of Polokwane also relates to the political ideology of ANC on redressing apartheid struggles by implementation of DFA normative planning principles.

8.2.4 Development control

In the lens of Lefebvre (1991 p.38) the production and reproduction of space in society is driven by spatial practices a third pillar of the spatial triad. The spatial practices are viewed as the material, physical developments, and daily routines (Campbell 2018 p.e27; Leary-Owhin 2015 p.3) that result from development controls in the city. Similarly, the case study review on Curitiba Brazil, provides a narrative on how development control leveraging on transit-oriented development (TOD) and bus rapid transit (BRT) system resulted in successfully driving spatial transformation of the city's materiality and spatial structure overtime. In line with this

perspective, the spatial transformations in the City of Polokwane narrated in chapter 8 have been driven by development controls discussed in chapter 6. In particular the overarching legislative policy frameworks that provided directions for development control include the DFA and LDO, BNG, SDF's, local development frameworks, IDP's, Town Planning Ordinance, Polokwane/Perskebult Town Planning Scheme 2007 (reviewed 2017) which encompass information relevant to regulate development such as land use zone classes and permitted density among other controls. Thus development control has also been a contributing driver guiding the witnessed spatial transformation such as increased development of retail facilities across the city, changes in the built-up areas in figure 7.14, settlement model changes figure 7.19 and population distribution and density changes in figure 7.20 among others.

On the contrary, the land use scheme for Polokwane did not cover the wider geographical area of the municipality, an unjust negation of the rural areas in planning systems. Polokwane (2016, p. 87); Polokwane (2008 p.74) supports this stating that "land use schemes are not applicable to all areas." Discourse analysis of policy frameworks substantiates this revealing that the LUS covering all the areas (Mankweng, Sebayeng and other rural areas), is dated 2012 and was revised in 2017. Despite being historically excluded from land use management scheme (LUMS), some of the dense settlements in rural areas under the traditional authority experienced intensive spatial transformation, particularly surroundings of Mankweng, (refer to figure 7.19, and figure 7.23). In the context of complexity theory, this entails that cities are complex systems that not only experience spatial transformation driven by the municipal role as the main arbiter of development control. However, the interaction between agents within the City also drive spatial transformation resulting in the emergent spatial changes witnessed in the rural areas. In particular the spatial composition of Polokwane reveals that 71% of the land is rural compared to 23% urban land (Polokwane 2020 p.74). This denotes that action by other agents such as the traditional authorities of providing land for development also drives spatial transformation. Therefore this suggests that in proclaimed areas development control measures implemented by the City's officials drive spatial transformation, and that within the un-proclaimed areas, the interactions of other city's agents such as the traditional authorities in the rural areas also drive spatial transformation in cities. In another perspective, this scenario implies an unjust spatial planning processes that seclude other areas from benefiting from development control within the same municipal area.

8.2.5 Land tenure system and land use

Guzman *et al.*, (2016 p.4); Winkler *et al.*, (2012 p.1) posit that the theoretical view of spatial turn theory, propounds the need for having an open mind beyond the realities we see. This assists in finding any other available explanations that help deepen the understanding of space, particularly drivers of spatial transformation in the context of this study. In line with this

view, land tenure system can also be viewed as a driver of spatial transformation. In particular the case study review on Harare, Zimbabwe, pointed that the Fast Track Land Reform Programme (FTLRP) in the 2000s resulted in land tenure reforms and redistribution of land from the white colonialists (Muchadenyika and Williams 2017 p.35). This initiative proved to be a significant driver of spatial transformation regardless of being desirable or not, the spatial landscape of the city changed. Similarly, the land reform programme in South Africa is also driving spatial transformation through land redistribution and reforms on land tenure. In line with this perspective, a typical example in this study is the land between Seshego and Polokwane referred as the strategic development area (SDA) 1. In this area blacks were forcefully dispossessed off their land, particularly from New Pietersburg area into the homeland Seshego township (Donaldson p.2001). Polokwane 2007 SDA1 (p.32) adds that in post-apartheid era the land in question here, was then transferred to the municipality, forming part of land claims and land tenure reforms. This is echoed in figure 6.8 showing that large share of then white farm land between Seshego and Polokwane is public owned. Consequently, this area has also experienced extensive spatial transformation leading to spatial integration of these areas (Cloete and Massey 2017 p.152). These results suggest that land tenure system drives spatial transformation. The land use was changed from apartheid agricultural farming land to post apartheid residential land use activities leading to the successful spatial integration as outlined in the spatial transformation directions in chapter 6.

8.2.6 Traditional authorities and land markets

In view of complexity theory Alberti *et al.*, (2018 p.47), argue that cities are complex systems, comprise of agents that make decisions and whose interactions with economic markets and other social networks result in the emergent spatial transformations. Similarly, on one hand approximately 71% of land in the City of Polokwane is considered rural falling under the governance process of customary administration by traditional authorities (Polokwane 2020 p.74; Abrahams 2017 p.4). These tribal authorities act as agents of change, they make decisions that drive spatial transformation. In support of this figure 7.23 evidences extensive spatial transformation traditional rural areas around Mankweng and Perskebult driven by land allocation of tribal authorities. Abrahams (2017 p.6), echoes that tribal authorities are responsible for allocation and management of land in their areas leading to spatial transformation in these areas.

On the other hand, land markets from the interactions of agents within the City also drive the resultant emergent spatial transformations evidenced in the City of Polokwane. In support of this, a key informant also pointed out that;

“..land is cheaper in the rural areas outside the city, compared to inside the city, and people are building big houses there, then drive to work less than 30km to town” (Key informant: Municipal Official).

This suggests that interactions of agents and land markets drives spatial transformation.

8.3 Spatial characteristics/ biophysical factors driving spatial transformation

To determine spatial characteristics / biophysical drivers of spatial transformation in the City of Polokwane, exploratory factor analysis (EFA) was employed. The results for the correlation coefficient matrix for the 9 items that were used in the questionnaire measurement instrument are presented in table 8.5.

Table 8.5: Correlation matrix on variables on spatial characteristics/biophysical drivers of spatial transformation

Correlation Matrix ^a									
	1.	2.	3.	4.	5.	6.	7.	8.	9.
Correlation	Drivers.ST-SCBF1.	1.000							
	Drivers.ST-SCBF2.	.383	1.000						
	Drivers.ST-SCBF3.	.304	.474	1.000					
	Drivers.ST-SCBF4.	.225	.383	.543	1.000				
	Drivers.ST-SCBF5.	.190	.248	.408	.530	1.000			
	Drivers.ST-SCBF6.	.132	.110	.208	.279	.460	1.000		
	Drivers.ST-SCBF7.	.088	.163	.281	.176	.331	.418	1.000	
	Drivers.ST-SCBF8.	.148	.170	.221	.221	.295	.325	.448	1.000
	Drivers.ST-SCBF9.	.138	.165	.063	.209	.176	.082	.245	.461

a. Determinant = .102

Source: Author, 2019

In assessing the problems of multicollinearity the study followed rules highlighted in a study by Ashehri (2012) and augmented by checking the computed determinant score i.e. rule of thumb for absence of multicollinearity >0.00001 . Table 8.5 shows that the determinant score is 0.102, which is greater than the suggested rule of thumb score. Therefore, the variables seems to have a patterned relationship and there is the absence of multicollinearity problem.

The factorability of output matrix, was scrutinized using the statistical procedures, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity as highlighted in a study by Bai, Hira and Deshpande (2016). The results for these two statistical procedures are presented in table 8.6.

Table 8.6: KMO and Bartlett's Test

Kaiser-Meyer-Olkin MSA.		.751
Bartlett's Test of Sphericity	Approx. Chi-Square	1021.023
	df	36
	Sig.	.000

Source: Author, 2019

The results presented in table 8.6 shows that, computed KMO statistic 0.751, is greater than 0.50 recommended in a study by Lin and Wu (2016), indicating sampling adequacy. The computed statistic for Bartlett's test of sphericity, Approx. Chi-square $\chi^2 = 1021.023$, (df) 36, Sig. value is statistically significant (less than 0.05) at $p < 0.001$, demonstrating that R-matrix is not an identity matrix. In view of Field (2009; 2013), these results indicates that variables included in this analysis have adequate relationships for EFA as distinct and reliable factors can be yielded that are useful in determining the spatial characteristics/biophysical factors driving spatial transformation in the City of Polokwane. The computed factor analysis output for variables on spatial characteristics/biophysical factors driving spatial transformation is presented in table 8.7.

Table 8.7: Rotated Factor Matrix^a spatial characteristics/biophysical drivers of spatial transformation

Variable on spatial characteristics/biophysical drivers of spatial transformation	Factor		
	1	2	3
Drivers.ST-SCBF2.Availability of vacant developable land within the area	.683		
Drivers.ST-SCBF3.The area is flat, easy for development	.672		
Drivers.ST-SCBF4.Underdeveloped land open for infill developments	.581		
Drivers.ST-SCBF1.The area is good for building	.445		
Drivers.ST-SCBF6.Soil condition is good for building		.659	
Drivers.ST-SCBF5.Natural environment makes the area good to live in		.638	
Drivers.ST-SCBF7.Availability of natural resources and drainage patterns		.452	
Drivers.ST-SCBF8.Weather and climate is good in this area,			.767
Drivers.ST-SCBF9.The air quality is good in this area,			.554
Eigenvalues	3.217	1.400	1.100
Cumulative %	35.75	51.31	63.53

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 5 iterations. Factor loading less than 0.40 are not shown*

Source: Author, 2019

Table 8.7 presents the factor loadings of the 9 variables from the measurement instrument on spatial characteristics/biophysical factors driving spatial transformation in the City of Polokwane. These results show that all 9 variables included in the measurement instrument

are of practical significance, because the factor loading values for all the variable exceeded 0.40 as recommended by Field (2009; 2013).

This study adopted multiple approaches in determining the number of factors to retain namely; percentage (%) of variance i.e. above 50% Williams *et al.*, (2010 p.6), Kaiser criterion i.e. retain latent factors with eigenvalues above 1.0 (Azevedo *et al.*, 2019; Yong and Pearce 2013), and scree test (Yong and Pearce 2013). The scree tests results for variables from the measurement instrument on spatial characteristics/biophysical factors driving spatial transformation in the City of Polokwane are shown in figure 8.3.

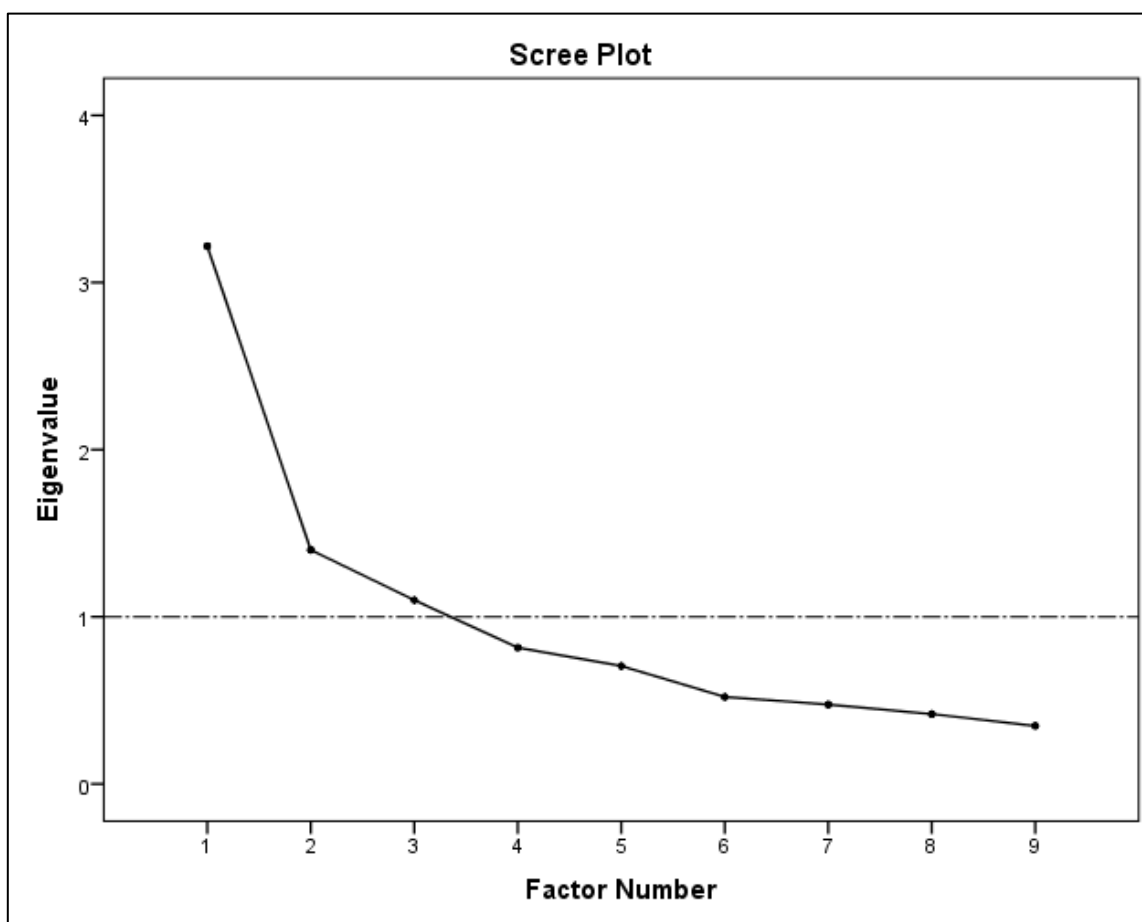


Figure 8.3: Scree plot factors on spatial characteristics/biophysical drivers of spatial transformation

Source: Author, 2019

Figure 8.3 depicts supporting evidence that the measurement scale used has a three-factor solution that explain the analysis problem on spatial characteristics/biophysical factors driving spatial transformation in the City of Polokwane. These underlying three factors are summarised in table 8.8.

Table 8.8: Categorizing spatial characteristics/biophysical drivers of spatial transformation

Factor no.	Factor name	% of variance	variables
1	Availability of land conducive for development	35.75	Drivers.ST-SCBF2.Availability of vacant developable land within the area Drivers.ST-SCBF3.The area is flat, easy for development Drivers.ST-SCBF4.Underdeveloped land open for infill developments Drivers.ST-SCBF1.The area is good for building
2	Good living environment	15.56	Drivers.ST-SCBF6.Soil condition is good for building Drivers.ST-SCBF5.Natural environment makes the area good to live in Drivers.ST-SCBF7.Availability of natural resources and drainage patterns
3	Good weather	12.22	Drivers.ST-SCBF8.Weather and climate is good in this area, Drivers.ST-SCBF9.The air quality is good in this area,

Source: Author, 2019

Table 8.8 shows that the 9 variables were reduced into three factors namely: availability of land for development; good living environment; and good weather. These extracted latent factors are presented using the mathematical model (4.1) in relation to measured variables as follows;

$$Y_i = b_1X_{1i} + b_2X_{2i} + \dots + b_nX_{ni} + \varepsilon_i \quad 8.2$$

$$1. \text{Availability of land conducive for development}_i = 0.683\text{Drivers.STS_CBF2}_i + 0.672\text{Drivers.ST_SCBF3}_i + 0.581\text{Drivers.ST_SCBF4}_i + 0.445\text{Drivers.ST_SCBF1}_i + \varepsilon_i$$

$$2. \text{Good living environment}_i = 0.659\text{Drivers.ST_SCBF6}_i + 0.638\text{Drivers.ST_SCBF5}_i + 0.452\text{Drivers.ST_SCFB7}_i + \varepsilon_i$$

$$3. \text{Good weather}_i = 0.767\text{Drivers.ST_SCBF8}_i + 0.554\text{Drivers.ST_SCBF9}_i + \varepsilon_i$$

In view of spatial turn theory, Winkler *et al.*, (2012 p.1) posit that critical analysis of space, particularly drivers of spatial transformation in the context of this study requires giving attention to the neglected categories of 'spatiality' i.e., geographical and physical spaces. In line with this perspective, this section discusses the spatial/ biophysical characteristics driving spatial transformation in the City of Polokwane.

8.3.1 Availability of land conducive for development

The case study review, attests that early 1920s spatial transformation in Berlin Germany was driven by the potential availability of land conducive for further developments, leading to amalgamation of agricultural land, forests, water bodies and then small towns into a broader city (Arandelovic and Bogunovich 2014 p.4). Similarly, availability of land and its suitability for development of human settlements is also driving spatial transformation in the City of Polokwane, as presented in figure 8.4.

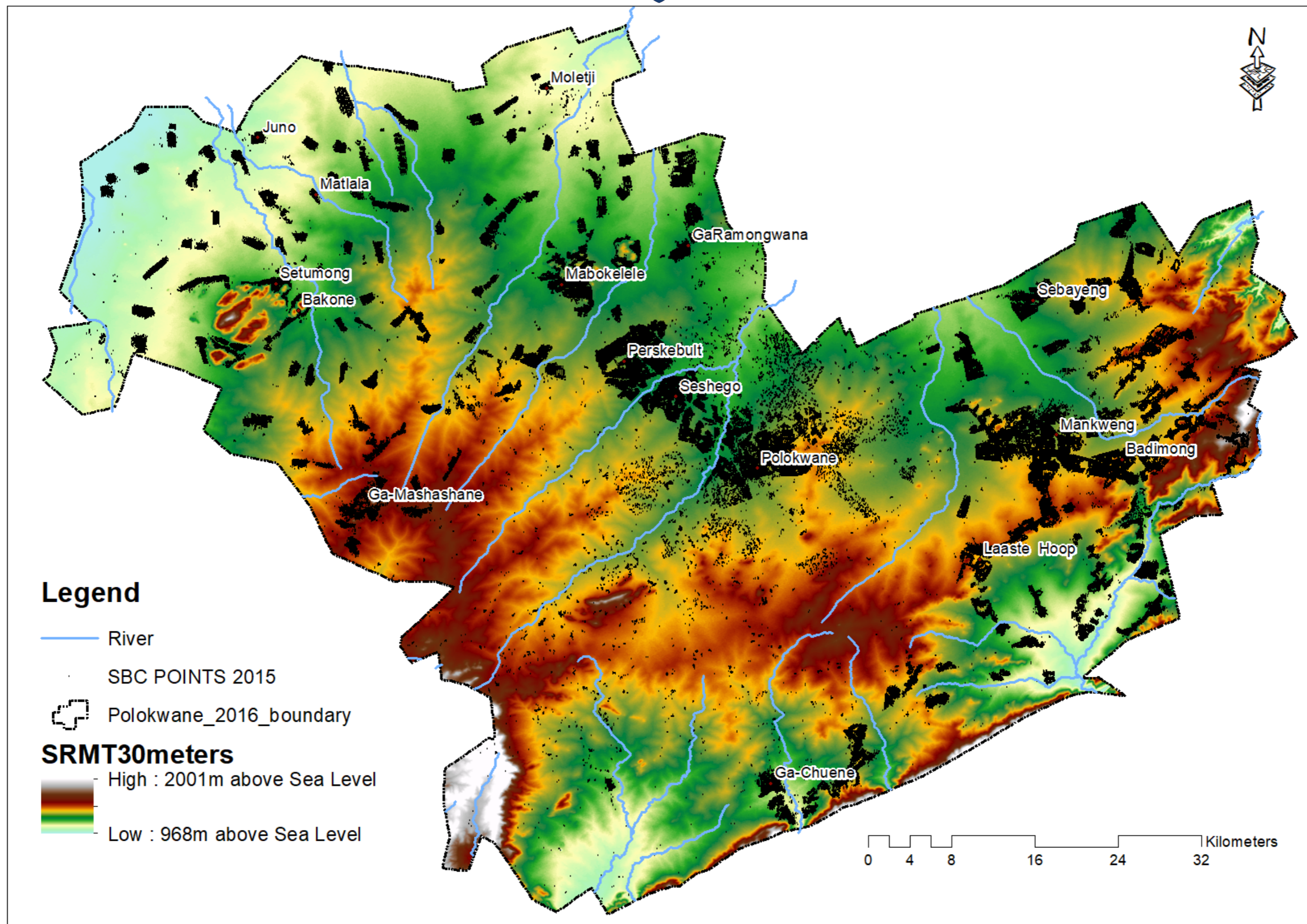


Figure 8.4: Topographic elevation driving spatial transformation in the City of Polokwane

Source Author, 2020

The digital elevation data in figure 8.4, for City of Polokwane substantiates that the topography of an area drives spatial transformation. It is evident that settlements developed in relatively flat to undulating areas closer to the altitude of 968m. Whereas mountainous areas with an altitude closer to 2001m above sea level, do not have considerable settlements as substantiated by the SBC points for the year 2015. Polokwane SDF (2010 p.15), supports this pointing out that the City is divided into 'moderately undulating and strong undulating plains', bordered by rugged mountainous terrains namely; Strydpoort mountains in the south; Great Escarpment to the east and Waterberg mountains to the west and north areas. In addition to this, Polokwane (Sebayeng framework 2013 p.17) echoes that biophysical considerations are always considered in providing directions for spatial transformation. In support of this, figure 6.7 shows the example of strategic development areas 1, 2 and 3, where environmental assessment was conducted and reported that the physical environment is highly suitable for development following the form giving biophysical elements in the areas (SDA1 2007 p.34, Polokwane SDA3 2007 p.20). This suggests that availability of land with biophysical characteristics that are conducive for development drives spatial transformation.

8.3.2 Good living environment

The living environment comprises of both the natural and built environment whose functioning drives spatial transformation of human settlements be it sustainable or not. EuroStat (2019), posit that the natural and living environment is a crucial dimension, on quality of life which indirectly influences the nature of spatial transformation in cities. A good living environment is viewed as an area with assets that are essential for meeting basic needs and better living conditions such as water resources, land, forests among others. Similarly, these characteristics of a good living environment contributed to the decision of amalgamation of settlements which led to spatial transformation of the small towns forming Greater Berlin Germany (Arandelovic and Bogunovich 2014 p.2). In line with this perspective, the Strydpoort mountain areas south of Polokwane, forms part of the watershed supplying water to resources to the Sand River and Olifants (Polokwane SDF 2010 p.15), making the Pietersburg Plateau a favourable area for establishment of human settlements. In another perspective, the example of SDA1 is viewed as being low impact zone with good soil condition and development of human settlements do not have a significant impact on the natural environment (Polokwane SDA1 2007 p.36). Overall, this implies good living environment drives spatial transformation, affording people good quality of life.

8.3.3 Good weather

UN (1986 p.20), echoes that, that meteorological conditions influences the strategic planning of cities. Polokwane is also viewed as having delightful weather conditions, its lying in the

summer rainfall region with warm climate i.e. its mostly sunny weather, day temperature ranges between 28,1°C to highest recording of 36,8°C (Polokwane SDF 2010 p.15).

This favourable climate for human habitation is also attributed to the good microclimate in the broader municipal area, such as vegetation and topography. In support of this, the municipality was given an award in 2017 for being the overall winner of Greenest Municipality Competition (GMC) in the category of local municipalities in South Africa (Capricorn District Municipality (CDM) 2017). The competition considers various dimensions amongst them include the component on, landscaping, trees and beautification, which also impact on the microclimate of an area. In addition to this, Polokwane (2020 p.766) boasts that the continuously, improving physical environmental conditions of the City continues to attract people into the City”. This suggests that the favourable climatic conditions of the City also drives spatial transformation. A key informant, reiterated this stating that there is a reason why settlements are established in certain places, for example in Polokwane such reasons include;

“... wind direction, do not affect health... when its winter is not that cold, sunny area...” (Key informant: HDA).

This implies that a place with good atmospheric conditions is likely viewed as the best place people would want to live in, consequently pulls more people which drives spatial transformation.

8.4 Social and cultural drivers of spatial transformation

To analyse social and cultural norms driving spatial transformation in the City of Polokwane, exploratory factor analysis (EFA) was employed. The results for the correlation coefficient matrix for the 13 items that were used in the questionnaire measurement instrument are presented in table 8.9.

Table 8.9: Correlation matrix^a on variables on social and cultural norms driving spatial transformation

	1	2	3	4	5	6	7	8	9	10	11	12	13
Drivers.ST-S&CN1.	1.000												
Drivers.ST-S&CN2.	.473	1.000											
Drivers.ST-S&CN3.	.466	.596	1.000										
Drivers.ST-S&CN4.	.310	.329	.523	1.000									
Drivers.ST-S&CN5.	.336	.379	.434	.430	1.000								
Drivers.ST-S&CN6.	.174	.199	.301	.434	.505	1.000							
Drivers.ST-S&CN7.	.206	.260	.324	.258	.376	.471	1.000						
Drivers.ST-S&CN8.	.253	.209	.279	.275	.318	.374	.483	1.000					
Drivers.ST-S&CN9.	.219	.194	.122	.148	.234	.308	.403	.497	1.000				
Drivers.ST-S&CN10.	.195	.152	.204	.236	.163	.227	.304	.440	.531	1.000			
Drivers.ST-S&CN11.	.277	.248	.201	.172	.287	.231	.300	.398	.438	.551	1.000		
Drivers.ST-S&CN12.	.138	.165	.086	.089	.193	.194	.221	.293	.231	.363	.450	1.000	
Drivers.ST-S&CN13.	.007	.118	.027	-.067	.110	.126	.180	.161	.277	.234	.304	.494	1.000

a. Determinant = .012

Source: Author, 2019

In assessing the problems of multicollinearity the study followed rules highlighted in a study by Ashehri (2012) and augmented by checking the computed determinant score i.e. rule of thumb for absence of multicollinearity >0.00001 . Table 8.9 shows that the determinant score is 0.012, which is greater than the suggested rule of thumb score. Therefore, the variables seems to have a patterned relationship and there is the absence of multicollinearity problem.

The factorability of output matrix, was scrutinized using the statistical procedures, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity as highlighted in a study by Bai, Hira and Deshpande (2016). The results for these two statistical procedures are presented in table 8.10.

Table 8.10: KMO and Bartlett's Test

Kaiser-Meyer-Olkin MSA.		.827
Bartlett's Test of Sphericity	Approx. Chi-Square	1775.973
	df	78
	Sig.	.000

Source: Author, 2019

The results presented in table 8.10 shows that, computed KMO statistic 0.827, is greater than 0.50 recommended in a study by Lin and Wu (2016), indicating sampling adequacy. The computed statistic for Bartlett's test of sphericity, Approx. Chi-square $\chi^2 = 1775.973$, (df) 78, Sig. value is statistically significant (less than 0.05) at $p < 0.001$, demonstrating that R-matrix is not an identity matrix. The reproduced correlations matrix was also assessed to check the residuals that were computed between observed and reproduced correlations, there were 5 (6.0%) nonredundant residuals with absolute values greater than 0.5, which is below the accepted value of $<50\%$ (Field 2009). The computed anti-image matrix^a showed that the diagonal values of individual variables KMO ranged between 0.691^a to 0.869^a, which is above the recommended of 0.5. In view of Field (2009; 2013), these results indicates that variables included in this analysis have adequate relationships for EFA as distinct and reliable factors can be yielded that are useful in determining social and cultural drivers of spatial transformation in the City of Polokwane. The computed factor analysis output for variables on social and cultural drivers of spatial transformation is presented in table 8.11.

Table 8.11: Rotated Factor Matrix^a social and cultural norms driving spatial transformation

	Factor			
	1	2	3	4
Drivers.ST-S&CN3.People moved from other towns and cities to Polokwane city	.776			
Drivers.ST-S&CN2.Natural increase of population in the city	.713			
Drivers.ST-S&CN1.People moved from rural areas to Polokwane city	.590			
Drivers.ST-S&CN4.People prefer to live in this area of the city	.463			
Drivers.ST-S&CN10.Controlled developments by community organizations		.704		
Drivers.ST-S&CN9.Influence of the public attract people to this area		.676		
Drivers.ST-S&CN8.This area is closer to employment opportunities		.570		
Drivers.ST-S&CN11.Availability of social amenities such as churches in this area		.557		
Drivers.ST-S&CN6.This place is located in a good environment			.795	
Drivers.ST-S&CN5.Presence of religious institutions such as churches			.520	
Drivers.ST-S&CN7.This area is affordable because of the money people can get			.467	
Drivers.ST-S&CN12.Housing development by the government				.681
Drivers.ST-S&CN13.This city is safe than other cities				.657
Eigenvalues	4.468	1.921	1.172	1.003
Cumulative percentage variance	34.37	49.15	58.17	65.88

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations. Factor loading less than 0.42 are not shown

Source: Author, 2019

Table 8.11 presents the factor loadings of the 13 variables from the measurement instrument on social and cultural drivers of spatial transformation in the City of Polokwane. These results show that all 13 variables included in the measurement instrument are of practical significance, because the factor loading values for all the variable exceeded 0.40 as recommended by Field (2009; 2013).

This study adopted multiple approaches in determining the number of factors to retain namely; percentage (%) of variance i.e. above 50% Williams *et al.*, (2010 p.6), Kaiser criterion i.e. retain latent factors with eigenvalues above 1.0 (Azevedo *et al.*, 2019; Yong and Pearce 2013), and scree test (Yong and Pearce 2013). The scree tests results for variables from the measurement instrument on spatial characteristics/biophysical factors driving spatial transformation in the City of Polokwane are shown in figure 8.5.

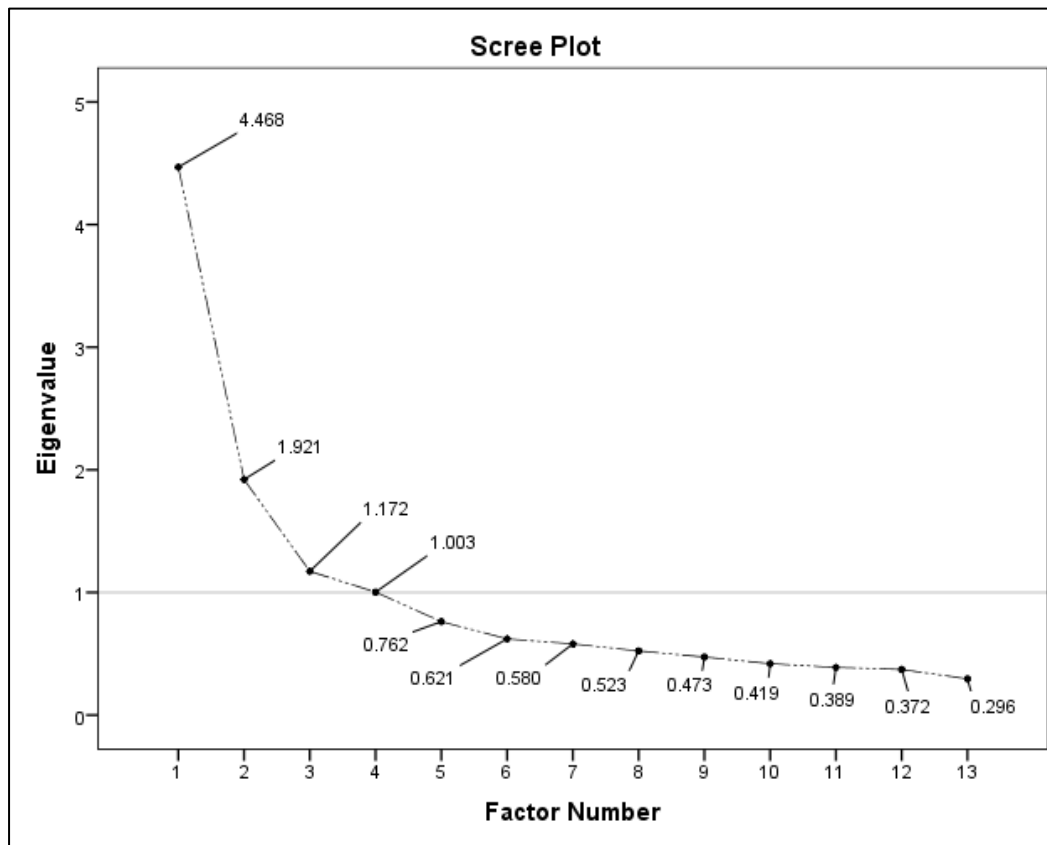


Figure 8.5: Scree plot factors on social and cultural drivers of spatial transformation

Source: Author, 2019

Figure 8.5 depicts supporting evidence that the measurement scale used has four-factor solution that explain the analysis problem on social and cultural drivers of spatial transformation in the City of Polokwane. These underlying four factors are summarised in table 8.12.

Table 8.12: Categorizing social and cultural drivers of spatial transformation

Factor number	Factor name	% of variance	
1	Urbanization process	34.37	Drivers.ST-S&CN3.People moved from other towns and cities to Polokwane city Drivers.ST-S&CN2.Natural increase of population in the city Drivers.ST-S&CN1.People moved from rural areas to Polokwane city Drivers.ST-S&CN4.People prefer to live in this area of the city
2	Citizen influence, proximity to opportunities and social facilities	14.78	Drivers.ST-S&CN10.Controlled developments by community organizations Drivers.ST-S&CN9.Influence of the public attract people to this area Drivers.ST-S&CN8.This area is closer to employment opportunities Drivers.ST-S&CN11.Availability of social amenities such as schools in this area
3	Personal /cultural preferences	9.02	Drivers.ST-S&CN6.This place is located in a good environment Drivers.ST-S&CN5.Presence of religious institutions such as churches Drivers.ST-S&CN7.This area is affordable because of the money people can get
4	Housing development and safety	7.71	Drivers.ST-S&CN12.Housing development by the government Drivers.ST-S&CN13.This city is safe than other cities

Source: Author, 2019

Table 8.12 shows that the 13 variables were reduced into four latent factors namely: urbanization process; citizen influence, proximity to opportunities and social facilities; personal /cultural preferences; housing development and safety. These extracted latent factors are presented using the mathematical model (4.1) in relation to measured variables as follows;

$$Y_i = b_1X_{1i} + b_2X_{2i} + \dots + b_nX_{ni} + \varepsilon_i \quad 8.3$$

$$1. \text{Urbanization process}_i = 0.776\text{Drivers.ST_S\&CN3}_i + 0.713\text{Drivers.ST_S\&CN2}_i + 0.590\text{Drivers.ST}_s\&\text{CN1}_i + 0.463\text{Drivers.ST_S\&CNP4}_i + \varepsilon_i$$

$$2. \text{Citizen influence, proximity to opportunities and social facilities}_i = 0.704\text{Drivers.ST_S\&CN10}_i + 0.676\text{Drivers.ST_S\&CN9}_i + 0.570\text{Drivers.ST_S\&CN8}_i + 0.557\text{Drivers.ST_S\&CN11}_i + \varepsilon_i$$

$$3. \text{Personal /cultural preferences}_i = 0.795\text{Drivers.ST_S\&CN6}_i + 0.520\text{Drivers.ST_S\&CN5}_i + 0.467\text{Drivers.ST_S\&CN7}_i + \varepsilon_i$$

$$4. \text{Housing development and safety control}_i = 0.681\text{Drivers.ST_S\&CN12}_i + 0.657\text{Drivers.ST_S\&CN13}_i + \varepsilon_i$$

Cities are contested territories with multiple meanings, and interpretations to different groups of people. The right to the city theory provides a lens of understanding the production, reproduction of space as a manifestation of spatial transformation in the City of Polokwane. Spatial transformation towards the desired city is expected to incorporate principles, such as the societal norms needed to develop human potentials and capabilities to meet their needs such as housing. Similarly, social and cultural norms are also driving spatial transformation in the City of Polokwane towards the desired future city by the citizens. This also entails spatial transformation is attributed to the interactions within Lefebvre's (1991 p.38) conception, representational space-lived spaces a pillar of the spatial triad. Which implies spatial transformation in the City of Polokwane as directly imagined, driven, appropriated and lived everyday by citizens following social and cultural norms.

8.4.1 Urbanization process

The narrative from the various case study cities in chapter 3, boldly points out that various scholars (Brushett 2011 p.24; Arandelovic and Bogunovich 2014 p.2; Collins 2010 p.940; Rosario 2016 p.114; Wei 2012 p.397; Muronda 2008 p.37), concurs that spatial transformation is driven by rapid urbanization among other factors. In view of complexity theory, this rapid urbanization is attributed to right to the city, agents of change as part of their everyday life are able to make decisions such as migration from one area to the other. Similarly, intensive

different city scales and stages of growth, in both developed and developing countries is also being driven by rapid urbanization.

8.4.2 Citizen influence, proximity to opportunities and social facilities

The case study review on Auckland New Zealand points out that, the collective attitude and social cohesion of citizens as agents of change in the lived spaces drives spatial transformation (Early *et al.*, 2015 p.223). Similarly, the community also influences spatial transformation in the City of Polokwane through the institutionalized legislative policy requirements for public participation i.e. Municipal Systems Act 2000 sec 17(2); 1996 RSA Constitution Bill of rights. This denotes citizen's right to the City in strategic planning to redress the apartheid legacy of spatial injustices inherent in the City. In particular, key strategic planning policy frameworks providing directions for spatial transformation emanating from collective projects identified through citizen participation are IDPs, Budgets and SDF's among others. In support of this Polokwane (2020 p.29) cites that "we appreciate participation by all stakeholders during various planning stages..." ensuring that spatial transformation initiatives redress the challenges collectively raised by the citizens.

Cities are perceived as having abundant opportunities essential for social development of people which then act as a pull factor for migration leading to population increase and ultimately spatial transformation of the area. In addition to this, availability of social amenities such as tertiary education institutions attracting people all over including international students contributed significantly to spatial transformation in Auckland through studentification (Collins 2010 p.946). In the context of City of Polokwane, during the apartheid era blacks were deprived of having access to social amenities for their personal development and growth. Spatial loosening, a right to the city in the post apartheid era have witnessed increasing population of various age groups in the city. In particular, figure 7.6 shows that the core urban areas have the greatest share of population age group 15-64years (range 37038-74104 people in 2016), who are in the city for access to opportunities and social amenities.

In particular, City of Polokwane as the hub for Limpopo province comprises of various social facilities. In view of right to the city, the available facilities offer an opportunity to redress social justice by attracting people from different regions to get access to such facilities in order to nurture their development, liberating them from poverty. The available social facilities in the city include tertiary education institutions, regional shopping centres, regional medical node, recreation facilities and sports stadiums among others which act as drivers of spatial transformation in the city. In support of this, Polokwane (2020 p.94) states that amongst its development projects as outlined in the policy frameworks, is establishment of student accommodation in response to the spatial transformation pressure resulting from the

education institutions. The major higher education and learning institutions putting pressure in the city are; UNISA Polokwane Campus, Tshwane University of Technology TUT Polokwane Campus, University of Limpopo, Boston City Campus and Business College and Capricorn Further Education and Training (FET) College (Polokwane 2020 p113). These results suggest that the availability of social amenities drives spatial transformation across all city scales, from developed countries i.e. Auckland New Zealand and developing countries i.e. City of Polokwane South Africa.

8.4.3 Personal/cultural preferences

In the perspective of the spatial turn theory, a retrospection on evolution of cities, reveals that the drivers of spatial transformation are also changing. The narrow focus limited to organic evolution, industrialization as witnessed in the past is inadequate, cultural preferences in the contemporary world are also viewed as drivers of spatial transformation in cities. In particular, the case study review, pointed that the cultural preference of residing in family houses with a yard, detached houses and preference on use of private vehicles (77% of the people) is viewed as one of the significant drivers of spatial transformation of Auckland New Zealand (Early *et al.*, 2015 p.44; Salmon 2015 p.27). In the context of City of Polokwane the influence of personal, cultural preferences on spatial transformation is manifold;

Historically the growth of the Jewish community and formation of its congregation for Pietersburg in 1890s influenced spatial transformation in the City (Weiner 2006 p.1). This pattern of cultural and religious influence is still evident in the City in this contemporary era. In support of this, Polokwane (2013 p. 24) points out that the annual Easter event held by Zion Christian Church (ZCC) at its headquarters in Moria, Polokwane each year attracts approximately 3 to 5 million people who are congregants of this church. As part of nurturing this social activity in an area previously spatially segregated in former homeland area, the City has made spatial transformation plans on developing the transport corridor route linking the city centre and Moria, unlocking development opportunities and growth potential in this area.

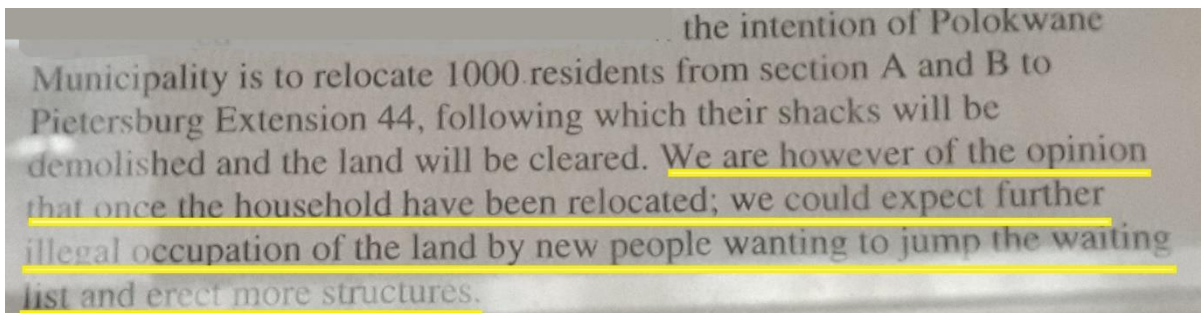
In another perspective, a key informant adds that personal preferences drives spatial transformation in the city stating that,

“if you don't own you can't control what you don't own you will have your SDF plans encouraging social cohesion and spatial justice but then if you don't own land it means it will be a policy but not effective because you can't force a developer to do say middle class housing without their consent” (key informant: Municipal Official).

This also corroborates with the nature of spatial transformation in SDA 2 Iydale agricultural holdings, as illuminated by figures 6.8 public owned land compared to figure 6.11 vacant land

with spatial transformation potential in this area. The spatial transformation revealed by the 2014 built-up areas in figure 7.14 shows that the developmental proposals were executed in public owned land, large share of land in the SDA 2 Ivydale is not yet developed. This implies that the personal preferences of those owning private land also affects the nature of spatial transformation.

To add on, the African Centre for Migration & Society (ACMS) and FIC, (2012 p.17) supports that social and cultural norms drive spatial transformation in the City of Polokwane. It is argued that some citizens in Polokwane strategically settle in informal settlements with the belief that they will be given preference in allocation of RDP houses as presented in box 8.1.



the intention of Polokwane Municipality is to relocate 1000 residents from section A and B to Pietersburg Extension 44, following which their shacks will be demolished and the land will be cleared. We are however of the opinion that once the household have been relocated; we could expect further illegal occupation of the land by new people wanting to jump the waiting list and erect more structures.

Box 8.1: Personal preference on places to stay driving spatial transformation
Source: Adapted from Polokwane (2006)

It's argued that most people allocated to the RDP housing extensions in Polokwane were previously staying in informal settlement (ACMS and FIC 2012 p.17). This is further substantiated by the relocation to Extension 71, of informal settlers in Mashinini a high risk flood area and Tosca city also a high risk area located under electricity power utility lines. These findings suggests that personal preferences by part of the people staying in the informal settlements are linked to the broader idea that they will be allocated the RDP houses first. Putting all these together it is evident that spatial transformation in some parts of City of Polokwane is being driven by the preferences and motives of citizens such as to jump the long RDP housing waiting list.

In another perspective, peoples preferences on where to settle also drives spatial transformation. Despite the city's moratorium on water and sanitation services to limit development in certain areas such as land between Polokwane central and Mankweng people still built their dream homes. In support of this, there are settlements of various types emerging between Dalmada and Orange Groove Farms i.e. rural gated settlements. In particular, plate 8.1. shows a house built in this area where the researcher was accommodated part of the days during the course of fieldwork.



Plate 8.1: Preferred house built in Dalmada gated rural area

Source Author, 2019

The newly emerging gated rural settlement between Dalmada and Orange Groove Farms in Polokwane, evidences that peoples preferences drives spatial transformation. Lack of basic service infrastructure and the municipal moratorium did not stop people to establish settlement in their preferred places. Plate 8.1 shows that people will find their own solutions to live in comfort, they use an alternative source of energy for electricity which is solar energy. For sanitation services, the plate shows people digging for the installation of a septic tank.

Therefore, personal preferences on places of settlement drives spatial transformation across cities of all scales.

8.4.4 Housing development and safety

Housing development is also viewed as a key mechanism driving spatial transformation. The case study reviews echoes the same pointing that, dense housing construction during the industrial revolution era influenced spatial transformation of the City of Berlin (Arandelovic and Bogunovich 2014 p.4). To add on, in Auckland New Zealand, the Unitary Plan proposed liberalization of housing development rules to allow brownfield and greenfield housing development (Salmon 2015 p.21-26; Early *et al.*, 2015 p.227). Housing development through the cooperatives contributed to spatial transformation in Harare (Muchadenyika and Williams 2017 p. 35). Similarly, in the context of City of Polokwane spatial injustices of apartheid engineered planning used segregated housing development as a mechanism to spatially transform the morphology of cities contributing to development imbalances and inequality. In post-apartheid era, housing development is further acknowledged of its critical role as outlined by the various legislative policy frameworks as discussed in chapter 6, to redress the apartheid injustices. For example, the spatial integration of SDA 1 an area between Seshego and Polokwane (figure 6.7) was facilitated by housing development, with a total of 27 988 catering for a population estimate of 86 021 (Polokwane 2007 p.30). The Eskom Dwelling layer presented in figure 7.23 also substantiates the contribution of housing development in driving spatial transformation in the City of Polokwane. In another perspective, an entity was established by the City which is called, “Thabatshweu Housing Company Pty, t/a Polokwane Housing Association (PHA)”, and level 2 housing accreditation to facilitate and fast track housing development ensuring that people have access to shelter, a right to the city enshrined in the constitution of the Republic. This suggests that housing development drives spatial transformation owing to the determination of the municipality in executing its mandate as the main arbiter of housing development to ensure spatial justice.

Looking back at the history of the City establishment of then Pietersburg, can be directly linked to this site being a safe haven after the early wars in South Africa. In particular, the war over grazing and hunting territory, led to the Boers’ being defeated by the Venda people in 1867, consequently leading to Schoemansdal being razed to the ground. After the 1880-1881 Anglo-Boer War, with abandonment of Schoemansdal a decision was made to establish a new capital for the Boers (South African History Online (SAHO) 2016). This led to the finding of Pietersburg as the safe and conducive place for establishment of human settlements. Similarly, in the post-apartheid era, Polokwane is viewed as having the lowest crime rates compared to other South African cities. This makes it to be boasted around as being true to its Sotho name ‘Polokwane’ which means “Place of Safety” (Abrahams and Marais 2019 p.;

Polokwane 2016d), “place of rest” (Donaldson 2005 p.354). This implies the social characteristics of the City such as safety attracts people, consequently driving spatial transformation in the long run.

8.5 Economic drivers of spatial transformation

To analyse economic drivers of spatial transformation in the City of Polokwane, exploratory factor analysis (EFA) was employed. The results for the correlation coefficient matrix for the 13 items that were used in the questionnaire measurement instrument are presented in table 8.13.

Table 8.13: Correlation matrix^a on variables on economic drivers of spatial transformation

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
Drivers.ST-Eco1.	1.000												
Drivers.ST-Eco2.	.570	1.000											
Drivers.ST-Eco3.	.231	.191	1.000										
Drivers.ST-Eco4.	.134	.163	.589	1.000									
Drivers.ST-Eco5.	.209	.122	.486	.490	1.000								
Drivers.ST-Eco6.	.165	.203	.474	.455	.545	1.000							
Drivers.ST-Eco7.	.180	.186	.415	.408	.469	.596	1.000						
Drivers.ST-Eco8.	.157	.166	.235	.247	.301	.370	.473	1.000					
Drivers.ST-Eco9.	.143	.130	.229	.187	.410	.364	.385	.481	1.000				
Drivers.ST-Eco10.	.170	.187	.268	.225	.324	.370	.311	.350	.458	1.000			
Drivers.ST-Eco11.	.200	.122	.205	.148	.310	.280	.201	.249	.372	.475	1.000		
Drivers.ST-Eco12.	.107	.128	.136	.073	.224	.202	.228	.291	.280	.384	.464	1.000	
Drivers.ST-Eco13.	.066	.135	.191	.097	.220	.214	.227	.231	.309	.267	.336	.443	1.000

a. Determinant = .015

Source: Author, 2019

In assessing the problems of multicollinearity the study followed rules highlighted in a study by Ashehri (2012) and augmented by checking the computed determinant score i.e. rule of thumb for absence of multicollinearity >0.00001 . Table 8.13 shows that the determinant score is 0.015, which is greater than the suggested rule of thumb score. Therefore, the variables seems to have a patterned relationship and there is the absence of multicollinearity problem. The factorability of output matrix, was scrutinized using the statistical procedures, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity as highlighted in a study by Bai, Hira and Deshpande (2016). The results for these two statistical procedures are presented in table 8.14.

Table 8.14: KMO and Bartlett's Test

Kaiser-Meyer-Olkin MSA.		.833
Bartlett's Test of Sphericity	Approx. Chi-Square	1636.601
	df	78
	Sig.	.000

Source: Author, 2019

The results presented in table 8.14 shows that, computed KMO statistic 0.833, is greater than 0.50 recommended in a study by Lin and Wu (2016), indicating sampling adequacy. The computed statistic for Bartlett's test of sphericity, Approx. Chi-square $\chi^2 = 1636.601$, (df) 78, Sig. value is statistically significant (less than 0.05) at $p < 0.001$, demonstrating that R-matrix is not an identity matrix. The reproduced correlations matrix was also assessed to check the residuals that were computed between observed and reproduced correlations, there were 15 (19.0%) nonredundant residuals with absolute values greater than 0.05, which is way below the acceptable value of $<50\%$ (Field 2009). The computed anti-image matrix^a showed that the diagonal values of individual variables KMO ranged between 0.627^a to 0.887^a which above the acceptable values of >0.50 . In view of Field (2009; 2013), these results indicates that variables included in this analysis have adequate relationships for EFA as distinct and reliable factors can be yielded that are useful in determining economic drivers of spatial transformation in the City of Polokwane. The computed factor analysis output for variables on economic drivers of spatial transformation is presented in table 8.15.

Table 8.15: Rotated Factor Matrix^a economic drivers of spatial transformation

	Factor		
	1	2	3
Drivers.ST-Eco4.People are moving from staying in Polokwane CBD to this area	.713		
Drivers.ST-Eco6.This place is attractive than surrounding areas	.683		
Drivers.ST-Eco3.The property values are affordable around this area	.671		
Drivers.ST-Eco5.Easy access to public services,	.645		
Drivers.ST-Eco7.Changes in economic function of city of Polokwane creating employment	.619		
Drivers.ST-Eco12.Redevlopment projects in this area		.659	
Drivers.ST-Eco11.There is easy access to education and health facilities		.628	
Drivers.ST-Eco10.Industrial developments attracting people this area		.586	
Drivers.ST-Eco9.Development of infrastructure by the government		.554	
Drivers.ST-Eco13.Real estate developments by private sector		.516	
Drivers.ST-Eco8.There are financial institutions and investment opportunities		.435	
Drivers.ST-Eco1.Availability of employment opportunities in Polokwane city			.822
Drivers.ST-Eco2.Technological improvements such as internet live & work from home			.657
Eigenvalues	4.512	1.617	1.385
Cumulative percentage of variance	34.71	47.15	57.78

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations. Factor loading less than 0.40 are not shown

Source: Author, 2019

Table 8.7 presents the factor loadings of the 13 variables from the measurement instrument on economic drivers of spatial transformation in the City of Polokwane. These results show that all 13 variables included in the measurement instrument are of practical significance, because the factor loading values for all the variable exceeded 0.40 as recommended by Field (2009; 2013).

This study adopted multiple approaches in determining the number of factors to retain namely; percentage (%) of variance i.e. above 50% Williams *et al.*, (2010 p.6), Kaiser criterion i.e. retain latent factors with eigenvalues above 1.0 (Azevedo *et al.*, 2019; Yong and Pearce 2013), and scree test (Yong and Pearce 2013). The scree tests results for variables from the measurement instrument on economic drivers of spatial transformation in the City of Polokwane are shown in figure 8.7.

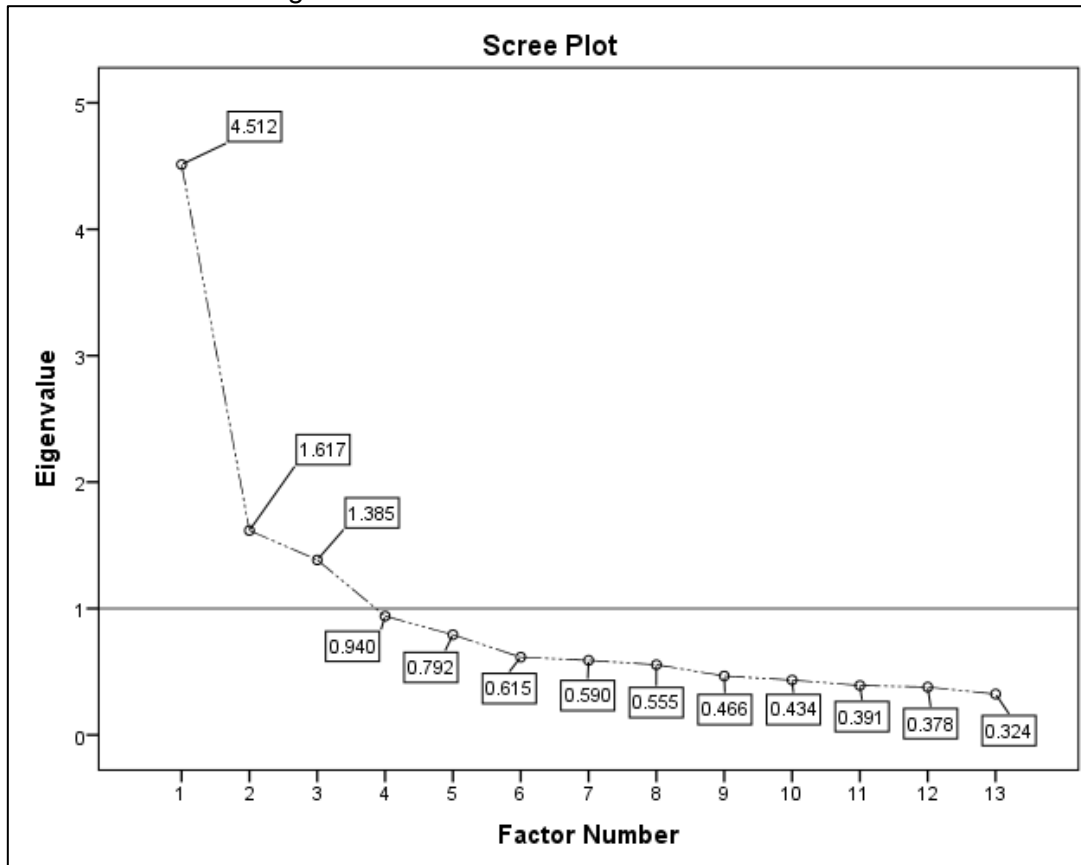


Figure 8.7: Scree plot factors on economic drivers of spatial transformation

Source: Author, 2019

Figure 8.6 depicts supporting evidence that the measurement scale used has three-factor solution that explain the analysis problem on economic drivers of spatial transformation in the City of Polokwane. These underlying three factors are summarised in table 8.16.

Table 8.16: Categorizing economic drivers of spatial transformation

Factor number	Factor name	% of Variance	Variables contributing to the identified latent factor
1	Attractiveness and affordability	34.71	Drivers.ST-Eco4.People are moving from staying in Polokwane CBD to this area Drivers.ST-Eco6.This place is attractive than surrounding areas Drivers.ST-Eco3.The property values are affordable around this area Drivers.ST-Eco5.Easy access to public services, Drivers.ST-Eco7.Changes in economic function of city of Polokwane creating employment
2	Infrastructure developments	12.44	Drivers.ST-Eco12.Redevlopment projects in this area Drivers.ST-Eco11.There is easy access to education and health facilities Drivers.ST-Eco10.Industrial developments attracting people this area Drivers.ST-Eco9.Development of infrastructure by the government Drivers.ST-Eco13.Real estate developments by private sector Drivers.ST-Eco8.There are financial institutions and investment opportunities
3	Employment and tech advancements	10.65	Drivers.ST-Eco1.Availability of employment opportunities in Polokwane city Drivers.ST-Eco2.Technological improvements such as internet live & work from home

Source: Author, 2019

Table 8.16 shows that the 13 variables were reduced into three latent factors namely: attractiveness and affordability; infrastructure developments; employment and tech advancements. These extracted latent factors are presented using the mathematical model (4.1) in relation to measured variables as follows;

$$Y_i = b_1X_{1i} + b_2X_{2i} + \dots + b_nX_{ni} + \varepsilon_i \quad 8.4$$

$$\begin{aligned} 1. \text{Attractiveness and affordability}_i &= 0.713\text{Drivers.ST_Eco4}_i + \\ &0.683\text{Drivers.ST_Eco6}_i + 0.671\text{Drivers.ST_Eco3}_i + 0.645\text{Drivers.ST_Eco5}_i + \\ &0.619\text{Drivers.ST_Eco7}_i + \varepsilon_i \end{aligned}$$

$$\begin{aligned} 2. \text{Infrastructure developments}_i &= 0.659\text{Drivers.ST_Eco12}_i + \\ &0.628\text{Drivers.ST_Eco11}_i + 0.586\text{Drivers.ST_Eco10}_i + 0.554\text{Drivers.ST_Eco9}_i + \\ &0.516\text{Drivers.ST_Eco13}_i + 0.435\text{Drivers.ST_Eco8}_i + \varepsilon_i \end{aligned}$$

$$\begin{aligned} 3. \text{Employment and technological advancements}_i &= 0.822\text{Drivers.ST_Eco1}_i + \\ &0.657\text{Drivers.ST_Eco2}_i + \varepsilon_i \end{aligned}$$

8.5.1 Attractiveness and affordability

Attractiveness and affordability in relation to liveability act as significant pull factors that attract more people to the City causing rapid urbanization, consequently driving spatial transformation in urban areas. Attractiveness in this context implies pleasing quality, and the amount or range of choices, economic choices one can make in any given area which are not limited to means of transport, distance to access services, markets and amenities among others. Thus, the quality of urban lifestyle is viewed as better, attractive and there is exposure to economic opportunities compared to predominantly agrarian rural lifestyle leading to swarming of many people to cities. Similarly, the apartheid engineered planning resulted in

spatial injustices of segregation, inequality and development imbalances between the white areas and rural homeland area. In support of this, previously homeland areas have low agricultural potential RSA DRDLR and DAFF (2015 p.3), no industries, and lacks commercial sectors (Donaldson 2001 p.208) indicating poor economic activities and low quality life. Consequently people are migrating from various places (plate 8.1) to City of Polokwane the hub of Limpopo province with better quality life and numerous economic opportunities. This is evidenced in figure 7.6 showing intensive concentration of economically active age groups (15-64 years) with population range of 37038-74104 in the 1st order node Perskebult-Polokwane and Mankweng-Badimong. This suggests that the City is attractive to various groups of people at different stages of their life cycles. Consequently, this increases population and ultimately drives spatial transformation as witnessed in the built area changes in figure 7.14.

In another perspective, affordability particularly of living costs among others in cities also cause an influx of urban migration which then drives spatial transformation. Affordability can be viewed in relation to transport, housing, diversity i.e. race, place of origin, age among others. The case study on Auckland New Zealand, revealed that diversity attributed to influx of international migrants particularly students enrolled in the universities is steering spatial transformation through studentification. In line with this perspective, figure 8.5 evidences diversity in the City as it shows some of the various places of origin of the respondents in Polokwane. In addition to this, diversity in age structure is also witnessed in areas (1st order node and 2nd order node) that are experiencing intensive spatial transformation as presented in figure 7.5 and 7.6. In addition to this, transport is affordable to commuting residents which attracts more people consequently driving spatial transformation in the City (Abrahams 2017 p.19). Polokwane SDF (2010 p.193); Polokwane CBD PLAN (2005 p.60) adds that the availability of cheap and affordable land, also contributes to horizontal spatial transformation through expansion of sub-urban areas and offices in the City. In addition, the African Centre for Migration & Society (ACMS) and FIC *et al.*, (2012 p.15) points out that Polokwane has “relatively low rents” which make the City to be more attractive and affordable to live in for the rising proportion of migrants who only afford to rent. Furthermore, the City is also implementing housing programmes to ensure access to affordable housing, which is also contributing to spatial transformation (Polokwane IDP 2020 p.765; Polokwane CBD Plan 2016 p.7; Polokwane SDF 2010 p.194). This denotes that there are low living costs in small and intermediate cities such as City of Polokwane compared to major metropolitan areas such as Johannesburg, where living expenses are very high for most people. This in turn contributes to increasing population and housing needs which then drives spatial transformation in the City of Polokwane.

8.5.2 Infrastructure developments

The development of infrastructure facilities to support services and activities acts as a catalyst in promoting the development of the wider economy of the City. In doing so, infrastructure development itself drives spatial transformation. In support of this, the case study of Curitiba Brazil is heralded as the best example on the role of integrating BRT transport infrastructure and land use as a mechanism for the desired spatial transformation (Lindau *et al.*, 2010a p.17). Furthermore, Hangzhou China case study reveals how various economic infrastructure development projects contributed to spatial transformation of the City into a world class tourist destination (Oranje 2014 p.47; Wei 2012 p.399). Similarly, infrastructure developments projects in the City of Polokwane are also contributing to spatial transformation towards redressing apartheid spatial injustices, particularly transport infrastructure. In particular, Seshego-Polokwane F1_Public Transport Integrated Corridor (figure 6.12) which is also being upgraded into an Integrated rapid public transport network system (IRPTN) known as Leeto la Polokwane (Polokwane IRPTS Operational Plan 2014 p.5). Furthermore, figure 6.13 presents other transport network plans by the City such as the N1 by-pass road (1st order road), urban district distributor roads (2nd order) and urban collectors (3rd order) roads. These transport network plans are aimed at facilitating and unlocking spatial transformation and land development possibilities i.e. spatial integration between Seshego and Polokwane.

In another perspective, cities are complex systems that are part of the global village, their spatial transformation is also driven by externalities such as world events. In support of this, spatial transformation in Curitiba was also fast tracked through expediting infrastructure development such as airports and roads, towards hosting 2014 FIFA World Cup™ (de Oliveira Cavalcanti *et al.*, 2017 p.395; Rosário 2016 p.115). Similarly, the development of sports and tourism related infrastructure facilities i.e. the construction of Peter Mokaba stadium in support of the FIFA World Cup 2010 hosted by South Africa influenced spatial transformation in the City of Polokwane. In support of this, Polokwane (2008 p.50) pointed out that hosting the 2010 World Cup™ presented an opportunity of accelerated infrastructure investment and development, which could have taken several years to be constructed and more budget was made available. This denotes that the city was geared to leverage on infrastructure development facilitate spatial transformation towards hosting the 2010 World Cup™ and improving quality of life for the citizens in the long run.

8.5.3 Employment and technological advancements

The availability of employment opportunities in cities act as pull factors attracting an influx of migrants, consequently leading to spatial transformation in cities from the pressure to accommodate the increasing population. The case study reviews concurs with this pointing

out that, spatial transformation in Hangzhou China (Liu *et al.*, 2011 p.706) and in Harare, Zimbabwe (Kamusoko *et al.*, 2013 p.324) was also driven by employment opportunities.

To add on, SACN (2016 p.54), reiterates that cities in South Africa have experienced spatial transformation of their footprint in post-apartheid era, attributed to increased influx of migrants searching for employment opportunities. Similarly, the positioning of City of Polokwane as the provincial hub with service functions hosting government offices, retail centres, education institutions among others and its location increases the potential availability of employment opportunities as presented in table 8.1. The anticipation for employment opportunities in the City is also witnessed by high GVA contribution values presented in figure 7.17.

Table 8.17: Employment changes (1996-2011)

Municipality	1996		2001		2011	
	Employed	Unemployed	Employed	Unemployed	Employed	Unemployed
LIM351: Blouberg	11313	17337	16590	21177	15840	18372
LIM352: Aganang	9003	17736	8682	21963	11400	18786
LIM353: Molemole	13728	11778	16227	15318	15225	16164
LIM354: Polokwane	70935	51822	93768	87021	155691	102000
LIM355: Lepele-Nkumpi	20814	29397	19326	38331	27513	39021

Source: StatsSA SuperCROSS 2020

Table 8.17 shows that Polokwane has the highest employment figures (70935 in 1996 to 155691 in 2011) compared to any other local authorities within the jurisdiction of Capricorn District Municipality. Ultimately, this attraction causing the influx of migrants into the City, consequently drives spatial transformation in the receiving settlement clusters as evidenced by the growing built-up areas presented in figure 7.14. Abrahams (2017 p.9); African Centre for Migration & Society (ACMS) and FIC *et al.*, (2012 p.6); reiterates that availability of economic opportunities such as employment are part of spatial transformation drivers in the City of Polokwane. ACMS *et al.*, (2012 p.6) adds that in a survey carried out in Polokwane, approximately half of the migrants responded argued that economic reasons influenced their decision for migration into Polokwane (Gemey 2017 p.9; African Center for Migration & Society (ACMS) *et al.*, 2012 p.6). On the contrary, a key informant also raised that,

“there is no much economic activities in the City of Polokwane. It has nothing special, its not a mining town or whatsoever. However its strongest potential is its location. Location of Polokwane as the hub and heart of Limpopo province there is economic potential which attracts people as it is the gateway of Southern Africa” (Key informant: Consultant).

There are a multitude of factors that drive spatial transformation in cities as discussed earlier, also technology matters. Technological advancements over the years have also improved the living experiences of people. The case study of Auckland New Zealand, revealed that in 1950’s-80’s technological advancement such as automobiles resulted in spatial transformation

of the City through urban sprawling. It is regarded as one of the cities with limited public transport users and highly dependant on private vehicles supported by the developed road infrastructure such as motorways and arterial roads (Salmon 2015 p.17; Early *et al.*, 2015 p.223). Contrary to this, the case study of Curitiba Brazil, is one of the world's best exemplars on how technology was leveraged in the transport sector to support development and functioning of the bus rapid transit cradle for the world (Lindau *et al.*, 2010a p.17). This in turn, has significantly contributed to spatial transformation of Curitiba Brazil over the years. In line with these discussions, reliance in automobiles as reflected by personal preferences of other people to stay in the traditional rural areas, is also influencing spatial transformation in the City of Polokwane. The City is also leveraging on transport technologies by developing a BRT system Leeto la Polokwane ($\pm 40\text{km}$) to spearhead spatial transformation by spatial integration of the urban core with the previous homeland areas such as Moletji.

In another perspective, Polokwane has a vision to develop as a smart city leveraging on technology to provide directions for spatial transformation. Polokwane Growth Dev Plan (2013 p.33) supports this citing that the City has adopted the smart city concept and its innovative technologies in driving solutions to challenges being faced. In addition to this, the key pillars or elements supporting the smart vision for the city are, smart people; smart mobility, smart living, smart governance, smart environment and smart economy (Polokwane 2020 p.315; Polokwane Growth Dev Plan 2013 p.33). Putting it all together, these results suggest that employment opportunities and technological advancements drive spatial transformation in the City.

8.6 Chapter summary

This chapter employed EFA to determine the drivers of spatial transformation in the City of Polokwane. The findings from this chapter suggests that there are multitude of factors that drive spatial transformation in cities. This denotes that the neo-classical quasi-biological metaphor analysis is inadequate in explaining the contemporary spatial transformation in cities. The structuralist analysis on the complex drivers of spatial transformation shows that the complex urban systems on governance and political systems, spatial characteristics/biophysical factors, social and cultural norms, and economic factors.

CHAPTER 9: IMPLICATIONS OF SPATIAL TRANSFORMATION IN THE CITY OF POLOKWANE

9.1 Introduction

This chapter analyses the implications of spatial transformation in the City of Polokwane. Section 1 introduces this chapter and its orientation as presented in figure 9.1. This section also sets out the theoretical lens guiding this chapter in data analysis. Sections 2 to 6, discuss the environmental, economic, social, governance and political and spatial planning, monitoring and evaluation implications of spatial transformation respectively. Section 7, summarises this chapter.

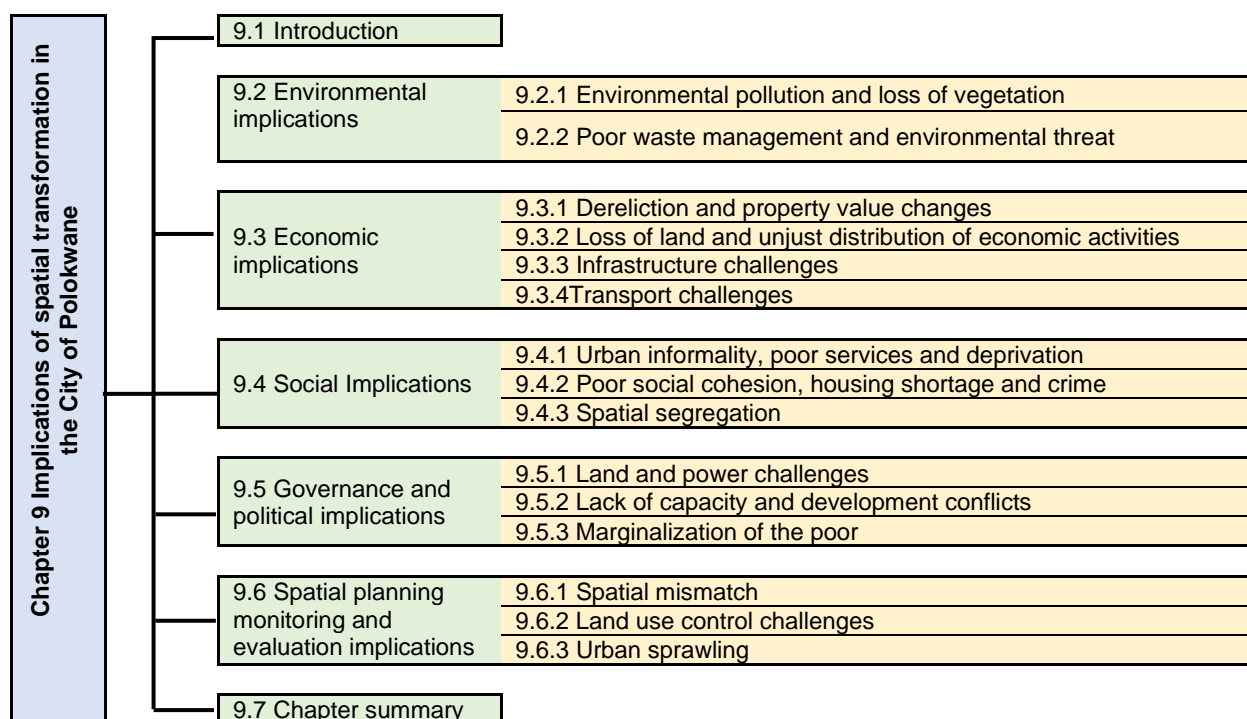


Figure 9.1: Chapter 9 Orientation

Source: Author, 2020

Data analysis and interpretation in this chapter is also informed by the critical urban theory, which provides for having an evaluative mindset, attitude towards reality (Marcuse 2012 p.20). This implies questioning the implications of spatial transformation rather than accepting the emergent spatiality as it is. Adding on, spatial dialectics and didactics theory propounds that the world contradicts itself. Similarly, the notion of spatial transformation in South African context is to redress apartheid spatial planning legacy of spatial injustice. However, the reality is that spatial transformation has various implications that contradict the notion of spatial transformation. In another perspectives, the narrative account a conceptualization of Theory of Change (ToC) reiterates the need to also describe the implications of observed and visualized reality, such as spatial transformation. This warrants the need to also analyse the implications of spatial transformation in the City of Polokwane. In the perspective of Pirie (1983

p.467), spatial (in)justice is a condition, a state of something, and it has an effect, impact on everyday life. Similarly, spatial transformation is a condition resulting from the notion of redressing apartheid injustices and driven by various factors discussed in the previous chapter. Hence there is need to unravel the implications of spatial transformation within the context of the right to the city as every citizen has the right to voice how they are being affected. This offers a platform for hearing the voices of the City of Polokwane community which is the space of representation-lived space, as expressed on the questionnaires, together with experts' views those in the domain of representation of space on the implications of spatial transformation. This is further augmented by discourses to illuminate and deepen the understanding on implications of spatial transformation in the City of Polokwane. Thus, the narrative on implications of spatial transformation in the City of Polokwane is framed along the following dimensions; environmental, economic, social, governance/political and spatial planning, monitoring and evaluation.

9.2 Environmental implications of spatial transformation

To determine environmental implications of spatial transformation in the City of Polokwane, exploratory factor analysis (EFA) was employed. The results for the correlation coefficient matrix for the 11 items that were used in the questionnaire measurement instrument are presented in table 9.1.

Table 9.1: Correlation matrix^a on variables on environmental implications of spatial transformation

	1	2	3	4	5	6	7	8	9	10	11
Implications.ST-Env.1.	1.000										
Implications.ST-Env.2.	.480	1.000									
Implications.ST-Env.3.	.491	.480	1.000								
Implications.ST-Env.4.	.349	.411	.550	1.000							
Implications.ST-Env.5.	.298	.281	.389	.519	1.000						
Implications.ST-Env.6.	.296	.246	.329	.368	.455	1.000					
Implications.ST-Env.7.	.210	.197	.291	.269	.314	.515	1.000				
Implications.ST-Env.8.	.125	.210	.197	.298	.265	.409	.427	1.000			
Implications.ST-Env.9.	.210	.178	.272	.185	.255	.388	.431	.448	1.000		
Implications.ST-Env.10.	.210	.133	.250	.238	.320	.268	.213	.423	.507	1.000	
Implications.ST-Env.11.	.186	.120	.196	.209	.264	.212	.313	.226	.321	.453	1.000

a. Determinant = .032

Source: Author, 2019

In assessing the problems of multicollinearity the study followed rules highlighted in a study by Ashehri (2012) and augmented by checking the computed determinant score i.e. rule of thumb for absence of multicollinearity >0.00001 . Table 9.1 shows that the determinant score is 0.032, which is greater than the suggested rule of thumb score. Therefore, the variables seems to have a patterned relationship and there is the absence of multicollinearity problem.

The factorability of output matrix, was scrutinized using the statistical procedures, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity as highlighted in a study by Bai, Hira and Deshpande (2016). The results for these two statistical procedures are presented in table 9.2.

Table 9.2: KMO and Bartlett's Test: variables for environmental implications of spatial transformation

Kaiser-Meyer-Olkin MSA.		.823
Bartlett's Test of Sphericity	Approx. Chi-Square	1363.276
	df	55
	Sig.	.000

Source: Author, 2019

The results presented in table 9.2 shows that, computed KMO statistic 0.823, is greater than 0.50 recommended in a study by Lin and Wu (2016), indicating sampling adequacy. The computed statistic for Bartlett's test of sphericity, Approx. Chi-square $\chi^2 = 1363.276$, (df) 55, Sig. value is statistically significant (less than 0.05) at $p < 0.001$, demonstrating that R-matrix is not an identity matrix. The reproduced correlations matrix was also assessed to check the residuals that were computed between observed and reproduced correlations, there were 16 (29.0%) nonredundant residuals with absolute values greater than 0.05, which is within the acceptable value of <50% (Field 2009). The computed anti-image matrix^a showed that the diagonal values of individual variables KMO criterion for measurement of sampling adequacy (MSA) ranged between 0.740^a to 0.838^a which is above the acceptable values of >0.50. In view of Field (2009; 2013), these results indicates that variables included in this analysis have adequate relationships for EFA as distinct and reliable factors can be yielded that are useful in determining environmental implications of spatial transformation in the City of Polokwane. The computed factor analysis output for variables on environmental implications of spatial transformation is presented in table 9.3.

Table 9.3: Rotated Factor Matrix^a: variables for environmental implications of spatial transformation

	Factor	
	1	2
Implications.ST-Env.9.More solid waste being washed into water bodies	.696	
Implications.ST-Env.8.Pollution of rivers by increasing dirt from increasing population	.621	
Implications.ST-Env.10.More soil being washed into water bodies	.613	
Implications.ST-Env.7.Smoke pollution emitted by increasing cars moving around this area	.560	
Implications.ST-Env.6.Loss of vegetation to developments taking place	.523	
Implications.ST-Env.11.Increased paved surfaces in the city	.468	
Implications.ST-Env.3.More waste being dumped indiscriminately		.731
Implications.ST-Env.4.Environmental destruction by developments taking place		.653
Implications.ST-Env.2.Municipality no-longer have capacity to collect waste regularly		.629
Implications.ST-Env.1.Loss of wetlands		.602
Implications.ST-Env.5.Loss of habitat for animal species		.482
Eigenvalues	4.136	1.546
Cumulative percentage of variance	37.60	51.65

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations. Factor loading less than 0.40 are not shown*

Source: Author, 2019

Table 9.3 presents the factor loadings of the 11 variables from the measurement instrument on environmental implications of spatial transformation in the City of Polokwane. These results show that all 11 variables included in the measurement instrument are of practical significance, because the factor loading values for all the variables exceeded 0.40 as recommended by Field (2009; 2013). This study adopted multiple approaches in determining the number of factors to retain namely; percentage (%) of variance i.e. above 50% Williams *et al.*, (2010 p.6), Kaiser criterion i.e. retain latent factors with eigenvalues above 1.0 (Azevedo *et al.*, 2019; Yong and Pearce 2013), and scree test (Yong and Pearce 2013). The scree test results for variables from the measurement instrument on environmental implications of spatial transformation in City of Polokwane are shown in figure 9.2.

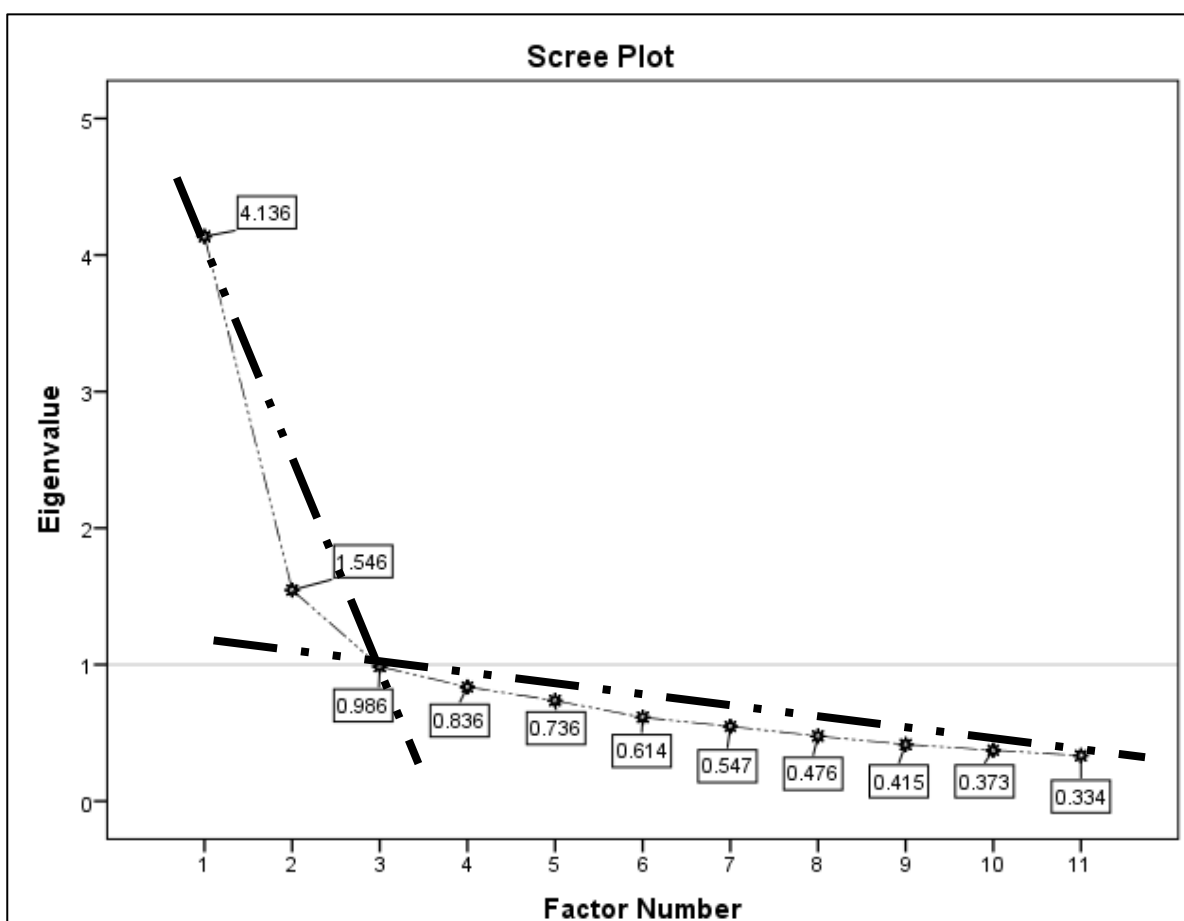


Figure 9.2: Scree plot variables on variables for environmental implications of spatial transformation

Source: Author, 2019

Figure 9.2 depicts supporting evidence that the measurement scale used has two-factor solution that explain the analysis problem on environmental implications of spatial transformation in the City of Polokwane. These underlying two factors are summarised in table 9.4.

Table 9.4: Latent factor names: variables for environmental implications of spatial transformation

Factor number	Factor name	% of variance	variables contributing to a latent factor
1	Environmental pollution and loss of vegetation	37.60	Implications.ST-Env.9.More solid waste being washed into water bodies Implications.ST-Env.8.Pollution of rivers by increasing dirt from increasing population Implications.ST-Env.10.More soil being washed into water bodies Implications.ST-Env.7.Smoke pollution emitted by increasing cars moving around this area Implications.ST-Env.6.Loss of vegetation to developments taking place Implications.ST-Env.11.Increased paved surfaces in the city
2	Poor waste management and environmental threat	14.05	Implications.ST-Env.3.More waste being dumped indiscriminately Implications.ST-Env.4.Environmental destruction by developments taking place Implications.ST-Env.2.Municipality no-longer have capacity to collect waste regularly Implications.ST-Env.1.Loss of wetlands Implications.ST-Env.5.Loss of habitat for animal species

Source: Author, 2019

Table 9.4 shows that the 11 variables were reduced into three latent factors namely: environmental pollution and loss of vegetation; and poor waste management and environmental threat. These extracted latent factors are presented using the mathematical model (4.1) in relation to measured variables as follows;

$$Y_i = b_1X_{1i} + b_2X_{2i} + \dots + b_nX_{ni} + \varepsilon_i \quad 9.1$$

$$\begin{aligned} 1. \text{Environmental pollution and loss of vegetation}_i = & \\ & 0.696\text{Implications.ST_Env}9_i + 0.621\text{Implications.ST_Env}8_i + \\ & 0.613\text{Implications.ST_Env}10_i + 0.560\text{Implications.ST_Env}7_i + \\ & 0.523\text{Implications.ST_Env}6_i + 0.468\text{Implications.ST_Env}11_i + \varepsilon_i \end{aligned}$$

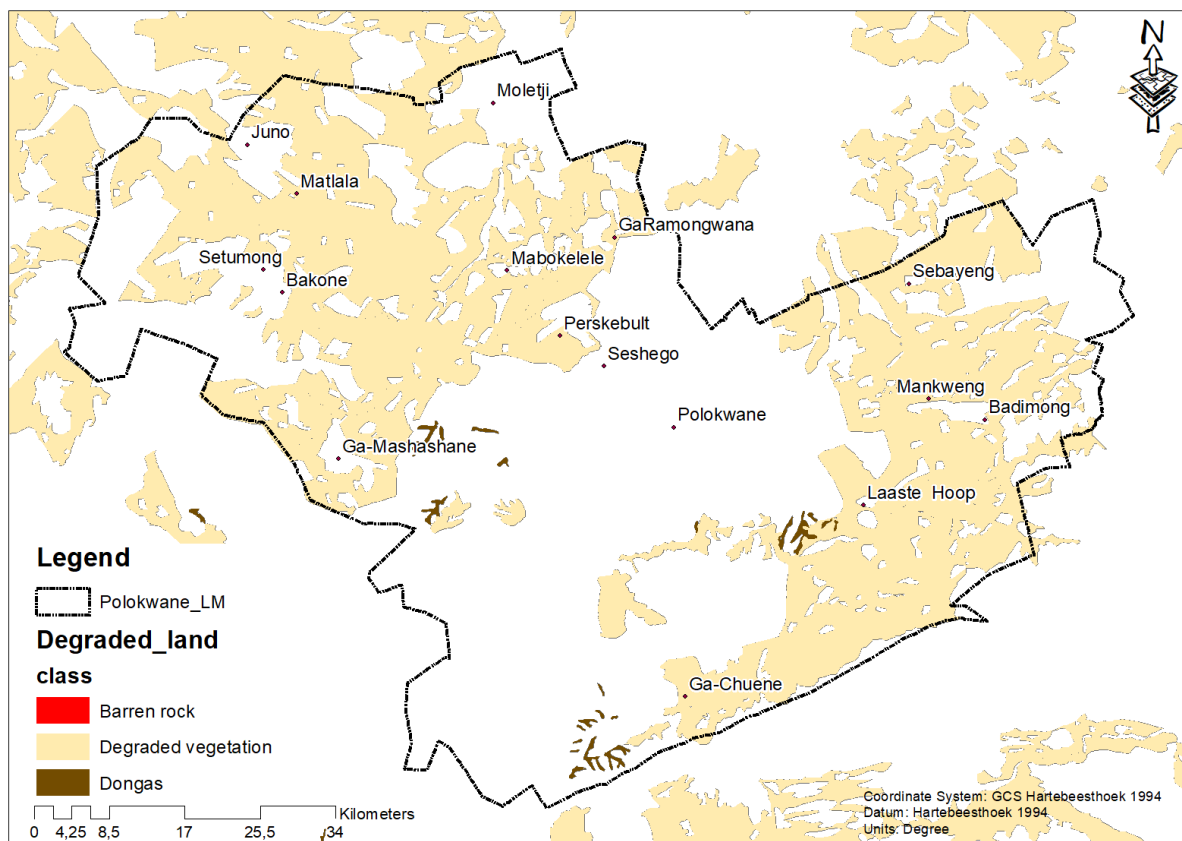
$$\begin{aligned} 2. \text{Poor waste management and environmental threat}_i = & \\ & 0.731\text{Implications.ST_Env}3_i + 0.653\text{Implications.ST_Env}4_i + \\ & 0.629\text{Implications.ST_Env}2_i + 0.602\text{Implications.ST_Env}1_i + \\ & +0.482\text{Implications.ST_Env}5_i\varepsilon_i \end{aligned}$$

9.2.1 Environmental pollution and loss of vegetation

There is widespread perception that urbanization, and spatial transformation of cities have an impact on the urban environment. Literature review concurs with this, pointing out that spatial transformation has resulted in multiple environmental challenges in cities (Ibrahim 2017 p.8; Stats Canada 2016 p.13; Salmon 2015 p.36; Early *et al.*, 2015 p.233; Rabinovitch and Leitman 1996 p.52; Maronedze and Schutt 2018 p.11). Similarly, Abrahams (2017 p.22); Polokwane SDF (2010 p.155) points out that the SWOT analysis for the city reveals that challenges being faced by Polokwane include air, water and land pollution. In addition, Polokwane SDF (2010 p.158) reiterates that environmental issues need to be addressed in the City to prevent further

degeneration and degradation of land induced by spatial transformation activities as witnessed in figure 9.3. are; illegal sand mining, soil erosion (plate 9.1), deforestation, groundwater pollution, dust and other particulates suspended in the atmosphere. A key informant, also echoed the issue on degradation of land in most rural areas by indicating that;

“there is this issue also of sand mining all over even next to the road causing them to collapse and hinder accessibility to certain settlements”, (key informant: CoGHSTA).



* South African land-cover characteristics database
Figure 9.3: Degraded land from spatial transformation activities

Source: Author, 2020

Polokwane (2020 p.149), adds that there is a concern on increasing declining of water quality attributed to urban and industrial effluent discharge from servicing the increasing urban population and resultant spatial transformation activities. To add on, increasing hazardous wastes generated in the City from growing households being disposed at the landfills include compact fluorescent lights (CFLs) and batteries. This increases the risk of heavy metals such as cadmium and mercury to be released from such waste contaminating large bodies of water source in the City and beyond the river systems (Polokwane IWMP 2016 p.28). Furthermore, SACN (2014 p.29) adds that other domestic waste, medical and other waste which are hazardous are being disposed in the city posing a threat to water bodies.



Plate 9.1: Soil erosion

Source: Author, 2020

Furthermore, Limpopo Department of Economic Development Environmental and Tourism (LDEDET) (2013 p.25), reiterates that Polokwane, particularly the 1st nodal area, is one of the four hotspots of air pollutants in the province. The major environmental pollutants identified in this area attributed to spatial transformation activities are, PM_{10} generated from brickworks, asphalt plant and SO_2 from smelters. In addition to this a key informant pointed out that, “moulding of clay cultural artifacts is increasing the threat of air pollution in the rural areas.” (Key informant: CoGHSTA).

9.2.2 Poor waste management and environmental threat

Polokwane (2010a p.158) points out that amongst major environmental issues there is waste management as part of the priority issues that needs to be addressed by the City as presented in plate 9.2.

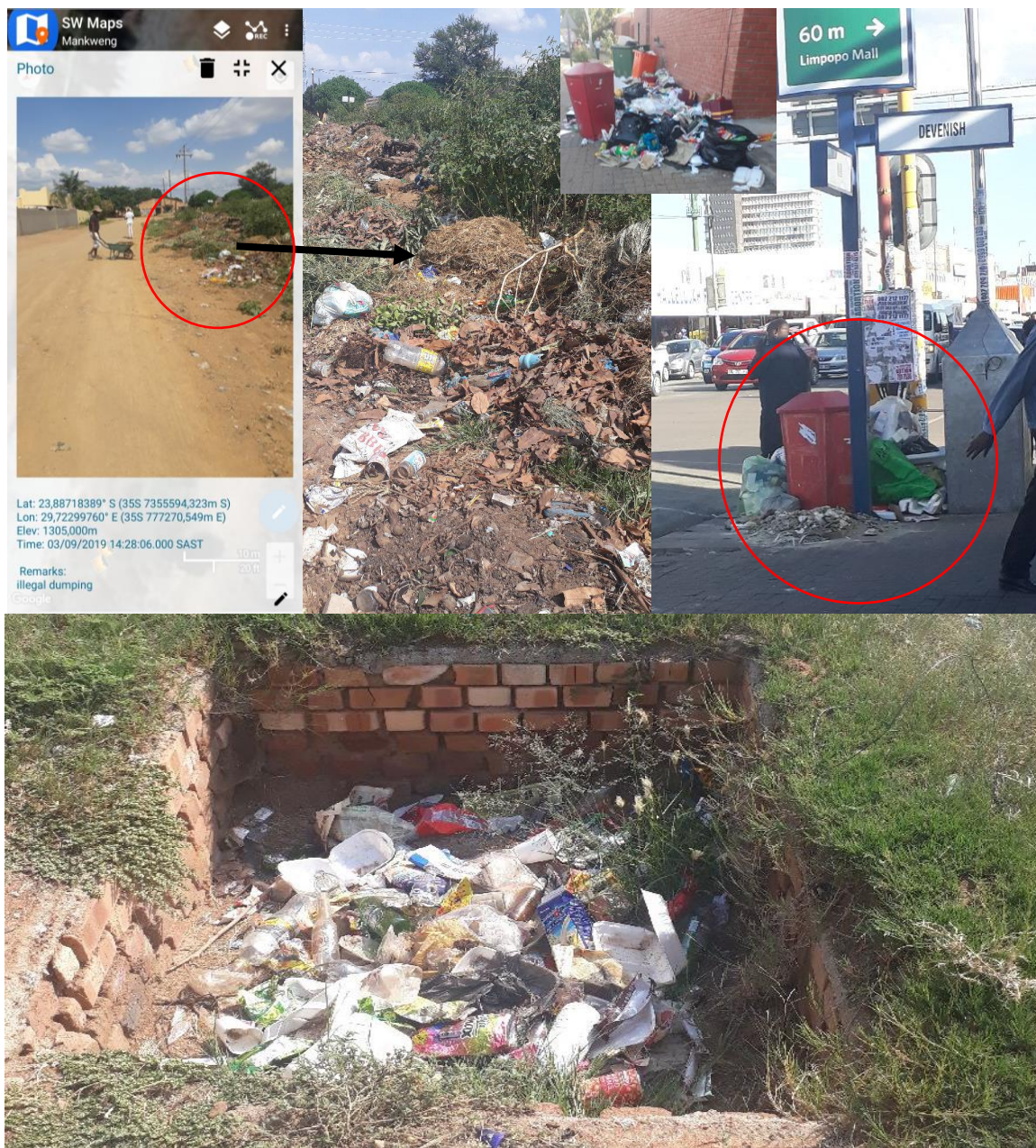


Plate 9.2: Poor waste management

Source: Author, 2020

Polokwane (2020 p.150) cites that a systematic and efficient refuse collection system is in place for the major urban nodal areas of the city. However in view of spatial dialectics and didactics theory, this contradicts the social reality evidenced in plate 9.2, that the City is having challenges in promoting proper waste management. This is further reinforced by table 9.5, illustrating that the local authority removed refuse from 24% of the households in 1996, and from 33% of the population from the 2016 community survey. This implies that with the increasing population in the City, issues of illegal dumping are also on the rise as the local authority is failing to decrease the backlog on refuse removal. In support of this, Polokwane

(2016a p.41), acknowledges that illegal dumping is an issue in both rural and urban areas attributed to increasing population.

Table 9.5: Refuse removal in Polokwane 2016

Refuse removal	1996 (HH)	2001 (HH)	2011(HH)	2016 (Population)
Removed by local authority/private company/community members at least once a week	20646 (24%)	41007 (33%)	79107 (44%)	263773 (33%)
Removed by local authority/private company/community members less often than once a week	768 (1%)	1737 (1%)	1323 (1%)	26307 (3,3%)
Communal refuse dump	1569 (2%)	1434 (1%)	1830 (1%)	21590 (2,7%)
Own refuse dump	53790 (63%)	72213 (58%)	88902 (50%)	428188 (53,7%)
Dump or leave rubbish anywhere (no rubbish disposal)	6897 (8%)	8589 (7%)	5619 (3%)	41892 (5,3%)
Other	18(-)	-	1221 (1%)	12453 (1,6%)
Unspecified	1680 (2%)	-	-	-
Communal container/central collection point	-	-	-	2924 (0,4%)
Total	85368	124980	178002	797127

Source: StatsSA SuperCROSS 2016

In another perspective, poor waste management is not only limited to residential areas in the City, it extends to the CBD and industrial areas. In support of this Polokwane (IWMP 2016 p.47), the skips and containers used in these areas creates unhealthy and unsafe environments when they are full, the public and the business owners continue dumping waste next to it (refer to plate 9.2). This creates an environment that is aesthetically unpleasant in the CBD as such waste is seen next to the bins all over the pavements.

The case study review on Toronto Stats Canada (2016 p.43), echoes that spatial transformation through urban developments significantly contributed to ecological infrastructure such as wetlands, grasslands, forests among others. Similarly, Polokwane (2007b p.41), points out that although natural corridor buffer areas are encouraged, spatial transformation activities are always a threat to the environment. In particular, there are Giant Bullfrogs in certain areas of Koppiefontein and Eduan Park that are being threatened by development potential in this area. In addition, Polokwane (2010a p.158) echoes this stating that amongst the priority environmental issues that needs to be addressed, threatened by spatial transformation activities are; protection of sensitive natural habitat for endangered species. Thus, the results suggests that spatial transformation activities in cities contribute to environmental challenges.

9.3 Economic implications of spatial transformation

To analyse economic implications of spatial transformation in the City of Polokwane, exploratory factor analysis (EFA) was employed. The results for the correlation coefficient

matrix for the 14 items that were used in the questionnaire measurement instrument are presented in table 9.6.

Table 9.6: Correlation matrix^a on variables on economic implications of spatial transformation

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Implications.ST-Eco.1.	1.000													
Implications.ST-Eco.2.	.462	1.000												
Implications.ST-Eco.3.	.366	.413	1.000											
Implications.ST-Eco.4.	.112	.266	.449	1.000										
Implications.ST-Eco.5.	.201	.264	.429	.449	1.000									
Implications.ST-Eco.6.	.179	.289	.409	.365	.488	1.000								
Implications.ST-Eco.7.	.158	.157	.260	.291	.331	.486	1.000							
Implications.ST-Eco.8.	.161	.187	.109	.195	.328	.365	.437	1.000						
Implications.ST-Eco.9.	.225	.229	.196	.224	.239	.271	.458	.494	1.000					
Implications.ST-Eco.10.	.163	.195	.157	.192	.218	.314	.350	.340	.479	1.000				
Implications.ST-Eco.11.	.057	.116	.164	.113	.232	.260	.249	.284	.311	.386	1.000			
Implications.ST-Eco.12.	.196	.160	.174	.176	.229	.138	.126	.134	.209	.256	.322	1.000		
Implications.ST-Eco.13.	.195	.152	.146	.171	.217	.126	.152	.061	.191	.202	.226	.643	1.000	
Implications.ST-Eco.14.	.170	.124	.090	.014	.145	.178	.138	.192	.199	.179	.292	.505	.538	1.000

a. Determinant = .014

Source: Author, 2019

In assessing the problems of multicollinearity the study followed rules highlighted in a study by Ashehri (2012) and augmented by checking the computed determinant score i.e. rule of thumb for absence of multicollinearity >0.00001 . Table 9.6 shows that the determinant score is 0.014, which is greater than the suggested rule of thumb score. Therefore, the variables seems to have a patterned relationship and there is the absence of multicollinearity problem.

The factorability of output matrix, was scrutinized using the statistical procedures, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity as highlighted in a study by Bai, Hira and Deshpande (2016). The results for these two statistical procedures are presented in table 9.7.

Table 9.7: KMO and Bartlett's Test: variables on economic implications of spatial transformation

Kaiser-Meyer-Olkin MSA.		.815
Bartlett's Test of Sphericity	Approx. Chi-Square	1625.903
	df	91
	Sig.	.000

Source: Author, 2019

The results presented in table 9.7 shows that, computed KMO statistic 0.815, is greater than 0.50 recommended in a study by Lin and Wu (2016), indicating sampling adequacy. The computed statistic for Bartlett's test of sphericity, Approx. Chi-square $\chi^2 = 1625.903$, (df) 91, Sig. value is statistically significant (less than 0.05) at $p < 0.001$, demonstrating that R-matrix is not an identity matrix. The reproduced correlation matrix was also assessed to check the residuals that were computed between observed and reproduced correlations, there were 11 (12.0%) nonredundant residuals with absolute values greater than 0.05, which is way below

the acceptable value of <50% (Field 2009). The computed anti-image matrix^a showed that the diagonal values of individual variables KMO criterion for measurement of sampling adequacy (MSA) ranged between 0.726^a to 0.868^a which is above the acceptable values of >0.50. In view of Field (2009; 2013), these results indicate that variables included in this analysis have adequate relationships for EFA as distinct and reliable factors can be yielded that are useful in determining economic implications of spatial transformation in the City of Polokwane. The computed factor analysis output for variables on economic implications of spatial transformation is presented in table 9.8.

Table 9.8: Rotated Factor Matrix^a: variables on economic implications of spatial transformation

	Factor			
	1	2	3	4
Implications.ST-Eco.9.Decline of CBD as business move out to other new shopping malls	.692			
Implications.ST-Eco.8.Redevlopment of properties to meet needs of people	.646			
Implications.ST-Eco.7.Increasing pressure on public services and facilities	.571			
Implications.ST-Eco.10.Property values are becoming expensive	.563			
Implications.ST-Eco.11.Increasing unemployment due to lack of jobs	.415			
Implications.ST-Eco.13.Loss of vacant land to developments		.791		
Implications.ST-Eco.12.Loss of urban agricultural land		.776		
Implications.ST-Eco.14.Economic activities concentrated in urban areas than rural areas		.629		
Implications.ST-Eco.5.Municipality not able to meet infrastructure demands by the people,			.626	
Implications.ST-Eco.4.Shortage of transport services			.617	
Implications.ST-Eco.3.Increasing transport costs			.610	
Implications.ST-Eco.6.Water supply infrastructure breakdown			.562	
Implications.ST-Eco.1.Traffic congestion because of more cars in this place				.718
Implications.ST-Eco.2.Long travel hours to get to places with opportunities				.574
Eigenvalues	4.312	1.811	1.502	1.102
Cumulative percentage of variance	30.80	43.74	54.47	62.34

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations. Factor loading less than 0.410 are not shown*

Source: Author, 2019

Table 9.8 presents the factor loadings of the 14 variables from the measurement instrument on economic implications of spatial transformation in the City of Polokwane. These results show that all 14 variables included in the measurement instrument are of practical significance, because the factor loading values for all the variable exceeded 0.40 as recommended by Field (2009; 2013).

This study adopted multiple approaches in determining the number of factors to retain namely; percentage (%) of variance i.e. above 50% Williams *et al.*, (2010 p.6), Kaiser criterion i.e. retain latent factors with eigenvalues above 1.0 (Azevedo *et al.*, 2019; Yong and Pearce 2013),

and a scree test (Yong and Pearce 2013). The scree tests results for variables from the measurement instrument on economic implications of spatial transformation in the City of Polokwane are shown in figure 9.4.

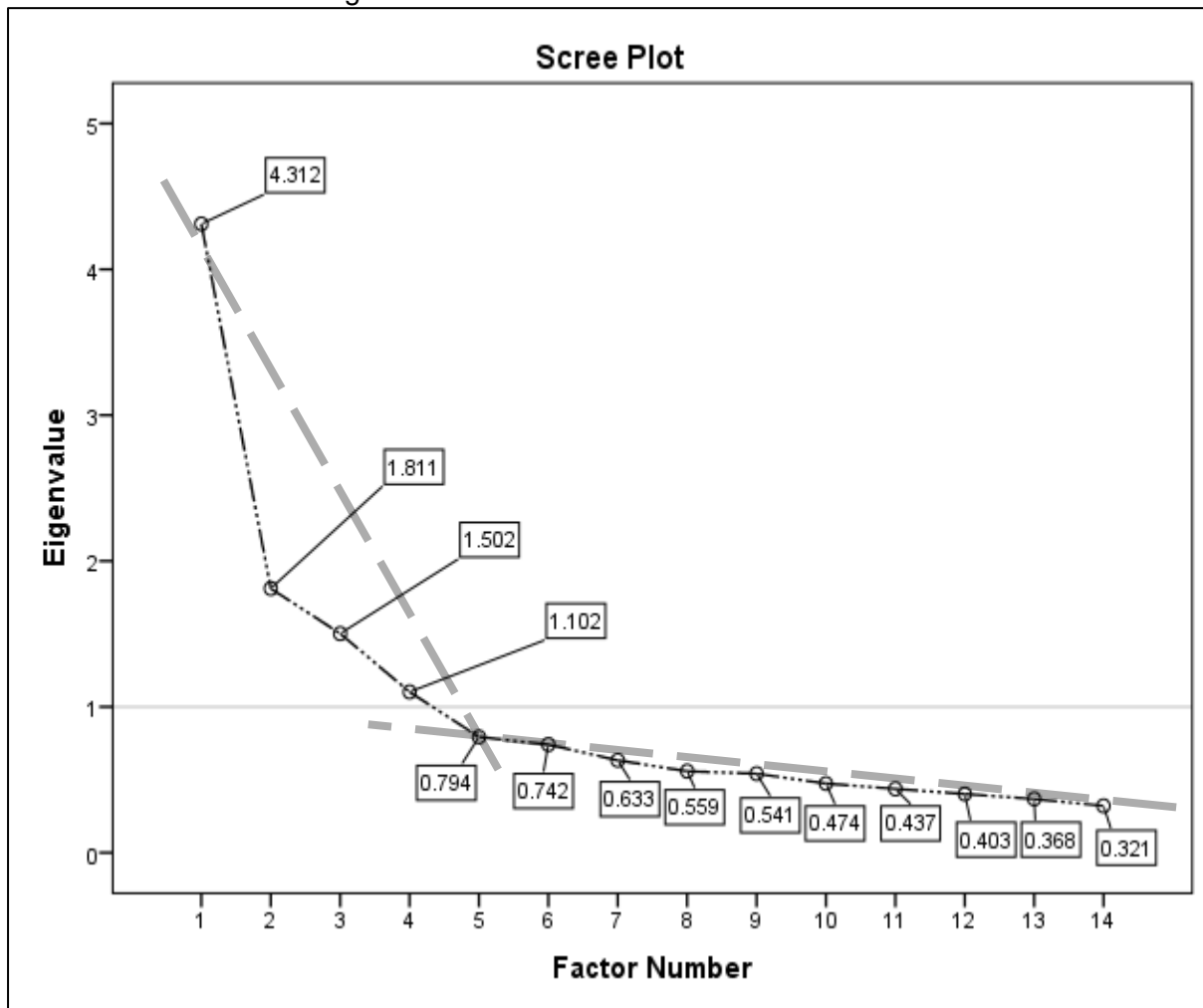


Figure 9.4: Scree plot variables on economic implications of spatial transformation

Source: Author, 2019

Figure 9.4 depicts supporting evidence that the measurement scale used has four-factor solution that explain the analysis problem economic implications of spatial transformation in the City of Polokwane. These underlying four factors are summarised in table 9.9.

Table 9.9: latent factor names: variables on economic implications of spatial transformation

Factor number	Factor name	% of variance	variables contributing to a latent factor
1	Dereliction and property value changes	30.80	Implications.ST-Eco.9.Dereliction of CBD as business move out to other new shopping malls Implications.ST-Eco.8.Redevlopment of properties to meet needs of people Implications.ST-Eco.7.Increasing pressure on public services and facilities Implications.ST-Eco.10.Property values are becoming expensive Implications.ST-Eco.11.Increasing unemployment due to lack of jobs
2	Loss of land and unjust distribution of economic activities	12.94	Implications.ST-Eco.13.Loss of vacant land to developments Implications.ST-Eco.12.Loss of urban agricultural land Implications.ST-Eco.14.Economic activities concentrated in urban areas than rural areas

3	Infrastructure challenges	10.73	Implications.ST-Eco.5.Municipality not able to meet infrastructure demands by the people, Implications.ST-Eco.4.Shortage of transport services Implications.ST-Eco.3.Increasing transport costs Implications.ST-Eco.6.Water supply infrastructure breakdowns
4	Traffic challenges	7.87	Implications.ST-Eco.1.Traffic congestion because of more cars in this place Implications.ST-Eco.2.Long travel hours to get to places with opportunities

Source: Author, 2019

Table 9.9 shows that the 14 variables were reduced into four latent factors namely: dereliction and property value changes; loss of land and unjust distribution of economic activities; infrastructure challenges; and traffic challenges. These extracted latent factors are presented using the mathematical model (4.1) in relation to measured variables as follows;

$$Y_i = b_1X_{1i} + b_2X_{2i} + \dots + b_nX_{ni} + \varepsilon_i \quad 9.2$$

$$1. \text{Dereliction and property value changes}_i = 0.692\text{Implications.ST_Eco}9_i +$$

$$0.646\text{Implications.ST_Eco}8_i + 0.571\text{Implications.ST_Eco}7_i +$$

$$0.563\text{Implications.ST_Eco}10_i + 0.415\text{Implications.ST_Eco}11_i + \varepsilon_i$$

$$2. \text{Loss of land and unjust distribution of economic activities}_i =$$

$$0.791\text{Implications.ST_Eco}13_i + 0.776\text{Implications.ST_Eco}12_i +$$

$$0.629\text{Implications.ST_Eco}14_i + \varepsilon_i$$

$$3. \text{Infrastructure challenges}_i = 0.626\text{Implications.ST_Eco}5_i +$$

$$0.617\text{Implications.ST_Eco}4_i + 0.610\text{Implications.ST_Eco}3_i +$$

$$0.562\text{Implications.ST_Eco}6_i + \varepsilon_i$$

$$4. \text{Traffic challenges}_i = 0.718\text{Implications.ST_Eco}1_i +$$

$$0.574\text{Implications.ST_Eco}2_i + \varepsilon_i$$

9.3.1 Dereliction and property value changes

The case study on Berlin echoes that spatial transformation results in negative implications, in particular after the fall of Berlin wall people relocated to the outskirts of the City living the city centre derelict (Bernt *et al.*, 2013 p.14). Similarly spatial transformation is impacting on City of Polokwane, in several ways. On one hand, it must be acknowledged that spatial transformation in line with the development directions discussed in chapter 6, particularly development of shopping centres (Seshego Circle Centre: Seshego; Mall of the North: Polokwane Central; Paledi Mall in Mankweng) and MPCC's positively impact the receiving communities by attracting further developments and promoting easy access to goods and services. On the other hand, spatial transformation patterns discussed in chapter 7, such as demographic changes, growth of built-up areas in the suburb areas among others are also negatively affecting City of Polokwane. It is slipping into uncontrollable urban decay in some areas such as the city centre (Polokwane 2016c p.9; Polokwane 2013d p.93; ACMS and WITS 2012 p.13; Polokwane SDA1 2007a p.12; Polokwane 2005 p.89). Most buildings are

characterized as fairly dilapidated (plate, 9.3) and down town area such as the Indian Complex is worst affected derelict part of the City. It has long been identified as a place that requires intervention. In support of this, chapter 6 substantiates that the City established an urban development zone (UDZ) figure 6.16 as a mechanism to facilitate urban regeneration in the city centre.

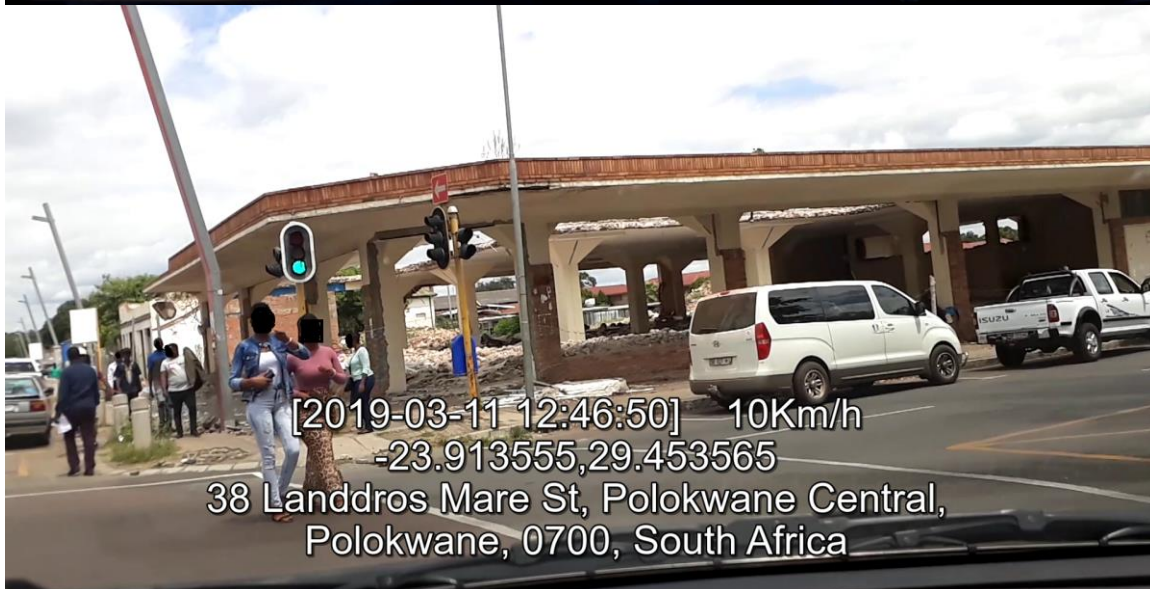
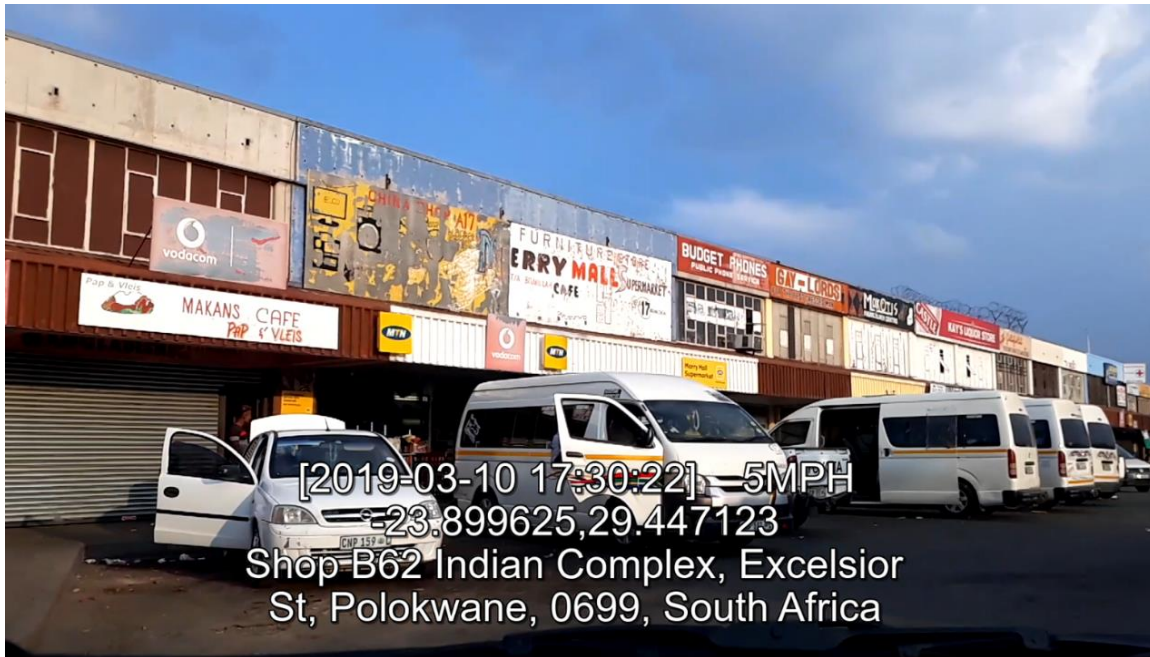


Plate 9.3: Derelict buildings in the City of Polokwane

Source: Author, 2019

Dereliction in Polokwane city centre is linked to businesses moving from the urban core to outer surrounding developed areas such as shopping malls i.e. Savannah Mall, Mall of the North among others (Polokwane 2013d p.96; Donaldson 2005 p.365). In support of this,

Polokwane (2016c p.14) points out that between 2005 and 2014, decentralized retail space developed is approximately 127 729m² an increase of 351% from 36 390 in 2005 compared to 91 575m², developed in the CBD during the same period. Similarly in Seshego, spatial transformation through development of Seshego Circle retail centre in the surrounding areas is resulting in oversupply of retail spaces causing closure of certain shops exacerbating dereliction in the City (Gildenhuys 2015 p.74). In support of this, figure 9.5, presents the geographical location of the vacant buildings in the city centre that lost tenants due to decentralization of office and retail facilities into the suburban areas.

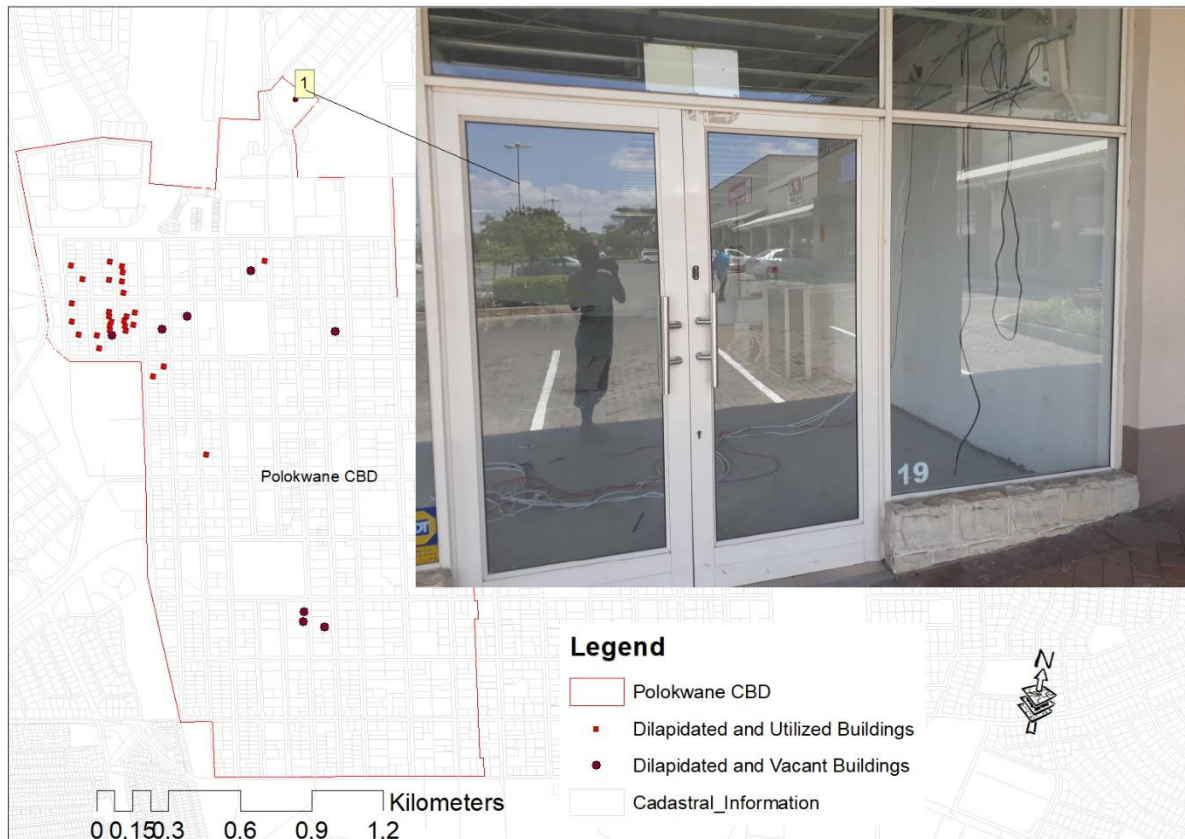


Figure 9.5: Location of vacant and or dilapidated buildings in Polokwane

Source: Adapted from Polokwane 2019

To add on, urban decay in the City of Polokwane also extends to housing, it is not only limited to shopping centres. In support of this, Donaldson and van de Merwe (1999 p.243) characterized the western area of the CBD as the having the most overcrowded rented housing facilities in Onderdorp which are in a state of decay and are not kept in a good habitable state. In addition to this, Polokwane (2005 p.13), still characterizes this area of the CBD presented in figure 9.5 showing concentration of dilapidated and utilized buildings; as the most “problematic”, with illegal boarding houses accommodating more than 20 people per house. These results suggests that spatial transformation activities such as decentralization of retail and office spaces exacerbates urban decay in cities.

In another perspective, spatial transformation activities such as gentrification and urban renewal programmes are also affecting property values in the City. In support of this, Ibrahim (2017 p.11) points out that extensive developments particularly down town have triggered property values to rise and low income earners are spending nearly 50% of their salary on housing in Toronto Canada. The poor people can no longer afford to reside in these areas and are being forced out of the areas closer to opportunities. In the case of Polokwane, the effect of urban decay such as low property values and lower rentals, is contributing to an influx of businesses that take opportunities of low rentals (Polokwane Economic Growth Research Report 2013 p.96; ACMS 2012 p.15). On the contrary, the spatial transformation activities such as spatial loosening and rapidly increasing urban population has increased the demand for land. This has affected the erf sizes and property values over the years as presented in table 9.10.

Table 9.10: Spatial transformation impact on residential erf sizes and values (1996-2019)

Suburb	1996		2019	
	Average residential Erf size m ²	Average value "R"	Average residential Erf size m ²	Average value "R"
Welgelegen	1 991	R312 981	1 100	R1 403 202
Penina Park	1 114	R226 800	727	R875 284
Nirvana	2 113	R200 734	1 379	R1 126 159
Ivy Park	1 000	R196 300	623	R927 811
Annadale	1 434	R160 500	966	R968 690
Bendor	1 048	R126 693	913	R1 637 001
Westenburg	390	R58 945	300	R352 202

Source: Derived from Donaldson and van de Merwe (1999 p.245); General Valuation Roll Polokwane LM (2019a, b, c)

Table 9.10 results support arguments from the literature that, spatial transformation has an impact on property values as evidenced in the case studies of Toronto, (Ibrahim 2017 p.8; Stats Canada 2016 p.14), Auckland (Terruhn 2020 p.134) making it more expensive for low income earners and the poor at large. Similarly, the influx of population in the City of Polokwane spiked the increase in of prices of housing and also reduced erf sizes to cater the increasing housing demand. In particular both suburbs shows a general decrease in average residential Erf sizes. Nirvana suburb had the largest erf size of 2113m² in 1996 and the average size decreased significantly to 1 379m² in 2019. Furthermore, the prices have also increased exorbitantly, particularly in Bendor Park from as little as R126 693 in 1996 to R1 637 001. This in turn impacts negatively on housing affordability, and increases disparity between the rich and the poor as the least affordable residential property is approximately R352 202 compared to a Bendor average price of R1 637 001. This in turn has forced people to buy affordable land for housing development in rural areas, as evidenced by intensive

housing development in land under tribal authorities i.e. plate 8.2 house developed in Dalmada. Kotze and Donaldson (1998 p.476) supports this citing that rates and services are cheaper in the traditional rural areas contributing to movement of people out of the City and buying residential land in the rural areas. These results denotes that spatial transformation activities such as rapid urbanization, decentralization, gentrification among others affects property values forcing people to move to the outskirts of the City.

9.3.2 Loss of land and unjust distribution of economic activities

Spatial transformation activities to accommodate increasing urban population results in loss of valuable agricultural land. In support of this, although densification reduces sprawling, by promoting compact cities, however it is linked to loss of vacant, open and green spaces in the City. In particular, 448km² of (semi)natural land and a further arable land of 961km² was lost in Toronto from spatial transformation (Stats Canada 2016 p.269). Similarly, in the context of City of Polokwane, spatial transformation is also threatening available agricultural land and sensitive environment. In support of this Polokwane (Subdivision and densification 2012 p.1) reiterates that on annual basis it receives a substantial number of applications on subdivision of agricultural land, farm portions to cater for the increasing population in the city. In addition to this, a key informant pointed out that spatial transformation in traditional authorities is leading to loss of valuable land which include,

“site allocation in environmentally sensitive areas, disaster risk areas, bigger stand sizes. For example someone gets 6000m² of land for a residential stand, land is scarce resource if more people get such sizes what will happen? Also other people come and apply for PTO’s of land same size to the whole village what would happen to the villagers?. The traditional leaders allocating sites next to road reserves or under Eskom power lines which is a human life risk as they can be electrocuted, they don’t have access to telecommunication services as the radio frequency is always interrupted by the powerlines meaning they don’t have access to internet and will be missing out from important communications. Its also a problem when SANRAIL wants to expand the road network infrastructure those people needs to be relocated and if the municipality does not have the land to compensate such people it becomes a challenge.” (Key informant CoGHSTA).

This implies that the increasing need to accommodate rising population in the City results in traditional authorities allocating land for residential development that is too big which is also unsustainable. Valuable land is also being lost from the increasing land invasion around the City (Abrahams 2017 p.11). In addition to this, another key informant raised a concern about land invasion in the City stating that;

“..we have given it out some of the stands already even if there is no bulk services. The municipality is servicing while the people are already there because you know why we are scared of the land invasion that is taking place. once there is a township and we will wait for the bulk we find out that the budget is very slow and we keeping it as vacant people start settling illegally. So rather give the beneficiary and they have to look after their property its off you hands now because the owner is going to guard that property unlike when its us we say no wait people we cannot give you now while you are waiting for the 5 years IDP whatever to get the money that we require for the infrastructure people will settle illegally. we will have to waste money now going to court and getting and removing those people it's a lot of money...” (key informant: municipal official).

In another perspective, it is inherent that despite several years of implementing spatial transformation directions, there is still evidence on imbalances in spatial distribution of economic activities in the City. In support of this figure 7.17 shows the unjust spatial distribution, concentration of different industry categories and largest share GVA contribution in few areas of the city. These areas are the 1st order node Perskebult-Polokwane and 2nd order node Mankweng-Badimong, which happen to be the areas with highest population concentration of the economically active age group. This entails that spatial transformation initiatives in post-apartheid era have not yet managed to fully redress the spatial imbalances in distribution of economic opportunities in the City.

9.3.3 Infrastructure challenges

Polokwane (2020 p.149); SACN (2014 p.13) points out that the implications of spatial transformation include straining of the inadequate and ageing infrastructure facilities. In particular, the increasing expansion of human settlements is increasing road network backlog, yet most roads in older settlements have exceeded their life span (Polokwane 2020 p.179). Consequently, the expansion of human settlements and ageing infrastructure has contributed to continuous water shortages among other challenges faced in the City of Polokwane.

However, on the bright side, the increasing pressure on infrastructure needs from the spatial transformation activities has also forced the municipality to forge partnerships for infrastructure development. In support of this, a key informant stated that spatial transformation;

“..affected the city in terms of infrastructure we are busy now upgrading our water and sewer systems which was ought to accommodate developments in the city and population growth. So that is why we are busy as you can see they are just digging everywhere because they are changing those asbestos old pipes and they are putting in the new pipes which can

accommodate development and I think there was a study done that's why there was a moratorium stopping development in certain areas, shows that our water system or sewer systems cannot accommodate further developments. That is why we are also receiving high cases reported about pipe bursting and all those things.” (Key informant: Municipal Official).

Polokwane (2020 p.176), states that a partnership was formed with the Department of Water and Sanitation for an investment of approximately R420million to replace ageing water infrastructure in the City. Plate 9.4, provide evidence that water infrastructure is being upgraded in the city centre.



Plate 9.4: Infrastructure developments

Source: Author, 2020 (Google Earth Pro)

In addition, a key informant also pointed out that;

“...available opportunities such as education institution for example Capricon FET is causing over population in Seshego, the municipality had to upgrade bulk infrastructure services to accommodate this population such as sanitation, electricity and water. They have also upgraded the roads Nelson Mandela drive to be able to carry more traffic from rural areas surrounding to Polokwane town” (Key informant: DRDLR).

This was also alluded in the discussion in chapter 6, on spatial transformation directions of the Nelson Mandela drive (figure 6.12, F1 Public Transport Integrated Corridor) and its being upgraded to accommodate the BRT system 'Leeto La Polokwane'.

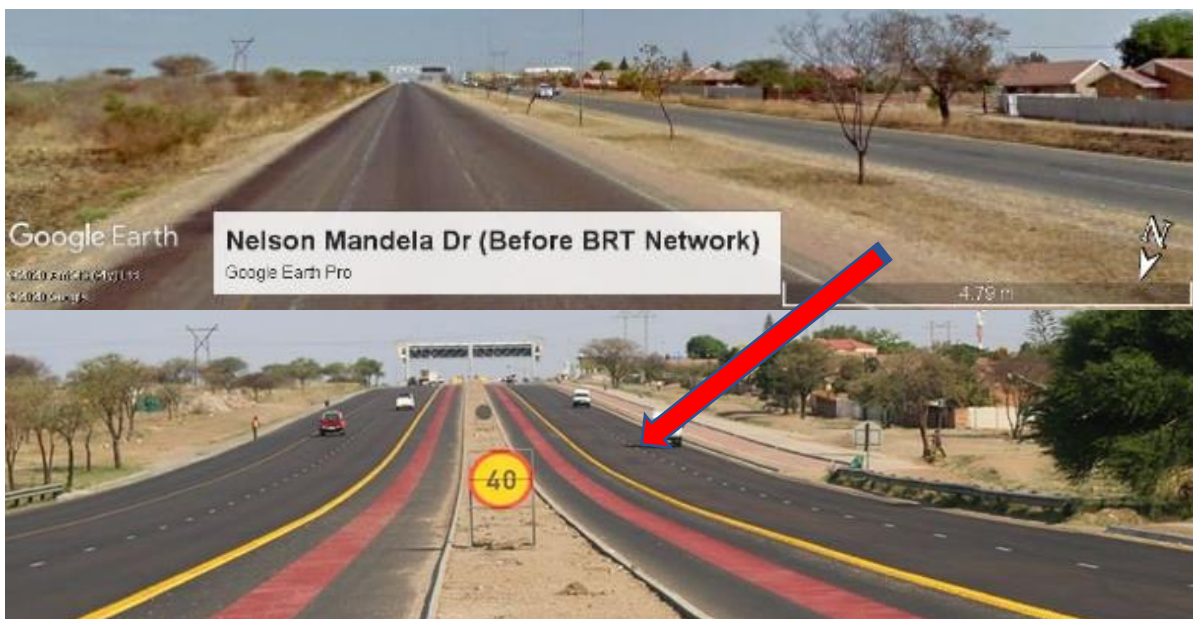


Plate 9.5: Transport network infrastructure development in Polokwane

Source: Author, 2020

Plate 9.5 shows empirical evidence that the City of Polokwane, is upgrading road infrastructure networks to accommodate the needs of the increasing pressure from spatial transformation i.e. rapid population growth in the City. This entails that the City is harnessing spatial transformation opportunities arising from human settlements development, increased urban population in this area to support a viable BRT system integrated with land uses along this transit corridor. In support of this, Polokwane LM (2014 p.21), points out that the settlements developed along the Polokwane-Moletji BRT route covers approximately $\pm 85\%$ of this corridor. This provided an opportunity to warrant the development of a BRT system along this route. This denotes that spatial transformation through development of human settlements is essential to support integrated transport and land use planning.

9.3.4 Transport challenges

Stats Canada (2016 p.14), pointed out that spatial transformation has implications on transport which include mode of travel and commuting times. In addition to this, Ibrahim (2017 p.12) reiterates that unprecedented urbanization in Toronto Canada, resulted in traffic congestion,

making it recognized as one of the cities in North America with longest commuting times. In the context of Polokwane, spatial transformation initiatives and concentration of economic activities in this provincial hub has attracted more people to the City. It is prevalent in the City that increased working population results in an increase in private vehicle ownership, ultimately leading traffic congestion as presented in plate 9.6. Polokwane (CBD PLAN 2005 p.70) concurs with this citing that the increasing number of work force in the CBD is also associated with the increase in private vehicle ownership, leading to traffic congestion in the City. In addition to this, Polokwane, LM (2014b p.4), supports that traffic congestion is a daily issue in the City during peak hours on roads mostly used by public transport. However, traffic congestion in the City is still witnessed in other roads without the presence of public transport, and it is also reported in the CBD during peak hours (Capricorn DM 2010 p.11).



Plate 9.6: Traffic congestion in Polokwane

Source: Author, 2020

Although congestion remains an issue, spatial transformation initiatives that were taken to reduce this challenge include development of the Polokwane N1 eastern by pass presented in figure 6.13. This by-pass route filters unnecessary local and regional traffic from the city centre as was the case in past when N1 traffic passed through the city centre exacerbating traffic congestion (Polokwane CBD PLAN 2005 p.77). This denotes that the implications of demographic spatial transformation of cities through rapid urbanization is twofold. On one hand, there are negative implications of traffic congestion, long travel hours, increased pollution from fuel combustion when more people own private vehicles, and prefer driving than using public transport. On the other hand, this also pushes the local authority from being

comfortable with the situation and provide solutions to cater for the increasing urban population such as developing BRT systems, arterial roads, by-pass routes among others, leading to the improvement of economic vitality of the city.

In another perspective, it is evident that spatial transformation is contributing to inadequate parking in the City of Polokwane. In support of this, Polokwane (CBD PLAN 2005 p.49), cites that there is lack of adequate parking spaces in the City (Plate 9.7), despite having ± 20 different parking areas around the City that are accessible to the public within a 5 minutes walking distance. However, the situation is worsened at month end when people flock to the City for shopping and by the general behaviour of people wanting to park in front of facilities they are accessing. This is also linked to the perception that if they park in an area where the car is not visible to them, their vehicle will not be safe (Polokwane CBD PLAN 2016 p.30; Polokwane CBD PLAN 2005 p.23).



Plate 9.7: Illegal parking in Polokwane

Source: Author, 2020

Although there are parking areas made available in the City, the expansion of the CBD boundary incorporating areas around Biccard and Voortrekker makes it unfavourable for people to walk to get access to offices in these areas. This in turn, is causing illegal parking blocking the sidewalks in these areas. In addition, parking issue in Polokwane is complex, Capricorn DC (2010 p.vi), stated that a detailed study is required on parking, the parking meters are damaged, more people must be employed to control parking in the City. This implies that parking challenges has long been issue in the City, the situation is further exacerbated by spatial transformation.

It is evident that spatial transformation activities in Polokwane have resulted in growing built-up areas (figure 7.14) and population increase in the surrounding rural areas adjacent to the city centre. Polokwane being the provincial hub is a multi-purpose centre offering most

functions, services and employment opportunities which attract people to travel from the rural areas largely relying on public transport. Consequently, this has resulted in inadequate public transport and related facilities in the City as presented in plate 9.8. In support of this, Polokwane, (2016c p.27; 2014b p.4; 2005 p.21), cites that transport remains a challenge, there is lack of long distance transport facilities, inadequate pick-up or drop-off points, inadequate public transport lay byes, taxis park blocking sidewalks and other parking spaces in the city. This challenge also extends to other major settlement clusters in the City, in particular the portion of parking lot at PnP in Mankweng was converted into a taxi rank (Polokwane 2013b p.18).



Plate 9.8: Lack of Public transport facilities

Source: Author, 2019

Polokwane (CBD PLAN 2005 p.49), in acknowledgement of the key role the City plays as the provincial hub and northern gateway to Africa proposals are made for development of 'transportation hub or logistic cluster' leveraging on the existing airport.

Spatial transformation in Polokwane contributed to development of human settlement adjacent to the City as witnessed by increasing population density, infill development and spatial integration as evidenced in figure 7.14 and 7.20. Subsequently, majority of the poor people commute to the City using other alternative modes of transport such as walking, cycling and others. However, the challenge is that the road infrastructure in the City is not yet developed sufficiently to accommodate non-motorised transport (NMT) (Polokwane CBD 2016 p.28). Consequently, this hinders easy mobility of people forcing the cyclists to share the road with vehicular traffic (plate 9.9), a huge risk to their lives.



Plate 9.9: Lack of NMT- cycling facilities

Source: Author, 2019

It must be acknowledged that spatial transformation experiences forced the municipality to initiate developments for NMT facilities. In support of this, Capricorn DM (2010 p.12) cites that sidewalks must be developed along Nelson Mandela Drive. This concurs with the spatial transformation directions discussed in chapter 6 that some streets need to support NMT, particularly Nelson Mandela Drive leading to Churchill Street as it has the highest pedestrian volume count of approximately 2550 people (Polokwane LM 2014b p.66). Plate 9.10 shows a google image providing evidence that Polokwane is implementing the NMT plans as sidewalks are already developed as people are seen walking in these dedicated areas.



Plate 9.10: NMT-Sidewalks along Nelson Mandela Dr

Source: Adapted from Google Earth Pro (2020)

9.4 Social implications of spatial transformation

To examine social implications of spatial transformation in the City of Polokwane, exploratory factor analysis (EFA) was employed. The results for the correlation coefficient matrix for the 12 items that were used in the questionnaire measurement instrument are presented in table 9.11.

Table 9.11 : Correlation matrix^a on variables on social implications of spatial transformation

	1	2	3	4	5	6	7	8	9	10	11	12
Implications.ST-Soc.1	1.000											
Implications.ST-Soc.2.	.538	1.000										
Implications.ST-Soc.3.	.465	.420	1.000									
Implications.ST-Soc.4.	.279	.354	.476	1.000								
Implications.ST-Soc.5.	.195	.319	.407	.563	1.000							
Implications.ST-Soc.6.	.332	.256	.366	.363	.474	1.000						
Implications.ST-Soc.7.	.215	.221	.272	.319	.319	.407	1.000					
Implications.ST-Soc.8.	.243	.219	.283	.212	.204	.249	.482	1.000				
Implications.ST-Soc.9.	.122	.218	.182	.134	.183	.222	.269	.473	1.000			
Implications.ST-Soc.10.	.194	.182	.202	.175	.163	.247	.208	.275	.390	1.000		
Implications.ST-Soc.11.	.089	.122	.201	.107	.100	.132	.192	.276	.261	.339	1.000	
Implications.ST-Soc.12.	.203	.255	.062	.096	.104	.071	.193	.246	.332	.319	.391	1.000

a. Determinant = .037

In assessing the problems of multicollinearity the study followed rules highlighted in a study by Ashehri (2012) and augmented by checking the computed determinant score i.e. rule of thumb for absence of multicollinearity >0.00001 . Table 9.11 shows that the determinant score is 0.037, which is greater than the suggested rule of thumb score. Therefore, the variables seems to have a patterned relationship and there is the absence of multicollinearity problem.

The factorability of output matrix, was scrutinized using the statistical procedures, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity as highlighted in a study by Bai, Hira and Deshpande (2016). The results for these two statistical procedures are presented in table 9.12.

Table 9.12: KMO and Bartlett's Test: variables on social implications of spatial transformation

Kaiser-Meyer-Olkin MSA.		.793
Bartlett's Test of Sphericity	Approx. Chi-Square	1235.507
	df	66
	Sig.	.000

Source: Author, 2019

The results presented in table 9.12 shows that, computed KMO statistic 0.793, is greater than 0.50 recommended in a study by Lin and Wu (2016), indicating sampling adequacy. The computed statistic for Bartlett's test of sphericity, Approx. Chi-square $\chi^2 = 1235.507$, (df) 66, Sig. value is statistically significant (less than 0.05) at $p < 0.001$, demonstrating that R-matrix is not an identity matrix. The reproduced correlations matrix was also assessed to check the residuals that were computed between observed and reproduced correlations, there were 16 (24.0%) nonredundant residuals with absolute values greater than 0.05, which is way below the acceptable value of $<50\%$ (Field 2009). The computed anti-image matrix^a showed that the diagonal values of individual variables KMO criterion for measurement of sampling adequacy (MSA) ranged between 0.724^a to 0.848^a which is above the acceptable values of >0.50 . In

view of Field (2009; 2013), these results indicate that variables included in this analysis have adequate relationships for EFA as distinct and reliable factors can be yielded that are useful in determining social implications of spatial transformation in the City of Polokwane. The computed factor analysis output for variables on social implications of spatial transformation is presented in table 9.13.

Table 9.13: Rotated Factor Matrix^a: variables on social implications of spatial transformation

	Factor		
	1	2	3
Implications.ST-Soc.5.Loss of open spaces to illegal developments	.735		
Implications.ST-Soc.4.Informal settlements development	.658		
Implications.ST-Soc.6.Poor service provision in certain areas than others	.561		
Implications.ST-Soc.3.increasing demand of basic service provision such as water	.495		
Implications.ST-Soc.7.People living in poverty are increasing	.447		
Implications.ST-Soc.9.Poor interaction with neighbours		.626	
Implications.ST-Soc.8.Housing shortages		.557	
Implications.ST-Soc.12.Restrictions on movement people to other areas, gated communities		.553	
Implications.ST-Soc.10.Increasing criminal activities		.525	
Implications.ST-Soc.11.increasing demand of student accommodation		.517	
Implications.ST-Soc.1.Increasing separation between the poor and the rich			.779
Implications.ST-Soc.2.Public health risks			.596
Eigenvalues	3.9421	1.6741	1.128
Cumulative percentage of variance	32.8546	80.0562	86.20

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations. Factor loading less than 0.445 are not shown

Source: Author, 2019

Table 9.13 presents the factor loadings of the 12 variables from the measurement instrument on social implications of spatial transformation in the City of Polokwane. These results show that all 12 variables included in the measurement instrument are of practical significance, because the factor loading values for all the variable exceeded 0.40 as recommended by Field (2009; 2013). This study adopted multiple approaches in determining the number of factors to retain namely; percentage (%) of variance i.e. above 50% Williams *et al.*, (2010 p.6), Kaiser criterion i.e. retain latent factors with eigenvalues above 1.0 (Azevedo *et al.*, 2019; Yong and Pearce 2013), and scree test (Yong and Pearce 2013). The scree tests results for variables from the measurement instrument on spatial characteristics/biophysical factors driving spatial transformation in the City of Polokwane are shown in figure 9.6.

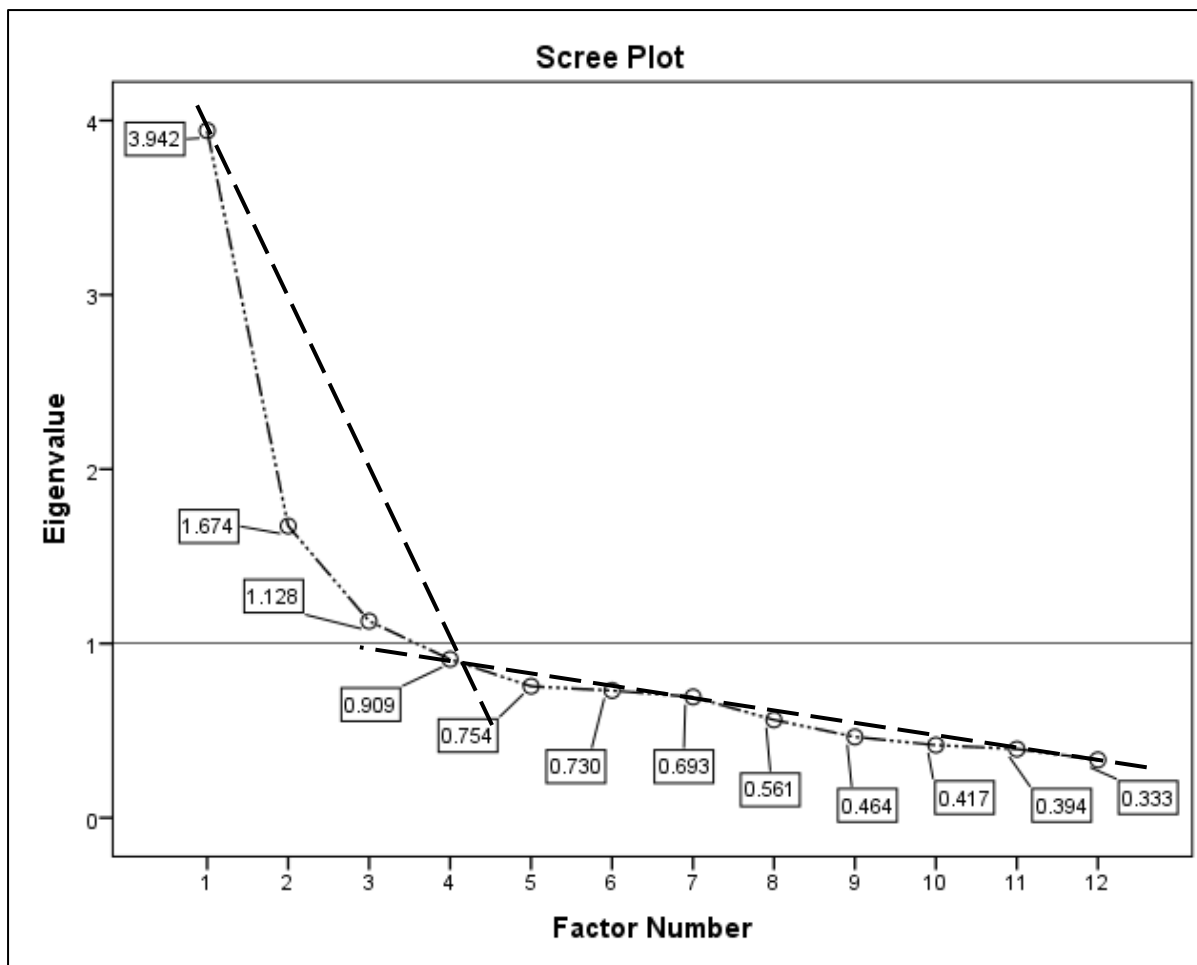


Figure 9.6: Scree plot variables on social implications of spatial transformation

Source: Author, 2019

Figure 9.6 depicts supporting evidence that the measurement scale used has three-factor solution that explain the analysis problem social implications of spatial transformation in the City of Polokwane. These underlying three factors are summarised in table 9.14.

Table 9.14: latent factor names: variables on social implications of spatial transformation

Factor number	Factor name	% of variance	variables contributing to a latent factor
1	Urban informality, poor services and deprivation	32.85	Implications.ST-Soc.5.Loss of open spaces to illegal developments Implications.ST-Soc.4.Informal settlements development Implications.ST-Soc.6.Poor service provision in certain areas than others Implications.ST-Soc.3.increasing demand of basic service provision such as water Implications.ST-Soc.7.People living in poverty are increasing
2	Poor social cohesion, housing shortage and crime	13.95	Implications.ST-Soc.9.Poor interaction with neighbours Implications.ST-Soc.8.Housing shortages Implications.ST-Soc.12.Restriction of movement people to other areas, gated communities Implications.ST-Soc.10.Increasing criminal activities Implications.ST-Soc.11.increasing demand of student accommodation
3	Spatial segregation	9.40	Implications.ST-Soc.1.Increasing separation between the poor and the rich Implications.ST-Soc.2.Public health risks

Source: Author, 2019

Table 9.14 shows that the 12 variables were reduced into three latent factors namely: urban informality and deprivation; poor social cohesion, housing shortage and crime; and spatial segregation. These extracted latent factors are presented using the mathematical model (4.1) in relation to measured variables as follows;

$$Y_i = b_1X_{1i} + b_2X_{2i} + \dots + b_nX_{ni} + \varepsilon_i \quad 9.3$$

$$\begin{aligned} 1. \text{Urban informality, poor services and deprivation}_i = & \\ 0.735\text{Implications.ST_Soc5}_i + 0.658\text{Implications.ST_Soc4}_i + & \\ 0.561\text{Implications.ST_Soc6}_i + 0.495\text{Implications.ST_Soc3}_i + & \\ 0.447\text{Implications.ST_Soc7}_i + \varepsilon_i & \end{aligned}$$

$$\begin{aligned} 2. \text{Poor social cohesion, housing shortage and crime}_i = & \\ 0.626\text{Implications.ST_Soc9}_i + 0.557\text{Implications.ST_Soc8}_i + & \\ 0.553\text{Implications.ST_Soc12}_i + 0.525\text{Implications.ST_Soc10}_i + & \\ 0.517\text{Implications.ST_Soc11}_i + \varepsilon_i & \end{aligned}$$

$$\begin{aligned} 3. \text{Spatial segregation}_i = 0.779\text{Implications.ST_Soc1}_i + & \\ 0.596\text{Implications.ST_Soc2}_i + \varepsilon_i & \end{aligned}$$

9.4.1 Urban informality, poor services and deprivation

The social realities emerging from spatial transformation reveals patterns of urban informality in the City of Polokwane. In support of this, Polokwane (IDP 2020 p.74), cites that there is an influx of people in the less formal settlements adjacent to the City, burdening the City to provide social services and infrastructure in these areas. The informal settlements are sprawling across the urban centres in the City, that has potential to offer better quality of life (Polokwane IDP 2020 p.255). Consequently, this has resulted in increased number of people residing in social conditions that are poor, such as informal settlements, backyard structures built with poor quality materials, overcrowded and lacking basic service access (Polokwane IDP 2020 p.115). In essence, the informal settlements are regarded as a threat in the City, in 1996 there were 10 447 informal dwellings and rose to 16 044 in 2011 (Polokwane 2020 p.85).

In another perspective, Donaldson and van de Merwe (1999 p.235), cites that there was no evidence of informality i.e. informal trading in Polokwane CBD around early 1990s. However, it is evident that spatial transformation in post-apartheid era contributed to concentration of informal traders in major urban centres of Polokwane as presented in Plate 9.11.

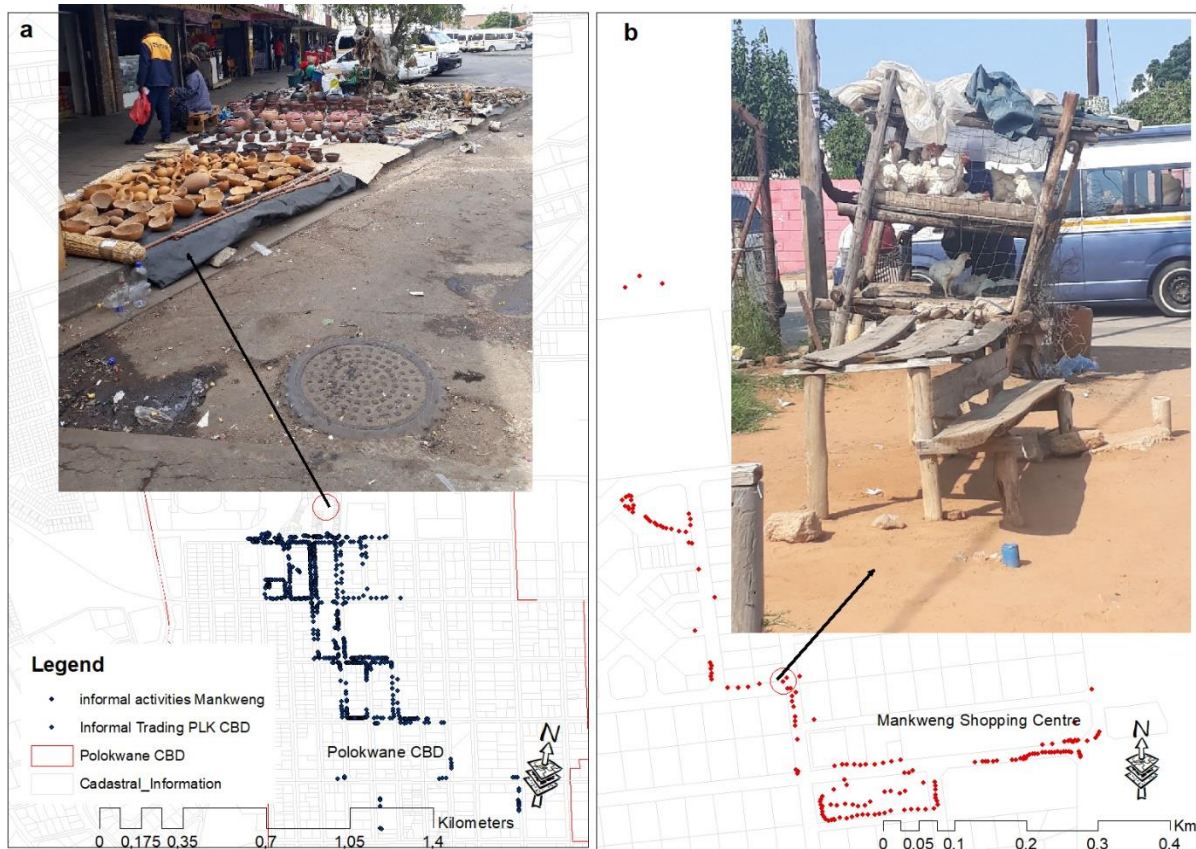


Plate 9.11: Informal trading in Polokwane

Source: Author, 2020

Literature reveals that local authorities around the world and in South Africa are failing to provide adequate and quality basic services to increasing urban population, despite having financial support from the central government (Chipu 2011 p.iii). In addition to this, a study by Chipu (2011 p.3) cites despite Polokwane's 86,46% capital budget for infrastructure development and basic service provision for the financial year 2008-10, communities still complain of poor quality services. Mmola (2012 p.64) concurs with this, stating that there are basic service delivery issues experienced in rural communities of Polokwane. On the contrary, despite the increasing population in the City, findings of StatsSA 2016 community survey presented in table 9.15 reveals that majority of the residents in both urban, traditional and farm areas consider the quality of service provision as good and average.

Table 9.15: Rating of the overall quality service provision in Polokwane

Rating of the overall quality	Geo type	Good	%	Average	%	Poor	%	No access	%	Do not use	%	Unspecified	%
Water Services	Urban	162827	20,43	88629	11,12	19427	2,44	863	0,11	250	0,03	88	0,01
	Traditional	188232	23,61	190462	23,89	116087	14,56	17817	2,24	386	0,05	750	0,09
	Farms	8595	1,08	1715	0,22	700	0,09	299	0,04	-	-	-	-
Refuse removal	Urban	189598	23,79	70430	8,84	9328	1,17	2091	0,26	702	0,09	35	0,00
	Traditional	70771	8,88	124768	15,65	88311	11,08	209562	26,29	19419	2,44	903	0,11
	Farms	6476	0,81	1328	0,17	488	0,06	2632	0,33	385	0,05	-	-
Electricity supply	Urban	157299	19,73	88855	11,15	22357	2,80	1949	0,24	1407	0,18	217	0,03
	Traditional	335637	42,11	124897	15,67	27147	3,41	23349	2,93	2079	0,26	626	0,08
	Farms	8218	1,03	2085	0,26	366	0,05	451	0,06	188	0,02	-	-
Toilet/sanitation	Urban	191479	24,02	66023	8,28	12836	1,61	847	0,11	670	0,08	230	0,03
	Traditional	171774	21,55	166610	20,90	109971	13,80	55706	6,99	8495	1,07	1178	0,15
	Farms	8950	1,12	1510	0,19	432	0,05	93	0,01	323	0,04	-	-

Source: StatsSA SuperCROSS 2016

Good-average overall quality rating of service provision in the City of Polokwane, proves that the City is performing well despite having pressure from rapid urbanization and spatial transformation initiatives in the city. Furthermore, the City acknowledges that spatial transformation is increasing service delivery backlogs. In support of this, Polokwane (IDP 2020 p.179) reveals the service backlog of; roads (6 131.5km), waste (84 281HH), housing (65 000 HH), electricity (11307HH), sanitation (92 815HH) and sanitation (40585HH).

9.4.2 Poor social cohesion, housing shortage and crime,

Spatial transformation is contributing to poor social networks, connectedness, solidarity and community support in the City of Polokwane. A study by ACMS and WITS (2012 p.46) on migration in Polokwane points out that a large proportion of migrants both internal and international had no place to borrow money in case of emergency because they lacked strong social relations with their neighbours. In particular, there is lack of trust, and community integration leading to poor social cohesion in the City of Polokwane (African Centre for Migration & Society & Feinstein International Centre (ACMS and FIC) & WITS 2012 p.51). Lack of social cohesion in the City is also being exacerbated by social class segregation between the rich and the poor, and through development of gated communities characterized by target hardening (Lukhele 2015 p.97). This concurs with Ibrahim (2017 p.11) who pointed out that extensive up market developments in Toronto Canada, are contributing to poor social cohesion, as low income earners are spending nearly 50% of their salary on housing. This pushes them out of the inner city, further increased “socio-spatial inequality and polarisation” (Walks 2001 p.436; Brushett 2001 p.18).

In addition, spatial transformation results in increased urban population, ultimately leading to increased housing supply shortages. Similarly, increased population in the City of Polokwane has caused social and non-social housing shortages (Polokwane 2020 p.138). In support of this, the housing backlog for 2008 was 35 627 (Polokwane IDP 2008 p.27), and has significantly increased with the rise of population in the City to 65 000 in 2019 (Polokwane IDP 2020 p.179). Although, spatial transformation is contributing to increased housing backlog in the City, it must be acknowledged that Polokwane has development plans in place to reduce this challenge. In support of this Polokwane (2020 p.138) points out that the major three proposed housing developments in the City include social housing projects; Ga-Rena Phase 2, Ext 76 rental housing, and Student accommodation (Ext 106 and 108). These results of housing backlogs in Polokwane concurs with case study literature that the implication of spatial transformation include housing shortages in cities around the world (Terruhn 2020 p.134; Zari 2018 p.170; Ibrahim 2017 p.8; Stats Canada 2016 p.14; Salmon 2015 p.2).

Polokwane (CBD PLAN 2005 p.99) adds that spatial transformation, has resulted in aspects such as increasing crime rates and poor by-laws enforcement in the City. In addition to this, there are also increasing cases of vandalism and theft of available infrastructure, such as the iron manhole covers which is a threat to peoples safety in the City (Polokwane 2020 p.176). To get better nuanced understanding of the level of safety in Polokwane, table 9.16 shows that only 5,2% (41 748) of 792127 people in the City were victims of crime. In addition to this 522188 people (65,51%) feel that the City is very safe and further 183188 (22,98%) view it as fairly safe compared to 34559 (4,34%) people that feel the city as very unsafe. This denotes that the issue of criminality can not be dismissed in Polokwane, however its magnitude is not severe and it does not pose a huge threat to migrants coming to the City.

Table 9.16: Victims of crime and Safety in Polokwane 2016 Community Survey

Victim of crime	Number of people	Percentage	Safety	Number of people	Percentages
Yes	41748	5,2%	Very safe	522188	65,51%
No	750770	94,2%	Fairly safe	183188	22,98%
Do not know	3387	0,4%	A bit unsafe	56849	7,13%
Unspecified	1222	0,2%	Very unsafe	34559	4,34%
Total	797127	100%	Unspecified	344	0,04%
			Total	797127	100%

Source: StatsSA SuperCROSS 2016

The low rate of people that are victims of crime is attributed to concentration of crime hotspots in certain areas in the City such as the urban centres. Feinstein IC & WITS (2012 p.50) in their study pointed out that more than one-fifth or +160 from 800 of the participants were victims of theft in City. Interestingly, the researcher and the team of research assistants were also victims

of theft during the field survey in Polokwane CBD. These results concurs with Munzwa and Wellington (2010 p.139), that implications of spatial transformation include increased poor safety concerns in cities. However the nature, and extent of severity of criminal activities differs between cities, in this study, the low rates of victims of crime, corroborates with the view that Polokwane is a safe area making it a favourable destination for most people.

9.4.3 Spatial segregation.

Donaldson and Kotze (2006 p.571) pointed out that spatial segregation was embedded in the establishment of the City, along race and socio-economic status. In line with this perspective, it can be acknowledged that spatial transformation contributed to significant racial desegregation in the city as presented in figure 7.12. SACN (2014 p.23) concurs with this citing that in post-apartheid era blacks had access to buy properties in previously white owned areas leading to racial desegregation. In addition to this, Donaldson and Kotze (2006 p.572) cites that eight years after abolishment of apartheid legislations Polokwane's level of racial desegregation was averaging up to 32%. The white suburbs that experienced highest desegregation were Penina Park (44%) and Flora Park Park (62%). In addition, a key informant reiterated that spatial transformation contributed to desegregation stating that;

“not only white people stay there anymore in Penina Park, there are now a lot of black people staying there now, owning properties...promoting integration and sharing of resources” (Key informant: HDA).

On the contrary, there is also another form of segregation emerging in the City, which social class-based segregation between the rich and the poor. Donaldson and Kotze (2006 p.567); Donaldson and van de Merwe (1999 p.238) pointed out that there are various structural forces perpetuating the inherent reality of socio-spatial segregation in the City. In particular gated communities are being developed and other elite suburbs are noticed in the City. For example Ster Park suburb, an upmarket area is nicknamed 'Tender park' for the high income earners and those getting huge tenders (SACN 2014 p.24). Thus, it is evident that implications of spatial transformation manifests itself in spatial injustice, as evidenced in the case study of Auckland which resulted in reinforced segregation by making the City liveable for the rich only such as land owners, developers and investors (Cole 2017 p.1; Salmon 2015 p.51).

Similarly, the manifestation of spatial transformation in increased property prices is also reinforcing spatial segregation between different social classes in the City of Polokwane. In the view of the spatial justice theory, this implies injustice through spatial disparities on where different social classes live in relation to areas of opportunities. Interestingly, the high income earners live in their own affluent communities (Bendor, Welgelegen) closer to opportunities and the city centre were as the poor, low income earners are forced to live in areas far away

from areas of economic opportunities were rental are cheaper. This concurs with the view that South African cities are still deeply divided along societal class contributing to spatial inequalities (Polokwane 2013d p.26).

9.5 Governance and political implications of spatial transformation

To analyse governance and political implications of spatial transformation in the City of Polokwane, exploratory factor analysis (EFA) was employed. The results for the correlation coefficient matrix for the 10 items that were used in the questionnaire measurement instrument are presented in table 9.17.

An initial analysis was run and it was noticed that variable 7 was cross-loading strongly on 2 latent factors. It was dropped and the analysis was run again and a simple structure was obtained. Table 9.17 shows the correlation matrix on variables of social and cultural norms driving spatial transformation.

Table 9.17: Correlation Matrix^a governance and political implications of spatial transformation

	Implications. ST-GP.1	Implications. ST-GP.2	Implications. ST-GP.3	Implications. ST-GP.4	Implications. ST-GP.5	Implications. ST-GP.6	Implications. ST-GP.8	Implications. ST-GP.9	Implications. ST-GP.10.
Correlation	1.000								
Implications.ST-GP.1	1.000								
Implications.ST-GP.2	.471	1.000							
Implications.ST-GP.3	.364	.490	1.000						
Implications.ST-GP.4	.268	.293	.379	1.000					
Implications.ST-GP.5	.221	.175	.332	.510	1.000				
Implications.ST-GP.6	.187	.246	.317	.314	.447	1.000			
Implications.ST-GP.8	.167	.288	.325	.263	.301	.372	1.000		
Implications.ST-GP.9	.213	.224	.255	.266	.270	.230	.478	1.000	
Implications.ST-GP.10	.143	.201	.216	.240	.254	.245	.346	.443	1.000

a. Determinant = .112

Source: Author, 2019

In assessing the problems of multicollinearity the study followed rules highlighted in a study by Ashehri (2012) and augmented by checking the computed determinant score i.e. rule of thumb for absence of multicollinearity >0.00001 . Table 9.17 shows that the determinant score is 0.112, which is greater than the suggested rule of thumb score. Therefore, the variables seems to have a patterned relationship and there is the absence of multicollinearity problem.

The factorability of output matrix, was scrutinized using the statistical procedures, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity as highlighted in a study by Bai, Hira and Deshpande (2016). The results for these two statistical procedures are presented in table 9.18.

Table 9.18: KMO and Bartlett's Test: variables on governance and political implications of spatial transformation

Kaiser-Meyer-Olkin MSA.		.806
Bartlett's Test of Sphericity	Approx. Chi-Square	824.093
	df	36
	Sig.	.000

Source: Author, 2019

The results presented in table 9.18 shows that, computed KMO statistic 0.806, is greater than 0.50 recommended in a study by Lin and Wu (2016), indicating sampling adequacy. The computed statistic for Bartlett's test of sphericity, Approx. Chi-square $\chi^2 = 824.093$, (df) 36, Sig. value is statistically significant (less than 0.05) at $p < 0.001$, demonstrating that R-matrix is not an identity matrix. The reproduced correlations matrix was also assed to check the residuals that were computed between observed and reproduced correlations, there were 2 (5.0%) nonredundant residuals with absolute values greater than 0.05, which is way below the acceptable value of <50% (Field 2009). The computed anti-image matrix^a showed that the diagonal values of individual variables KMO criterion for measurement of sampling adequacy (MSA) ranged between 0.757^a to 0.851^a which is above the acceptable values of >0.50. In view of Field (2009; 2013), these results indicates that variables included in this analysis have adequate relationships for EFA as distinct and reliable factors can be yielded that are useful in determining governance and political implications of spatial transformation in the City of Polokwane. The computed factor analysis output for variables on governance and political implications of spatial transformation is presented in table 9.19.

Table 9.19: Rotated Factor Matrix^a: variables on governance and political implications of spatial transformation

	Factor		
	1	2	3
Implications.ST-GP.2.Conflicts between municipality and traditional authorities over land	.803		
Implications.ST-GP.3.Lack of transfer of powers from government to municipality	.547		
Implications.ST-GP.1.Land use control challenges	.538		
Implications.ST-GP.5.Municipality has inadequate capacity to control developments		.838	
Implications.ST-GP.4.Development conflicts between municipality & traditional authorities		.521	
Implications.ST-GP.6.Corruption on distribution of resources and opportunities		.444	
Implications.ST-GP.9.Inadequate government infrastructure development fun			.726
Implications.ST-GP.8.Exclusion of people in municipal decision making processes			.578
Implications.ST-GP.10. Community organizations fighting for illegal settlers			.533
Eigenvalues	3.405	1.218	1.035
Cumulative percentages of variance	37.835	51.366	2.862

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

Source: Author, 2019

Table 9.19 presents the factor loadings of the 9 variables from the measurement instrument on governance and political implications of spatial transformation in the City of Polokwane. These results show that all 9 variables included in the measurement instrument are of practical significance, because the factor loading values for all the variable exceeded 0.40 as recommended by Field (2009; 2013).

This study adopted multiple approaches in determining the number of factors to retain namely; percentage (%) of variance i.e. above 50% Williams *et al.*, (2010 p.6), Kaiser criterion i.e. retain latent factors with eigenvalues above 1.0 (Azevedo *et al.*, 2019; Yong and Pearce 2013), and scree test (Yong and Pearce 2013). The scree test results for variables from the measurement instrument on governance and political implications of spatial transformation in the City of Polokwane are shown in figure 9.7.

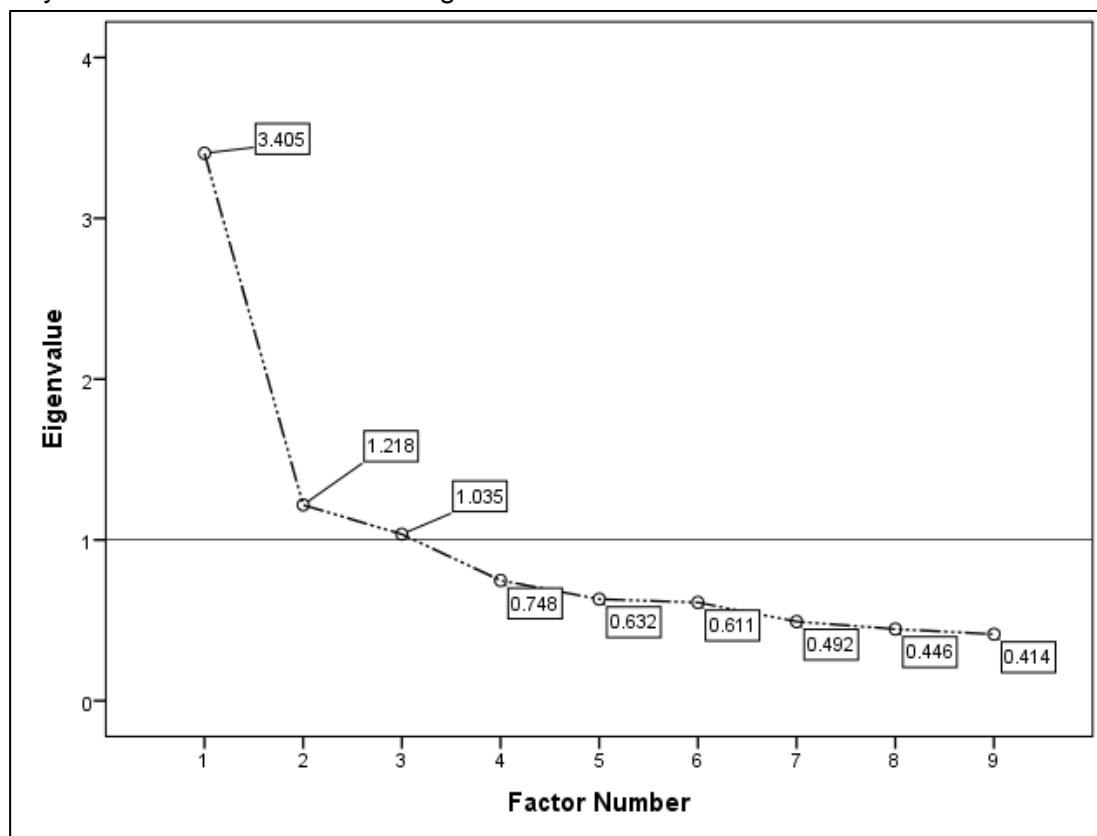


Figure 9.7: Scree plot variables on governance and political implications of spatial transformation

Source: Author, 2019

Figure 9.7 depicts supporting evidence that the measurement scale used has three-factor solution that explain the analysis problem governance and political implications of spatial transformation in the City of Polokwane. These underlying four factors are summarised in table 9.20.

Table 9.20: latent factor names: variables on governance and political implications of spatial transformation

Factor number	Factor name	% of variance	variables contributing to a latent factor
1	Land and power challenges	37.83	Implications.ST-GP.2.Conflicts between municipality and traditional authorities over land Implications.ST-GP.3.Lack of transfer of powers from government to municipality Implications.ST-GP.1.Land use control challenges
2	Lack of capacity and development conflicts	13.53	Implications.ST-GP.5.Municipality has inadequate capacity to control developments Implications.ST-GP.4.Development conflicts between municipality & traditional authorities Implications.ST-GP.6.Corruption on distribution of resources and opportunities
3	Marginalization of the poor	11.51	Implications.ST-GP.9.Inadequate government infrastructure development fun Implications.ST-GP.8.Exclusion of people in municipal decision making processes Implications.ST-GP.10. Community organizations fighting for illegal settlers

Source: Author, 2019

Table 9.20 shows that the 9 variables were reduced into three latent factors namely: land and power challenges; lack of capacity and development conflicts; and marginalization of the poor. These extracted latent factors are presented using the mathematical model (4.1) in relation to measured variables as follows;

$$Y_i = b_1X_{1i} + b_2X_{2i} + \dots + b_nX_{ni} + \varepsilon_i \quad 9.4$$

$$1. \text{Land and power challenges}_i = 0.803\text{Implications.ST_GP}2_i + 0.547\text{Implications.ST_GP}3_i + 0.538\text{Implications.ST_GP}1_i + \varepsilon_i$$

$$2. \text{Lack of capacity and development conflicts}_i = 0.838\text{Implications.ST_GP}5_i + 0.521\text{Implications.ST_GP}4_i + 0.444\text{Implications.ST_GP}6_i + \varepsilon_i$$

$$3. \text{Marginalization of the poor}_i = 0.726\text{Implications.ST_GP}9_i + 0.578\text{Implications.ST_GP}8_i + 0.533\text{Implications.ST_GP}10_i + \varepsilon_i$$

9.5.1. Land and power challenges,

Polokwane (2020 p.90) points out that the city “owns a sizable number of land parcels within the urban area”. However, the exponential rate at which the urban population is growing at, these few farm portions, agricultural holdings among others are not adequate for housing development. In contradiction to the earlier statement, (Polokwane Economic Growth Research Report 2013 p.30), argues that there is shortage of land in urban areas for development of housing projects attributed to the sale and or leasing of municipal property for short term financial gain to the private sector and a lack of coordinated inter-governmental planning and communication. In addition to this, Polokwane (2020 p.98, 291, 766) acknowledges that limited availability of land in the City; i) makes it difficult for the City to supply or deliver services at the rate at which the population is growing ii) causing disputes in

land allocation and ii) also hindering progress of special programmes by the CBO's and NGO's (Polokwane 2020 p.291). To add on, shortage of land in Polokwane, is posing a burden to the City, cemeteries are ending up being established in environmentally sensitive areas to accommodate the increasing demand for burial sites (Polokwane 2020 p.200).

In another perspective, Polokwane (2020 p.340) cites that the available land owned by the City for future strategic developments is not serviced minimizing the potential availability of that land worsening the shortage of land required for development . Department of Rural Development and Land Reform cited in Polokwane (2020 p.753) concurs that land scarcity is a challenge in South African cities worsened by land invasions that are politically motivated. Similarly, New Petersburg land was invaded by informal settlers early 1990's and the municipality through the claims and restitution process donated land at Polokwane Ext 40 for the restitution purpose for those who were forcefully removed from this area (Polokwane 2020 p.767).

Although municipalities and traditional authorities are known of having power challenges over land. However in the context of Polokwane, it is argued that, the tribal authorities receive a stipend, cell phone allowance on a monthly basis and they also participate actively in programmes planned by the municipality (Polokwane 2020 p.284).

9.5.2. Lack of capacity and development conflicts

Chipu (2011 p.iii) cites that Polokwane has the necessary institutional capacity to fulfil its constitutional developmental mandate. This, concurs with the City's accreditation to level 2 housing function, a decentralization of functions from the provincial government proving that Polokwane has the required institutional capacity to manage such projects. However, the municipality does not have the financial capacity to provide all the required service resulting in increased service backlogs. Polokwane (2020 p.251) acknowledges that the "municipality is experiencing challenges pertaining to funding of various key service delivery projects and programmes". In particular, Polokwane (2020 p.179), pointed out that 96% of rural roads belong to RAL. Although the municipal council budgeted R84.5million, to rehabilitate the roads for 2018/2019 financial, implementing 19km per year takes 320 years for the municipality to reduce the roads backlog. This denotes that Polokwane lacks the financial capacity to reduce the rural roads backlog timely amidst spatial transformation, rapid urbanisation and expansion of human settlements. Therefore, the municipality needs to enter an MoU, with RAL as approximately R2.57Billion is required to upgrade and rehabilitate the roads (Polokwane 2020 p.179). de Villas and Kalema (2005 p.88) echoed that without financial support from other spheres of government the City will not be able to meet the basic service needs of the communities. This concurs with Wei (2012 p.404); Lindau *et al.*, (2010a p.23) that spatial

transformation has implications on funding required for infrastructure development to support the increasing population in cities.

Development conflicts are arising in Polokwane because of uncoordinated developments in traditional rural areas as directed by tribal authorities is negatively affecting the capacity and budgeting of the City to provide basic services (Polokwane 2020 p.176). In addition to this a key informant pointed out that conflict is also arising because of the,

“issue on land invasion, Disteneng invaded long ago, and recently the land has been rezoned as residential area. When the municipality relocated the residents to another site. This informal settlement was further invaded by more people. Municipality prioritises those in informal settlements side lining those who applied for housing and are on the waiting list.” (Key informant: CoGHSTA)

In support of these development conflicts arising in the City Polokwane (2020 p.92) states that the City “obtained court orders” to assist in preventing and protecting approximately 11 land parcels and 6 farms from land invasions for effective land use management. In another perspective, Polokwane (2020 p.768); Polokwane (IDP 2008 p.81) points out that there are conflicts that the City is confronted with resulting in blocking of various projects. In particular, between 1994 to 2010 approximately 5 000 housing units at various development stages were reported to have been blocked because of conflicts with the community. A forensic study by the NHBRC pointed out that approximately R500million is required to finish these housing units (Polokwane 2020 p.768). This concurs with discussion in the case study reviews by Arandelovic and Bogunovich 2014 p.6); Lindau *et al.*, (2010a p.23) that spatial transformation results in implications such as development conflicts in cities. Polokwane (2020 p.341) also pointed out that part of the challenges being faced by the City regards to community perceptions with regards to corruption in the municipality.

9.5.3. Marginalization of the poor

The implications of spatial transformation in Polokwane also includes marginalization of the poor. In support of this SACN (2014 p.12); de Villas and Kalema (2005 p.88) pointed out that most poor people and other traditional authorities in the rural areas are excluded from meaningful participation in the development of Polokwane. This is further evidenced by rejection of some projects proposed by the municipality in the rural areas, a development conflict arising from poor citizen participation (SACN 2014 p.13). Mojapelo (2010 p.53), support this citing that communities are marginalized in the processes relating to projects implemented in their communities. They only learn about certain projects during IDP consultations and detailed information about the projects is not communicated they are not part of the project implementation scope. Hence they only happen to know further details when the contractors are already on site to kickstart infrastructure development projects. Mmola

(2012 p.ii), also reiterates that some stakeholders from poor rural communities are not consulted and do not participate in making service delivery decisions. Along the same lines findings by Mathonsi (2016 p.100) reveals that respondents pointed out that there is exclusion of people in processes of local economic development (LED) projects. Polokwane (2013d p.26), echoes these sentiments, arguing that apartheid planning contributed significantly to the current spatial fragmentation which left the poor marginalized, and such a phenomenon still remains being reinforced by current housing initiatives. All this, suggest that spatial transformation in Polokwane is contributing to the reinforcement of marginalization of the poor.

9.6 Spatial planning, monitoring and evaluation implications of spatial transformation

To analyse the spatial planning, monitoring and evaluation implications of spatial transformation in the City of Polokwane, exploratory factor analysis (EFA) was employed. The results for the correlation coefficient matrix for the 9 items that were used in the questionnaire measurement instrument are presented in table 9.21.

Table 9.21: Correlation Matrix^a Spatial planning, monitoring and evaluation implications of spatial transformation

	Implications. ST-SPME.1.	Implications. ST-SPME.2.	Implications. ST-SPME.3.	Implications. ST-SPME.4.	Implications. ST-SPME.5.	Implications. ST-SPME.6.	Implications. ST-SPME.7.	Implications. ST-SPME.8.	Implications. ST-SPME.9.
Correlation	1.000								
Implications.ST-SPME.1.		1.000							
Implications.ST-SPME.2.	.433		1.000						
Implications.ST-SPME.3.	.218	.471		1.000					
Implications.ST-SPME.4.	.204	.235	.419		1.000				
Implications.ST-SPME.5.	.205	.218	.247	.436		1.000			
Implications.ST-SPME.6.	.158	.193	.263	.318	.557		1.000		
Implications.ST-SPME.7.	.150	.180	.215	.248	.317	.408		1.000	
Implications.ST-SPME.8.	.142	.159	.179	.232	.222	.334	.417		1.000
Implications.ST-SPME.9.	.084	.126	.181	.285	.263	.213	.385	.537	

a. Determinant = .111

Source: Author, 2019

In assessing the problems of multicollinearity the study followed rules highlighted in a study by Ashehri (2012) and augmented by checking the computed determinant score i.e. rule of thumb for absence of multicollinearity >0.00001 . Table 9.21 shows that the determinant score is 0.111, which is greater than the suggested rule of thumb score. Therefore, the variables seems to have a patterned relationship and there is the absence of multicollinearity problem.

The factorability of output matrix, was scrutinized using the statistical procedures, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity as highlighted in a study by Bai, Hira and Deshpande (2016). The results for these two statistical procedures are presented in table 9.22.

Table 9.22: KMO and Bartlett's Test: variables spatial planning, monitoring and evaluation implications of spatial transformation

Kaiser-Meyer-Olkin MSA		.745
Bartlett's Test of Sphericity	Approx. Chi-Square	861.210
	df	36
	Sig.	.000

Source: Author, 2019

The results presented in table 9.22 shows that, computed KMO statistic 0.745, is greater than 0.50 recommended in a study by Lin and Wu (2016), indicating sampling adequacy. The computed statistic for Bartlett's test of sphericity, Approx. Chi-square $\chi^2 = 861.210$, (df) 36, Sig. value is statistically significant (less than 0.05) at $p < 0.001$, demonstrating that R-matrix is not an identity matrix. The reproduced correlations matrix was also assed to check the residuals that were computed between observed and reproduced correlations, there were 7 (19.0%) nonredundant residuals with absolute values greater than 0.05, which is way below the acceptable value of <50% (Field 2009). The computed anti-image matrix^a showed that the diagonal values of individual variables KMO criterion for measurement of sampling adequacy (MSA) ranged between 0.680^a to 0.856^a which is above the acceptable values of >0.50. In view of Field (2009; 2013), these results indicates that variables included in this analysis have adequate relationships for EFA as distinct and reliable factors can be yielded that are useful in determining spatial planning, monitoring and evaluation implications of spatial transformation in the City of Polokwane. The computed factor analysis output for variables on spatial planning, monitoring and evaluation implications of spatial transformation is presented in table 9.23.

Table 9.23: Rotated Factor Matrix^a: variables on governance and political implications of spatial transformation

	Factor		
	1	2	3
Implications.ST-SPME.5.The place is separated far from other areas	.775		
Implications.ST-SPME.6.The Places are not easy to get access to	.623		
Implications.ST-SPME.4.Loss of agricultural land to urban developments	.438		
Implications.ST-SPME.8.Developments not compliant to land use plans		.761	
Implications.ST-SPME.9.Inadequate technical resources to manage spatial changes		.659	
Implications.ST-SPME.7.Uneven developments around		.480	
Implications.ST-SPME.2.Outward expansion of developments on edges of the city			.856
Implications.ST-SPME.3.Many service malls are being developed around the city			.519
Implications.ST-SPME.1.Houses spaced far from each other			.453
Eigenvalues	3.22	1.38	1.03
Cumulative percentage of variance	35.78	51.13	62.52

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Source: Author, 2019

Table 9.23 presents the factor loadings of the 9 variables from the measurement instrument on spatial planning, monitoring and evaluation implications of spatial transformation in the City of Polokwane. These results show that all 9 variables included in the measurement instrument are of practical significance, because the factor loading values for all the variable exceeded 0.40 as recommended by Field (2009; 2013). This study adopted multiple approaches in determining the number of factors to retain namely; percentage (%) of variance i.e. above 50% Williams *et al.*, (2010 p.6), Kaiser criterion i.e. retain latent factors with eigen values above 1.0 (Azevedo *et al.*, 2019; Yong and Pearce 2013), and scree test (Yong and Pearce 2013). The scree tests results for variables from the measurement instrument on spatial planning monitoring and evaluation implications of spatial transformation in the City of Polokwane are shown in figure 9.8.

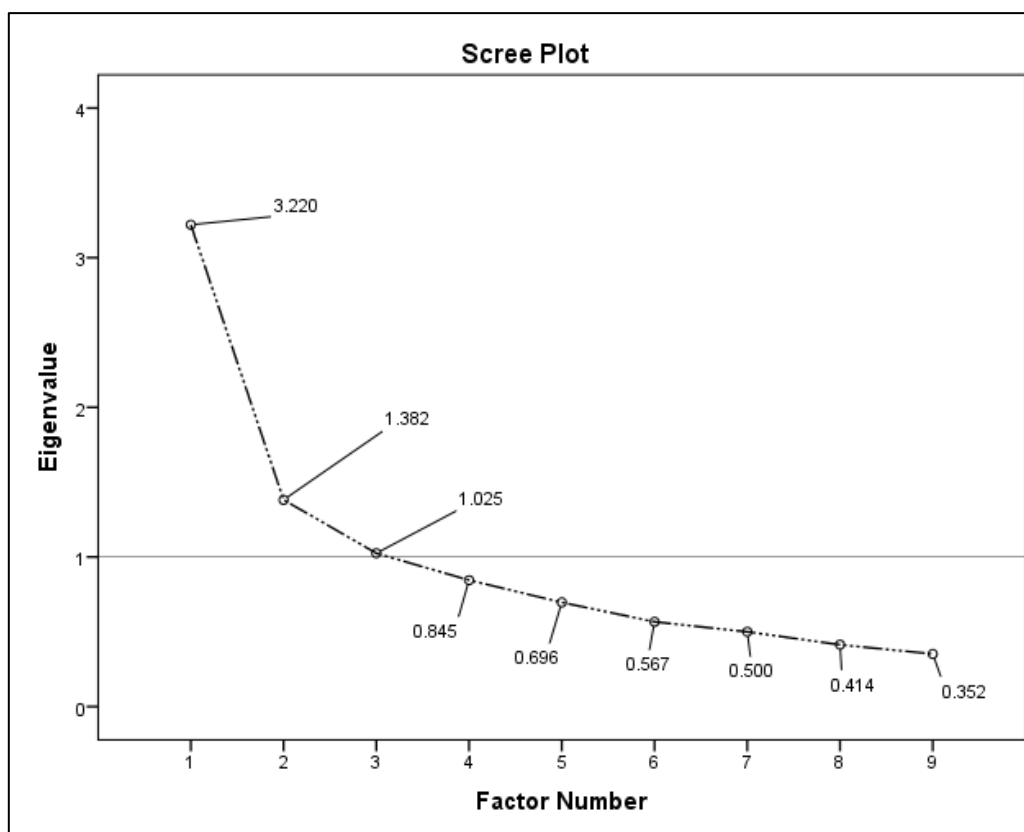


Figure 9.8: Scree plot spatial planning, monitoring and evaluation implications of spatial transformation

Source: Author, 2019

Figure 9.8 depicts supporting evidence that the measurement scale used has three-factor solution that explain the analysis problem governance and political implications of spatial transformation in the City of Polokwane. These underlying four factors are summarised in table 9.20.

Table 9.24: latent factor names: variables on spatial planning, monitoring and evaluation implications of spatial transformation

Factor number	Factor name	% of variance	variables contributing to a latent factor
1	Spatial mismatch	35.78	Implications.ST-SPME.5.The place is separated far from other areas Implications.ST-SPME.6.The Places are not easy to get access to Implications.ST-SPME.4.Loss of agricultural land to urban developments
2	Land use control challenges	15.35	Implications.ST-SPME.8.Developments not compliant to land use plans Implications.ST-SPME.9.Inadequate technical resources to manage spatial changes Implications.ST-SPME.7.Uneven developments around
3	Urban sprawling	11.39	Implications.ST-SPME.2.Outward expansion of developments on edges of the city Implications.ST-SPME.3.Many service malls are being developed around the city Implications.ST-SPME.1.Houses spaced far from each other

Source: Author, 2019

Table 7.24 shows that the 9 variables were reduced into three latent factors namely: spatial mismatch; land use control challenges; and urban sprawling. These extracted latent factors are presented using the mathematical model (4.1) in relation to measured variables as follows;

$$Y_i = b_1X_{1i} + b_2X_{2i} + \dots + b_nX_{ni} + \varepsilon_i \quad 9.5$$

$$1. \text{Spatial mismatch}_i = 0.775\text{Implications.ST_SPME5}_i + 0.623\text{Implications.ST_SPME6}_i + 0.438\text{Implications.ST_SPME4}_i + \varepsilon_i$$

$$2. \text{Land use control challenges}_i = 0.761\text{Implications.ST_SPME8}_i + 0.659\text{Implications.ST_SPME9}_i + 0.480\text{Implications.ST_SPME7}_i + \varepsilon_i$$

$$3. \text{Urban sprawling}_i = 0.856\text{Implications.ST_SPME2}_i + 0.519\text{Implications.ST_SPME3}_i + 0.453\text{Implications.ST_SPME1}_i + \varepsilon_i$$

9.6.1 Spatial mismatch

Dispersed settlement patterns in the City are contributing to spatial mismatch, which presents challenges on strategic planning. Polokwane (Polokwane 2013d p.30) states that, shortage of land is contributing to development of new housing far from areas with economic opportunities. Consequently, this has resulted in increased travel expenditure, impeding on upliftment of individuals quality of life. Polokwane (IDP 2020 p.98), states that spatial mismatch in the City is also resulting from uncoordinated spatial developments such as human settlements. This was further worsened by lack of land use scheme covering the whole municipal wide area, rural villages, farms and tribal land were previously excluded. Through the development directions of SPLUMA 2013, the municipality made efforts to develop a land use scheme for the previously excluded rural areas and was approved in 2017.

9.6.2 Land use control challenges

There are illegal land uses arising in the City attributed to increasing urban population. For example the north-west area of Polokwane CBD is concentrated with illegal land uses such as rental backyard housing and boarding houses for student accommodation (Polokwane IDP 2020 P.113). This is also extending to illegal connections of electricity, sanitation water and portioning of buildings. Polokwane (Polokwane 2013d p.30); Polokwane (2020 p.341) adds that land use challenges are also attributed to i) lack of appropriate frameworks guiding development, such as local spatial development frameworks, ii) poor implementation of the existing frameworks and iii) poor coordination between rural and urban developments. A key informant also supported that land use control is a challenge in the City stating that, *“...number 1 we have SDF that was adopted 2010. Its very old and it doesn't comply with our new laws legislation and that SDF doesn't talk to the current situation on the ground and we need a study work for us our future expectations of how the city will look like 20 years to come. because for now we don't have spatial development framework though for now we are still working on the process of reviewing our SDF...”* (Key informant: Municipal Official).

Land use control in the City is also being affected because the geospatial data for the municipality is still lacking, existing water valves are not indicated in some areas. This results in water infrastructure damages during construction and paving of drive ways in several residential areas and also delays in maintenance as the damaged pipes cannot be easily located (Polokwane 2020 p.176).

In another perspective, Polokwane (2008 p.172) raised a concern over incompatibility of land uses in the City arising from spatial transformation. In addition, a key informant echoes that land use management is also an issue in the rural areas of Polokwane indicating that;

“the municipality does not have capacity to monitor land use activities, incompatible land uses in rural areas taverns are also found next to schools which is a bad thing. People don't know that they should apply, and that there are procedures to follow to get land use rights. When we go there and explain what land use rights are they get surprised and some said we don't know about these things. We don't even know which department at municipality that deals with that. The problem between the municipality, community and other stakeholders, is the municipality. They are suppose to do public participation, land use awareness workshops and educate people from rural areas and what not.. but they are taking the responsibility and giving it to CoGHSTA, yet this department is there to support policy implementation. So since the municipality is not doing it, we are now educating the people in our workshops.” (Key informant: CoGHSTA).

Polokwane, (2020 p.86) acknowledges that the department of CoGHSTA is assisting the municipality in capacity building of tribal authorities since they have mixed challenges in relation to land use management. SACN (2014 P.12) pointed out that there is lack of capacity development programmes facilitated by the municipality for various stakeholders including traditional authorities which affect participation and land use management. . This denotes that spatial transformation is affecting the municipality, which is now failing to keep up with its responsibilities on capacity building of various stakeholders such as tribal authorities in land use management. This has far reaching implications because lack of coordinated developments continue to increase the service delivery backlog of the municipality.

9.6.3 Urban sprawling

Polokwane spatial composition is characterised by spatial fragmentation between urban and rural areas as presented in figure 7.13. In support of this, spatial transformation through municipal boundary redetermination increased spatial fragmentation between the urban and rural land composition in the City of Polokwane, more rural land was added making it approximately 70% rural (Abrahams 2017 p.4). The implication of this spatial characterization resembles a sprawling City making it difficult to provide basic services and infrastructure needs. Developments in the peri-urban and rural land adjacent to the City is also contributing to urban sprawl of Polokwane. In support of this, a key informant pointed out that,

“...in a radius of about 20 km from the urban build up you then have elements of the tribal authority ownership. This is where people mostly from my understanding middle class people who are now sort of moving from the inner cities to stay in the periphery that has resulted in the rapid growth in those growth points in the urban edge or just outside the urban edge...”
(Key informant: Municipal Official).

Polokwane (IDP 2008 p.14) reiterates that the City is experiencing expansion of residential areas leading to urban sprawl. In line with this perspective, Polokwane (2020 p.89) raised a concern that spatial transformation projections such as the projected 2030, 2050 urbanization rates put pressure on spatial planning of the city to reduce urban sprawling. This concurs with concerns raised by Bernt *et al.*, (2013 p.14).; Early *et al.*, (2015 p.223); Salmon (2015 p.27); Wei (2012 p.403); Munzwa and Wellington (2010 p.138) that spatial transformation implications include urban sprawling or spatial splintering of cities.

9.7 Chapter summary

This chapter employed EFA to determine the implications of spatial transformation in the City of Polokwane. The findings from this chapter suggests that although cities are complex systems, central to the implications of spatial transformation is unprecedented rate of

urbanisation. Population growth is acting as a catalytic factor, it contributed to the various complex implications of spatial transformation. The identified implications of spatial transformation in this study were broadly categorized as environmental, economic, social, governance/political and spatial planning monitoring and evaluation.

CHAPTER 10 SUMMARY, CONCLUSION AND RECOMMENDATIONS

10.1 Introduction

Following the analysis, presentation and discussion of findings in line with the study objectives, literature review, established theoretical and analytical framework in the previous chapters, this chapter presents the summary, conclusion and recommendations from this thesis. This chapter is divided into seven sections, the structure is as presented in figure 10.1.

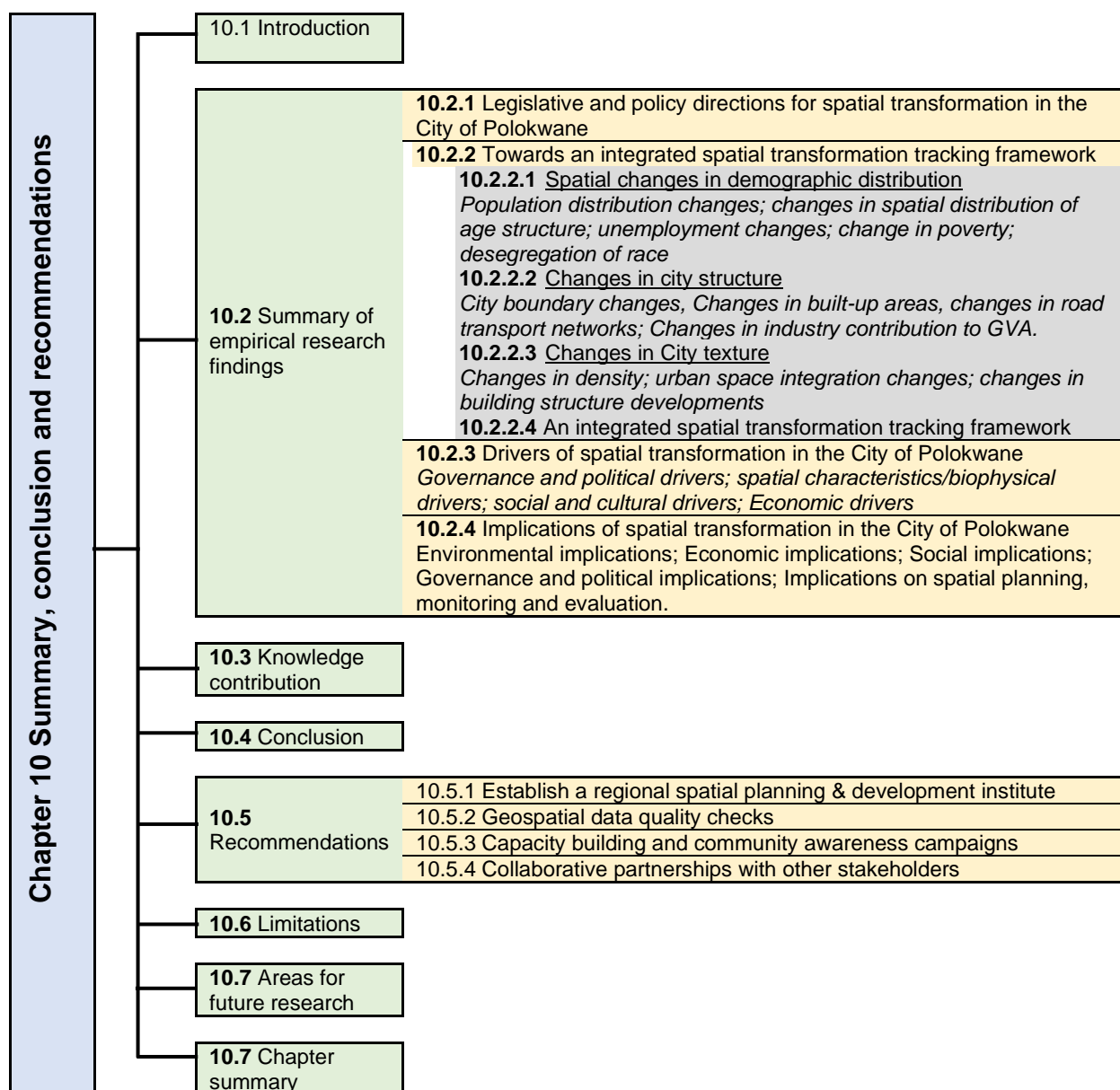


Figure 10.1: Chapter 10 Orientation

Source: Author, 2020

This study was set out to explore spatial transformation in the City of Polokwane an intermediate City in South Africa. Theoretical literature highlights a knowledge gap on spatial transformation of cities around the world (Parnell and Oldfield 2014, p.4). In addition, spatial

transformations of smaller and intermediate cities are even less explored, in the Global South (Steel, 2013 p.239) and usually not included in the realm of understanding cities (Marais & Visser 2008, p.iii). Particularly, spatial transformation in Sub Saharan Africa small and intermediate towns is not given adequate attention by academics and policy makers. This is largely attributed to the fact that there is no standard approach or framework for tracking spatial transformation in cities.

Additional challenges include inadequate application of existing tools, inability to develop necessary tools/frameworks, lack of easily available and interoperability of data, capacity constraints, and insufficient resources required to track spatial transformation. In the context of South Africa, the understanding of realities on spatial transformation in urban areas has been skewed towards the top nine primate cities (Marais and Nel 2019; Marais *et al.*, 2019; SoCR 2016; 2011; 2006 and 2004). The cues for tracking spatial transformation has been long identified in various progressive policy frameworks of South Africa, what has been missing is an integrated framework for tracking spatial transformation. Therefore, this thesis sought to contribute a knowledge on this gap by focusing on spatial transformation in the City of Polokwane.

The objectives of the study were to:

- i. analyse the policy framework directions for spatial transformation in the City of Polokwane (1996-2016)
- ii. map spatial transformation using spatial indicators in the City of Polokwane (1996-2016)
- iii. analyse the drivers of spatial transformation in the City of Polokwane
- iv. assess the implications of spatial transformation in the City of Polokwane
- v. develop a framework for tracking spatial transformation in small and intermediate cities in South Africa

To attain the aforementioned objectives of the study, the time horizon selected was 1996 to 2016 which also aligns to the currently available South African statistical census and community survey data in post-apartheid era. This study adopted the pragmatic spatial transformation research paradigm, an overarching philosophical and theoretical framework. This chosen paradigm has strong philosophical foundation in mixed methods approach which allowed the researcher to select the possible tools and methods for data collection and analysis that best helps to answer the broader research aim of this thesis. Primary data was collected from the study sample size of 588 (507 returned) households calculated using Raosoft online sample size calculator. This sample size of 588 was derived with a margin error of 5%, the confidence level of 98.5% and a response distribution of 50%. Furthermore, other

primary data collection methods used include; key expert interviews, observations, and mapping. Secondary data was collected from the internet, geospatial data, municipal documents, books, academic researches, and journal publications. Data analysis included spatial-temporal analysis of geospatial data using GIS-ArcMap functions, quantitative data was analysed using Exploratory Factor Analysis in SPSS v.23, and for qualitative data discourse analysis was employed using deductive reasoning approach. The following section provides a summary of the research findings.

10.2 Summary of empirical research findings

The discussion in this section provides a synthesis of empirical research findings from this thesis with respect to the research objectives outlined in the previous section.

10.2.1 Legislative and policy directions for spatial transformation in the City of Polokwane

Findings from this thesis revealed that, objects and normative principles of legislative policy frameworks provided directions for spatial transformation in the City of Polokwane. These legislative policy documents include UN Millennium Development Goals, RSA Constitution 1996, White Paper on Reconstruction and Development Programme 1994, Development Facilitation Act 67 of 1995 (Repealed by SPLUMA 16 of 2013), Urban Development Framework 1997, Limpopo Spatial Rationale 1999 (reviewed 2002), Municipal Systems Act 32 of 2000, National Spatial Development Perspective 2003 (reviewed 2006), Breaking New Ground (BNG) 2004, National Development Plan (NDP) 2030 (2012); Spatial Planning and Land Use Management Act (SPLUMA) 16 of 2013. The normative principles directing spatial transformation in redressing apartheid spatial injustices in Polokwane that emerged from the discourse analysis of the legislative policy frameworks can be summed up as; sustainability, integration, people driven, good governance, inclusiveness, efficiency, walkability, mixed use, compact city, spatial targeting, human capital development, corridor and nodal development, racial desegregation, good quality housing, resiliency, and justice.

In addition, the vision of the city as set out in the policy frameworks also act as the overarching guideline and direction for spatial transformation to redress apartheid spatial injustices and development imbalances. In particular, the vision of the 2010 SDF, provided directions that spatial transformation initiatives must promote sustainable development, reduce inequality and poverty. To attain this vision the spatial transformation tools and concepts that were adopted as directions for spatial transformation are; i) spatial concentration model combining selective cluster approach in rural areas aided with ii) nodal hierarchical settlement concept to differentiate the investment needs and potential and also, iii) identification of strategic development areas (SDA's) and potential development areas (PDA's). In addition to this,

spatial transformation directions from the legislative policy frameworks required the development of local spatial development framework plans (LSDFP) to provide land use, development and detailed investment guidelines. The spatial transformation directions from the LSDFPs are summarised as i) demarcating the urban edge, fringe and future development areas, ii) assessment of land ownership and potential land for residential use, iii) densification, iv) development corridors (DCs) and functional development areas (FDAs), v) developing transport infrastructure networks, i.e. N1-bypass, IRPTN – Leeto la Polokwane, vi) shopping centres, vi) multi-purpose community centres (MPCCs), and vii) demarcation of the urban development zone (UDZ) and urban renewal strategies for Polokwane CBD. These findings on policy directions for spatial transformation in the City of Polokwane concurs with objects and normative principles for spatial planning as set out by the progressive legislative policy frameworks in South Africa to redress the apartheid engineered spatial injustices and development imbalances. The findings are also in line with the case study literature, that legislative policy directions provide a pathway for the idealised nature of spatial transformation (Early *et al.*, 2015 p.224; Lindau *et al.*, 2010a p.17; Rosário 2016 p.114; Duarte 2011 p.86; Wei 2012 p.400; Qian 2012 p.432; Rabinovitch and Leitman 1996 p.52; Fan *et al.*, 2012 p.6).

10.2.2 Towards an integrated spatial transformation tracking framework

The analysis of geospatial data in the City of Polokwane between 1996 and 2016, this thesis has provided empirical evidence with maps on spatial transformation in the City that are useful in shaping spatial planning and policy making. An integrated framework for tracking spatial transformation building on work by Turok (2014 p.74) was employed, which identified the key indicators that were mapped in this study using CSIR mesozone geospatial data. This was followed by the conceptualization of an integrated spatial transformation tracking framework.

10.2.2.1 Spatial changes in demographic distribution:

a) population distribution changes - the following indicators were employed to understand population distribution changes; 'total population distribution', 'population count change', 'population change as percentage of total'. The computed values from CSIR mesozone geospatial data based on a percent error $\delta=1,92\%$ relative to StatsSA 2016 population estimates, reveals that total population increased from 57821 in 1996 to 812 395 in 2016. The population count change revealed a pattern of rural-urban migration with major urban settlement clusters having the highest population gain. In particular, Seshego, Perskebult and Mankweng/ Badimong cluster, experienced population count change increase range of 12 501 to 62 500. Polokwane central experienced the highest population increase within the range of 62 501 – 76 843 people. In another perspective, of the overall population changes between 1996 and 2016, Polokwane, Seshego, and Mankweng each experienced a population

increase from 10,2% to 32,1%. This denotes unprecedented rapid urbanization in the major urban settlement clusters in Polokwane.

b) changes in spatial distribution of age structure: interoperability of the geospatial data permitted the temporal analysis of age groupings 0-14yrs, 15-64years and above 65 years of age. The empirical evidence revealed a significant population decrease in the rural areas for those aged between 0-14 years between 1996 and 2016. Those that are old aged are also concentrated in the major urban core settlement clusters with a population range of 2918-5836 people, compared to most rural counterparts with a range of 187-391 old age people. Similarly, emergent spatial transformation revealed that those aged between 15-64 years are also largely concentrated in the major nodal settlement clusters; Seshego, Polokwane and Mankweng with population range of 37038-74104 in 2016.

c) unemployment changes; The spatial indicators that were adopted to understand demographic spatial transformation in the City are; 'percent unemployment', 'percent point change unemployment'. Findings reveal that in 1996 high unemployment levels were witnessed across the rural areas with the 1st order node having low unemployment range of 519-880 (approximately 5%) people. Subsequently, spatial transformation resulted in increased unemployment rates in the major urban areas with a range of 21074-42163 people in 2016. This resulted in percent point unemployment increase of 52% in 2016 for Polokwane central.

d) Change in Poverty- The findings on changes in spatial distribution of household poverty presented a spatial pattern that revealed widespread poverty in rural areas in 1996, The major urban node Polokwane central had household poverty range of 259-455 (25-29%). Spatial transformation that took place until 2016 revealed that rural-urban migration patterns perpetuated the increased concentration of poor households in the urban areas. In particular the major nodal areas; Polokwane, Seshego and Mankweng had household poverty range of 1287-4808 (9,81-36,65%).

e) Desegregation of race: Findings of this study reveals that spatial transformation patterns in the post apartheid era contributed to desegregation of race in the City of Polokwane. StatsSA 2011 census, provide empirical evidence that several wards that were predominantly white race are showing that a switch from a previously dominant race has taken place in certain wards i.e. ward 8, 20, 22, 23. In addition to this, Ward 19 was historically diverse and remained diverse, with ward 21 still having a single dominant race above 50%, with signs of race diversification. However in the rest of the other wards mostly the rural areas, the dominant group remained dominant (>66%) without showing any signs of diversification.

10.2.2.2 Changes in city structure

a) **City boundary changes:** The findings of this study revealed that structural spatial transformation, through re-determination of municipal boundaries is regarded as significant component on the process of redressing the spatial injustices as echoed in the various post apartheid progressive policy frameworks. Consequently, the initial boundary was redetermined in 1994, Pietersburg TLC which incorporated the previously segregated Seshego township. In 1999, the municipal boundary was further redetermined combined with the previously excluded former rural homeland areas. In addition to this, the boundary for City of Polokwane was further redetermined in 2016 to incorporate part of the dis-established Aganang LM. Furthermore, the findings indicates that the redetermination of City of Polokwane boundary resulted in increased land coverage from an estimate of 175km² in 1994 to approximately 5054km² in 2016. This is viewed as a redistributive opportunity, creating viable municipalities to afford the marginalized and poor an opportunity to have access to basic services.

b) **Changes in built-up area:** The study employed a strict definition of built up areas as employed in the GHSL geospatial datasets, which revealed the detailed quantifications on spatial transformation of the built-up areas derived from the computations of pixel count for City of Polokwane. The findings are that, in 1975 the built-up area was only 44,2km² (0.73%), this has exceedingly changed in approximately 4 decades as more anthropogenic developments took place which increased the built-up area. In particular, 26,9km² built-up area was added as of 1990, further 67km² which is the largest extensive increase that was recorded in 2000. In 2014, an additional 33,4km² was further built resulting in the cumulative increase of built-up area to 2,83% which is higher compared to 1,29% that of South Africa. Therefore, these results depicts that the urban footprint is growing attributed to the considerable spatial transformation of the built-up areas. The pace, magnitude of changes in built-up areas is significantly different between the establishment of the city in 1886 to 1975 (0.73%), compared to that of 1975 to 2014 (2.83%). However, the City remains spatially fragmented with rural settlements dispersed across the city, a characteristic of apartheid spatial segregation and injustice.

c) **Changes in road transport networks;** The broader structural spatial transformation of road transport networks in the City of Polokwane has changed significantly between 2000 and 2019. This concurs with results presented in relation to built-up area changes, an indication of considerable spatial transformation across the City. The computed results pointed out that in the 2000s, the City had road network length of approximately 4 794km, and it increased to 9 216km as of 2019. These results reveals that the pace at which the road network has increased is attributed to rapid urbanization, and the democratic government in post apartheid

era that seeks to ensure spatial justice, is greater than that at which the City was established until the year 2000.

d) Changes in industry contribution to GVA; The socio-spatial changes in gross value added (GVA) contribution of different industries per mesozone, with an overlay of total GVA for each mesozone in 'million' was employed to understand the structural spatial transformation in the City of Polokwane. The pattern that emerged shows that in both 1996 and 2013, the dominant economic sector (industry) across most mesozones is the category S9, which in this case is composed of general government, community, social and personal services. Despite S9 being dominant, the low employment figures and low incomes these economic sectors account for lower overall mesozone GVA estimates. In addition to this, findings of the study suggest a lack of socio-spatial diversity in economic activities per mesozone between 1996 and 2013. Only a few selected settlement clusters have remained significantly concentrated with diverse economic sectors which include, Polokwane central, Seshego, Perskebult, Ivydale farm holdings, Eastern Suburbs, Mankweng-Badimong. This entails that social spatial still prevails because of imbalances in distribution of spatial economic activities.

10.2.2.3 City texture

a) Changes in density; The empirical evidence presented in this study suggests that by 1975, the apartheid government had achieved its desired spatial segregation pattern. Only major settlements; Polokwane, Seshego, Perskebult, Mankweng, and Ga-Mashashane were characterised by moderate density clustering (MDC) of more than 300 people/km², with built-up area (buildings with roofs) coverage of 0.03 and population threshold of greater than 5 000 people. In 1990, the additional settlement clusters having reached moderate population and settlement densities of 300people/km² are; Badimong, Laaste Hoop, Sebayeng, and Mabokelele. However, most of the land area remain classified as low density cluster rural areas with population density of less than 300people/km². In 2015, a changing perspective is noticed on the narrative on variation of density characteristics and contiguity of the 1km² grid cells within the City of Polokwane in post-apartheid era. The major settlement clusters; Polokwane-Seshego and Mankweng-Badimong are rapidly urbanizing resulting in increased population densities. In particular, spatial transformation resulted in the emergent characterization of these areas as having an estimated settlement density of 1 500people/km², the built-up area of buildings with roofs increased to >0.5 and the population of the area is also above 50 000 people.

b) Urban space integration changes; This study employed the capabilities of space syntax analytical techniques with the intention of examining whether spatial transformation in the City

of Polokwane has maintained the apartheid status quo of spatial segregation or there has been improvement in spatial integration of the City. Findings for the base year 2000, reveals that spatial syntax, suggests that most human settlement clusters were not properly integrated in the City's system. The distribution of values in the histogram is skewed to the left, mean 615.0068; SD 403.3047; CV 0.6558, which are huge deviations from the mean a representation of low depth, demonstrating lower levels of spatial integration. This denotes, that most settlements; Seshego, Perskebult and Mankweng were spatially segregated, compared to then Pietersburg urban core which evidenced high levels of spatial integration relative to other settlements. However, spatial transformation initiatives in post apartheid era such as road infrastructure developments contributed to increased spatial integration of human settlements in 2015. In particular, space syntax computation revealed normal distribution of values, mean: 4235; SD: 950; CV: 0.2245, which implies there is no huge variation from the mean. This indicates moderate depth level, which implies improved levels of spatial integration in the City's system in 2015, compared to low spatial integration levels in 2000.

c) **Changes in building structure developments;** The study employed Eskom Dwelling layer SBC which is derived from the satellite imagery SPOT 5, at a micro scale of 2,5m. The building structures are manually digitized, and mapped as points. The interoperability of the available datasets permitted the analysis of building structure developments to depict spatial transformation of city texture between 2007 and 2015.

Findings of this study shows the significant spatial transformation of building structure is occurring in urban edges of the three major settlement clusters in the city namely; Polokwane-Seshego, Mankweng-Badimong and Sebayeng-Dikgale. The urban edge of Polokwane-Seshego evidences highest level of building structure developments an increase from 38 443 in 2007 to a total of 50 369 in 2015. Comparatively, the urban edge for Mankweng-Badimong settlement cluster in 2007 had a total of 29 806 building structures and increased to 38 362 in 2015. This is followed by Sebayeng-Dikgale which had 7 459 in 2007 which slightly increased to 9 603 in 2015. These increasing figures on dwelling and other building structure developments suggests that these settlement clusters are experiencing spatial transformation and are urbanizing at different rates and scales.

10.2.2.4 An integrated spatial transformation tracking framework

Literature survey in this study, pointed a research gap and dearth of literature on framework for tracking spatial transformation. The framework conceptualized in this study is premised on various assumptions, of which key are that cities are in constant spatial transformation and that interoperable geospatial spatial data to map out, or track such spatial changes is

available. The identified parameters for an integrated spatial transformation tracking framework as presented in figure 7.24, can be summarised as follows: legislative and policy frameworks, status quo analysis of various development plans, expression of drivers, needs/demand characteristics, space reproduction supply and management, mapping/tracking plan followed by implementation and feedback loops to improve this process and outcomes.

10.2.3 Drivers of spatial transformation in the City of Polokwane

This section provides a summary of findings on drivers of spatial transformation in the City of Polokwane.

10.2.3.1 Governance and political drivers

With regards to governance and political drivers of spatial transformation in the City of Polokwane, an EFA was conducted on the 17 variable items of the measurement with varimax orthogonal rotation. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.755, and all KMO values for individual items were $>.50$ the acceptable limit. Bartlett's test of sphericity $\chi^2 = 1868.527$, $p < .001$, indicated that the correlations between items were sufficiently large warranting EFA. An initial analysis was run to obtain eigenvalues for each factor in the data, six factors had eigenvalues over the criterion of 1 and in combination explained 66.40% of the variance. The scree plot showed evidence that support retaining six factors suggesting that governance and political drivers of spatial transformation in the City of Polokwane can be summarised as; factor 1 governance process, factor 2 development directives, factor 3 political and community influence, factor 4 development control, factor 5 tenure and land use, factor 6 traditional authorities and land markets.

10.2.3.2 Spatial characteristics/biophysical drivers

In relation to spatial characteristics/biophysical drivers of spatial transformation, an EFA was conducted on the 9 variable items of the measurement instrument with varimax orthogonal rotation. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.751, and all KMO values for individual items were $>.50$ the acceptable limit. Bartlett's test of sphericity $\chi^2 = 1021.023$, $p < .001$, indicated that the correlations between items were sufficiently large warranting EFA. An initial analysis was run to obtain eigenvalues for each factor in the data, three factors had eigenvalues over the criterion of 1 and in combination explained 63.53% of the variance. The scree plot showed evidence that support retaining three factors from the problem solution as spatial characteristics/biophysical drivers of spatial transformation. Findings suggest that the items clustering on the same factor are summarised as; factor 1: *availability of developable land*, factor 2: *good living environment*, and factor: 3 *good weather*.

10.2.3.3 Social and cultural drivers

With regards to the social and cultural drivers, An EFA was conducted on the 13 variable items of the measurement instrument on social and cultural norms driving spatial transformation with varimax orthogonal rotational method. The Kaiser-Mayer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.827, and all KMO values for individual items were >.50 the acceptable limit. Bartlett's test of sphericity $\chi^2 = 1775.973$, $p < .001$, indicated that the correlations between items were sufficiently large warranting EFA. An initial analysis was run to obtain eigenvalues for each factor in the data, six factors had eigenvalues over the Kaiser criterion of 1 and in combination explained 65.88% of the variance. The scree plot showed evidence that support retaining four factors as social and cultural drivers of spatial transformation in the City of Polokwane. Summary of findings indicates that items that clustered on the same factor suggest that; factor 1: represents *urbanization process*, factor 2: *Citizen influence, proximity to opportunities and facilities*, factor 3: *Preference and affordability*, and factor 4: *housing development and safety*.

10.2.3.4 Economic drivers

In relation to economic drivers of spatial transformation in the City of Polokwane, an EFA was conducted on the 13 variable items of the measurement instrument varimax orthogonal rotational method. The Kaiser-Mayer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.833, and all KMO values for individual items were >.50 the acceptable limit. Bartlett's test of sphericity $\chi^2 = 1636.601$, $p < .001$, indicated that the correlations between items were sufficiently large warranting EFA. An initial analysis was run to obtain eigenvalues for each factor in the data, six factors had eigenvalues over the Kaiser criterion of 1 and in combination explained 57.78% of the variance. The scree plot showed evidence that support retaining three factors from the problem solution as economic drivers of spatial transformation in the City of Polokwane. Findings on the items that clustered together suggests that factor 1: represents *Attractiveness and affordability*, factor 2: *Infrastructure developments*, factor 3: *Employment and tech advancements*.

10.2.4 Implications of spatial transformation in the City of Polokwane

This section provides a summary of findings on implications of spatial transformation in the City of Polokwane.

10.2.4.1 Environmental implications

With regards to environmental implications of spatial transformation in the City of Polokwane, an EFA was conducted on the 11 variable items of the measurement instrument with varimax orthogonal rotational method. The Kaiser-Mayer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.823, and all KMO values for individual items were >.50

the acceptable limit. Bartlett's test of sphericity $\chi^2 = 1363.276$, $p < .001$, indicated that the correlations between items were sufficiently large warranting EFA. An initial analysis was run to obtain eigenvalues for each factor in the data, six factors had eigenvalues over the Kaiser criterion of 1 and in combination explained 51.65% of the variance. The scree plot showed evidence that support retaining two factors from the problem solution as key environmental implications of spatial transformation in the City of Polokwane. Findings from the items that clustered together suggest that the factors can be summarised as; factor 1: *environmental pollution and loss of vegetation*, and factor 2: *Poor waste management and environmental threat*.

10.2.4.2 Economic implications

An EFA was conducted on the 14 variable items of the measurement instrument on economic implications of spatial transformation with varimax orthogonal rotational method. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.815, and all KMO values for individual items were $>.50$ the acceptable limit. Bartlett's test of sphericity $\chi^2 = 1625.903$, $p < .001$, indicated that the correlations between item were sufficiently large warranting EFA. An initial analysis was run to obtain eigenvalues for each factor in the data, six factors had eigenvalues over the Kaiser criterion of 1 and in combination explained 62.34% of the variance. The scree plot showed evidence that support retaining four factors from the problem solution as the summary on economic implications of spatial transformation in the City of Polokwane. The findings from the items that clustering together suggest the following factors; factor 1: *Dereliction and property value implications*, Factor 2: *Loss of land and unjust distribution services*, Factor 3: *Infrastructure challenges*, and Factor 4: *Transport challenges*.

10.2.4.3 Social implications

With regards to the social implications, an EFA was conducted on the 12 variable items of the measurement instrument on social implications of spatial transformation with varimax orthogonal rotational method. The Kaiser-Mayer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.793, and all KMO values for individual items were $>.50$ the acceptable limit. Bartlett's test of sphericity $\chi^2 = 1235.507$, $p < .001$, indicated that the correlations between item were sufficiently large warranting EFA. An initial analysis was run to obtain eigenvalues for each factor in the data, six factors had eigenvalues over the Kaiser criterion of 1 and in combination explained 56.20% of the variance. The scree plot showed evidence that support retaining three factors from the problem solution, as the summary of social implications of spatial transformation in the City of Polokwane. Findings from the items that clustered together suggest that following social implications; factor 1: *Urban informality*,

poor services and deprivation, Factor 2: Poor social cohesion, housing shortage and crime, Factor 3: Spatial segregation.

10.2.4.4 Governance and political implications

Governance and political implications of spatial transformation in the City of Polokwane were identified by conducting an EFA on the 10 variable items, with varimax orthogonal rotational method. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.806, and all KMO values for individual items were $>.50$ the acceptable limit. Bartlett's test of sphericity $\chi^2 = 824.093$, $p < .001$, indicated that the correlations between item were sufficiently large warranting EFA. An initial analysis was run to obtain eigenvalues for each factor in the data, six factors had eigenvalues over the Kaiser criterion of 1 and in combination explained 62.87% of the variance. The scree plot showed evidence that support retaining three factors from the problem solution summarising the governance and political implications of spatial transformation in the City of Polokwane. The findings on items that clustered together, suggest that the following summary of implications; factor 1: *Land and power challenges*, factor 2: *Lack of capacity and development conflicts* and factor 3: *Marginalization of the poor.*

10.2.4.5 Spatial planning, monitoring and evaluation implications

With regards to implication of spatial transformation on spatial planning, monitoring and evaluation, an EFA was conducted on the 9 variable items of the questionnaire measurement instrument with varimax orthogonal rotational method. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.745, and all KMO values for individual items were $>.50$ the acceptable limit. Bartlett's test of sphericity $\chi^2 = 861.210$, $p < .001$, indicated that the correlations between item were sufficiently large warranting EFA. An initial analysis was run to obtain eigenvalues for each factor in the data, six factors had eigenvalues over the Kaiser criterion of 1 and in combination explained 62.3% of the variance. The scree plot showed evidence that support retaining three factors from the problem solution as summary of implications of spatial planning, monitoring and evaluation in the City of Polokwane. The findings reveal that items that clustering together suggest the following factors; factor 1: *Spatial fragmentation*, factor 2: *Land use control challenges*, factor 3 *Sprawling.*

10.3 Knowledge contribution

Literature search shows that there have been attempts at tracking spatial transformation in the City of Polokwane, however, such attempts are inadequate, outdated, and limited in theoretical scope. In particular, studies by Kotze and Donaldson (1998); Donaldson and Kotze (2006) were limited in focus on racial desegregation and land use change between 1994 to

2002 (Nemukula 2013). Interestingly these studies were both limited in geographical scope to the 1st order node Polokwane-Seshego nodal settlement cluster. Knowledge contribution of this thesis emanates from the employment of the most recent interoperable geospatial and census data to capture and provide updated maps on the multi-dimensional aspects of spatial transformation in the City of Polokwane between 1996 and 2016.

Theoretical literature highlights that urban critics express concern about the knowledge gap on spatial transformation of cities around the world (Parnell and Oldfield 2014, p.4; Christman 2014, p.236; Mubiwa and Annegarn, 2013, p. 3; Amindarbari and Sevtsuk, 2012, p. 2). In addition, spatial transformations of smaller and intermediate cities are even less explored, in the Global South particularly in Sub Saharan Africa (Marais and Nel 2019; Marais *et al.*, 2019; Steel, 2013 p.239) and usually not included in the realm of understanding cities (Marais & Visser 2008, p.iii). This is attributed partly to the fact that there is no standard approach or framework for tracking spatial transformation (Amindarbari and Sevtsuk, 2012, p. 2; Maritz *et al.*, 2016, p. 3; Maritz *et al.*, 2017, p. 408). Similarly, the progressive legislative policy frameworks for South Africa provides cues on the need to track the progress of spatial transformation in post-apartheid era, but runs short on providing the tools that can be employed. In the context of the early concerns, this thesis contributes knowledge to the broader understanding on spatial transformation of cities, particularly small and intermediate cities. It does so because the case study area focused on, the City of Polokwane which is categorized as an intermediate city in South Africa.

The other notable contributions of this thesis is the integrated spatial transformation tracking framework (see figure 7.24). This study acknowledges Turok (2014) dimensions (racial mixing, city structure and city texture) of tracking spatial transformation, however the 1st dimension is limited in scope. Therefore, this study went on further to redefine the 1st dimension into being all encompassing, as demographic distribution. Thus, this contribution resulted in at the conceptualization of a spatial transformation mapping triad with key dimensions i) demographic distribution, ii) city structure and iii) city texture as presented in figure 2.6.

Epistemologically, this study is consistent with Williams (2000 p.169) on knowledge contribution in relation to the broader understanding that, not all cities are transforming as a result of following the purported developmental path of global north cities. This thesis' chapters on policy frameworks directions and drivers spatial transformation provides a better perspective on the developmental path of South African cities. The thesis demonstrates that, what is driving spatial transformation in South African cities is the quest to redress the colonial and apartheid engineered spatial injustices, which resulted in developmental imbalances, which perpetuated inequalities and marginalization of the blacks.

Furthermore, this thesis' contribution on spatial transformation, concurs with various urban critics (Bruyns 2018 p.53; Muhammed and Onuche 2017 p.168; Thorns 2002 p.8) that the development trajectories of contemporary cities follows a different, complex evolutionary path, structuralist process, which renders classical theories on quasi-biological metaphor inadequate and limited in explaining the drivers and implications of spatial transformation in cities.

Contributions to knowledge from this study are also key generation of legacy spatial transformation maps in the City of Polokwane, any other maps linked to the interest of the municipality can be generated from the data gathered in this study.

The other contribution from this thesis includes a paper that was published by the University of Free State accredited Journal Town and Regional Planning titled: *Policy directions for spatial transformation and sustainable development in secondary cities*. In addition to this oral conference presentations were made namely;

- 1st International Conference on Sustainable Management of Natural Resources (ICSMNR2018) (15th-17th October 2018, Bolivia Lodge, Polokwane. Presentation Reference: ICSMNR08066 and title: *Use of Innovative Tools in Managing the Impacts of Built Environment on the Natural Environment*.
- Southern African City Studies Conference August-September 31stAugust-4th September 2020 (Virtual). Presentation title: *Exploring Urban Justice Practices in the City of Polokwane*

10.4 Conclusion

This thesis set out to explore spatial transformation in the City of Polokwane, South Africa between 1996 and 2016. In general there is a challenge of lack of readily available, easily interoperable geospatial data and a framework to track spatial changes in cities. However, this thesis employed other strategies that greatly assisted in contextualizing spatial transformation mapping methodology augmented by quantitative and qualitative analysis in tracking spatial transformation in the City of Polokwane. It can be concluded that granulated and differential spatial transformations have occurred in the City of Polokwane. It is evident that spatial transformation is concentrated in the 1st order node Pietersburg-Perskebult and 2nd order node Mankweng-Badimong.

This is drawn on the basis of the conceptual spatial transformation mapping triad that analysed changes in demographic distribution, urban structure and urban texture. The notable spatial demographic distribution changes in these key nodal areas include; population increase, desegregation of race, unemployment, and age structure. The structural spatial transformation

in the city include changes in; city boundary as well as urban edges, fringes, and future development areas; built-up areas; infrastructure developments (road networks) and industry contribution to GVA. In relation to urban texture, there have been considerable changes in density, space integration and building structure developments. However, it is contestable whether such changes in the city are desirable or not, or if they are in line with the notion of spatial transformation as envisioned by the South African legislations and policy framework plans.

In line with the structuralist analysis employed in this study, the results corroborate that spatial transformation and its manifestation into various implications is driven by a complex web of urban systems on economic, political, spatial/biophysical characteristics, social and cultural processes. Furthermore, an integrated spatial transformation tracking framework was also proposed and advanced. It provides foundational building blocks on how small and intermediate cities can track spatial transformation using the framework subject to customization in relation to their local context.

10.5 Recommendations

This section discusses the recommendations emanating from this study.

10.5.1 There is need to establish a spatial planning and development institute

This study suggests that City of Polokwane as a spatial data custodian, must set in motion the development of a spatial planning and development institute responsible for the establishment of an innovative land information, geospatial data management and maintenance for the broader province. This will boost the City in attaining the desired metro status and also taking a leading role in being a smart city. Literature, shows that successful metro cities have research institutions developed for continuous research and informing the municipality, e.g. Curitiba Brazil and Gauteng City Region Observatory South Africa. Gauteng province harbours several higher education institutions partnering together to drive forward planning in the city. Limpopo province has the same opportunities, there are institutions of higher learning available, a resource that is not being properly harnessed. There is need for university community partnerships that are meaningful, in particular University of Venda offers a professional degree in town planning. For instance, this can also be harnessed by leveraging on the collaborative partnerships between the Limpopo Provincial Government, Limpopo Research Forum, University of Limpopo and University of Venda that has culminated in hosting of several research seminars over the years.

10.5.2 Geospatial data quality checks

This study also suggests that Polokwane LM must engage in data quality checks, to ensure that work done by appointed consultants is submitted in an interoperable format for future use as base reference data. This is critical for spatial temporal analysis of the progress made by the municipality in spear heading spatial transformation and the attainment of the broader city's vision of developing as a smart city.

10.5.3 Capacity building and community awareness campaigns

It was alluded that the municipality is not forthcoming in undertaking its mandate in educating the rural communities about proper land use management processes that need to be followed. The study suggests that, there is need for collaboration in undertaking awareness and education workshop activities with other stakeholders than operating in silos. This denotes that the municipality needs to step up and resume its responsibilities in capacity building of various stakeholders in the City to ensure that spatial transformation activities are coordinated to the broader vision of the City and beyond. This will also promote active participation of the citizens in development of their communities. In turn, the municipality will also gain trust from the tribal authorities and communities in support of development projects, ultimately reducing development conflicts.

10.5.4 Collaborative partnerships with other stakeholders

The municipality lacks financial capacity to keep pace with rapid urbanization and associated implications of spatial transformation being experienced in the city. The study suggests that, partnerships and memorandum of agreements with various stakeholders are required to fast track service delivery in most rural communities. The municipality needs to enter necessary MoU's with various stakeholders and other government departments to ensure financial capacity to develop the necessary infrastructure required to cater for the increasing population and human settlements growth in the City.

10.6 Limitations

Lack of easily available and interoperable geospatial data: This is a major limitation associated with tracking spatial transformation (Amindarbari and Sevtsuk, 2012, p. 2; Maritz *et al.*, 2016, p. 3; Maritz *et al.*, 2017, p. 408). A key expert working in the GIS-section, pointed out that City of Polokwane geo-spatial database crashed and most of the historical spatial data was lost, data available is from 2014 onwards. In addition to this, some of the submitted geospatial data by consultants appointed to conduct research for development of municipal policies and development strategies does not open, attributed to missing files. Furthermore, despite spatial data infrastructure being touted as a databank for easily interoperable geospatial data, the case of South African Spatial Data Infrastructure (SASDI) is different. Their assumption is that

creating a metadata catalogue linked to different databases managed by responsible custodians makes it easy to access geospatial data, however this scenario further perpetuate inaccessibility of spatial data. To counter this limitation, the researcher took advantage of availability of historical images within municipal documents among others, and the use of ArcMap GIS software. ArcMap conversion tools were used to convert Portable Documents Format (PDF) into Tagged Image File Format (TIFF) and digitizing tools were then used, facilitating the easy reconstruction of the geo-spatial information required to understand spatial transformation in the City of Polokwane for this study. To add on to this, other geodatabases from external sources were also accessed to augment spatial transformation dynamics in the City of Polokwane. These external databases include Statistics South Africa Supercross, CSIR Mesozones, Global Human Settlements Layer datasets (GHSL) and Eskom Spot Building Count (SBC).

Language barrier: The researcher does not speak Sepedi the dominant language in Polokwane. To resolve this limitation the researcher was assisted by three research assistants. Two of these research assistants are graduates of Bachelor of Urban and Regional Planning at the University of Venda. Thus, in addition to proficiently conversing in Sepedi they had background understanding of research and the planning related matters in relation to spatial transformation in the City of Polokwane.

Lack of safety: The researcher and the research assistants were victims of crime in Polokwane CBD during the process of data collection. In order to address this situation, the researcher decided to video record the tour around Polokwane CBD using a geocoded android mobile application, *AutoBoy BlackBox*. This application captures the place name, street name, date, time and geographic coordinates whilst the video is being recorded. The recorded videos were of high quality resolutions and it greatly assisted the researcher during this 2020 global pandemic because of the movement restrictions. Furthermore, the researcher decided to use SW Maps a free android mobile app to map out observed activities, and also take pictures and simultaneously allowing writing of notes about the photograph integrating all the information in the app for ease of use.

10.7 Areas for future research

Spatial transformation debate is multifaceted, and the geographical scale at which this research was conducted is the extensive city wide area. In future, a similar research can be undertaken at local case study levels to make an assessment of the nature and intensity of spatial transformation between the urban and rural areas. Also, an analysis of the nature or quantitative relationship between the structure and dynamics/drivers of spatial transformation can be measured using parsimonious technique such as canonical correlation or Multiple

Analysis of Variance (MANOVA). Furthermore, the City is experiencing rapid urbanization, it is also essential to undertake a study on scenario modelling of future urban growth of City of Polokwane. This can be attained using available historical data as in this case, to predict future boundary, direction of urban expansion, quantum of land to be consumed in the next 20 to 30 years and draw up policy and programme implications. This will assist the City in strategic planning and harnessing the opportunities associated with rapid urbanization. Also another area of study identified focuses on testing the integrated framework for tracking spatial transformation in small and intermediate cities.

10.8 Chapter summary

This chapter aimed at providing the summary of research findings with respect to the research objectives of this thesis. A narrative was provided highlighting how the research objectives were attained, together with the associated limitation encountered and measures that were adopted. In addition to this, contribution to knowledge from this thesis was also discussed. Furthermore, this chapter outlined the suggested recommendations and conclusion of the thesis. Lastly, areas for future research were also outlined that are essential in providing empirical evidence required for strategic planning of the City.

11. REFERENCES

- 7th European Conference on African studies (ECAS7), (2017). Basel 29 June- 1July 2017. Urban transformations in Rural Africa: The role of small towns in Sub-Saharan Africa – revisited. Accessed on 25/01/2018. Retrieved from:
<https://www.nomadit.co.uk/ecas/ecas2017/panels.php5?PanelID=4848>
- Abrahams, G. (2017). Polokwane Municipality a Secondary City with a 20:30 Vision. SACN.
- Abrahams, G. and Marais, L. (2019). Polokwane: A Secondary City with a 2030 Vision. In Marais, L. and Nel, V. (eds). *Space and Planning in Secondary Cities: Reflections from South Africa*. Bloemfontein: SUN PRESS
- ACMS and FIC [African Centre for Migration and Society, University of Witwatersrand, Johannesburg Feinstein International Centre, Tufts University]. (2012). *Developing a profiling methodology for displaced people in urban areas, case study: Polokwane, South Africa*.
- Ahmad, P. and Pienaar, H. (2014). Tracking changes in the urban built environment: An emerging perspective from the City of Johannesburg. In Harrison, P., Gotz, G., Todes, A., and Wray, C. eds. 2014. *Changing Space, Changing City: Johannesburg After Apartheid*. Johannesburg: Wits Press.
- Alberti, M., McPhearson, T., and Gonzalez, A. (2018). Embracing Urban Complexity. In T. Elmqvist, X. Bai, N. Frantzeskaki, C. Griffith, D. Maddox, T. McPhearson, et al. (Eds.), *Urban Planet: Knowledge towards Sustainable Cities* (pp. 45-67). Cambridge: Cambridge University Press. doi:10.1017/9781316647554.004
- Al-Shehri, A. M. (2012). Quality management and medical education in Saudi Arabia. In K.-S. Ng (Ed.), *Quality management and practices*. Accessed on 15July2019. Retrieved from: <http://www.intechopen.com/books/quality-management-and-practices/qualitymanagement-and-medical-education-in-saudi-arabia>.
- Amindarbari, R. and Sevtsuk, A. (2012) *Measuring Growth and Change In Metropolitan Form*. Retrieved from:
http://web.mit.edu/11.521/papers/sevtsuk_measuring_growth_and_change_in_metropolitan_form.pdf.
- Anderson, K. T. and Holloway, J. (2020). Discourse analysis as theory, method, and epistemology in studies of education policy, *Journal of Education Policy*, 35:2, 188-221, DOI: 10.1080/02680939.2018.1552992
- Arandelovic, B. and Bogunovich, D., (2014). City profile: Berlin. *Cities*, 37, pp.1-26.

- Arias, S. (2010). Rethinking space: an outsider's view of the spatial turn. *GeoJournal*, 75(1), pp.29-41.
- Atkinson, M. (2012), 'Archival research', in Key concepts in sport and exercise research methods, SAGE Key Concepts, SAGE Publications Ltd, London, pp. 20-26, doi: 10.4135/9781446288092.n4
- Attoh, K. A. (2011) 'What kind of right is the right to the city?', *Progress in Human Geography*, 35(5), pp. 669–685. doi: 10.1177/0309132510394706.
- Avgerou, C., and Bonina, C. (2020). Ideologies implicated in IT innovation in government: A critical discourse analysis of Mexico's international trade administration. *Information Systems Journal*, 30(1), pp.70-95.
- Azevedo, R.S.A., Teixeira, B.S., da Silva Sauthier, M.C., Santana, M.V.A., dos Santos, W.N.L. and de Andrade Santana, D. (2019). Multivariate analysis of the composition of bioactive in tea of the species *Camellia sinensis*. *Food chemistry*, 273, pp.39-44.
- Bakker, J.D., Parsons, C. and Rauch, F. (2016). Migration and Urbanisation in Post-Apartheid South Africa. Discussion paper no. 10113.
- Banerjee-Guha, S., (2002). Shifting cities: urban restructuring in Mumbai. *Economic and Political Weekly*, (37)2.pp.121-128.
- Beauregard, R. (1989). The spatial transformation of Philadelphia. In Beauregard R (ed.) *Atop the Urban Hierarchy*. New Jersey: Rowman and Littlefield Publishers.
- Bernt, M., Grell, B, Holm, A. (ed) (2013). *The Berlin Reader: A Compendium on Urban Change and Activism*. Urban Studies, Berlin.
- Berrisford, S. (2008) *In Search of Land and Housing in the New South Africa The Case of Ethembaletu* World Bank Working Paper 130. Washington DC: World Bank. doi: 10.1596/978-0-8213-7373-6.
- Bickford, G. (2014). 'Transit-Oriented Development: An appropriate tool to drive improved mobility and accessibility in South African cities?', In *Spatial transformation of Cities Conference Report 4-6 March 2014*. Pretoria: South African Cities Network.
- Blommaert, J., and Bulcaen, C. (2000). Critical discourse analysis. *Annual review of Anthropology*, 29(1), pp.447-466.
- Boume, M.B., Bunce, M., Taylor, L., Luka, N. and Maurer, J., (2003). Contested ground: the dynamics of peri-urban growth in the Toronto region. *The Canadian Journal of Regional Science*.

Toronto: Department of Geography and Program in Planning, University of Toronto. XXVI 2&3 pp.251-270.

Bremner, L. (2000) Post-apartheid urban geography: a case study of greater Johannesburg's rapid land development programme. *Development Southern Africa*, 17.1, 87–104.

Brenner, N. (2009) 'What is critical urban theory?', *City*, 13(2–3), pp. 198–207. doi: 10.1080/13604810902996466.

Brenner, N., Marcuse, P. and Mayer, M. (eds) (2012b) *Cities for People not profit : critical urban theory and right to the city*. Oxon: Routledge.

Brewer, J., (2000). *Ethnography*. Open University Press. Buckingham, Philadelphia.

Brown, A. and Kristiansen, A. (2009). Urban Policies and the Right to the City Rights, responsibilities and citizenship. UN-HABITAT. UNESCO. Management of Social Sciences. SHS/SRP/URB/2008/PI/H/3

Brushett, K.T. (2001). *Blots on the Face of the City: The politics of slum housing and urban renewal in Toronto* (Doctoral dissertation, Dissertation, Queen's University).

Bruyns, G. (2018). The Social and the Spatial, Urban Models as Morphologies for a 'Lived' Approach to Planning. *Cubic Journal*, 1(1), 52-73.

Campbell, C.J. 2018. Space, place and scale: Human geography and spatial history in past and present. *Past and Present*, 239(1), pp.e23-e45.

Campbell, K. (2017). South African spatial data infrastructure is developing, but not as fast as desired. *Engineering News* [online newspaper]. Retrieved from: <https://www.engineeringnews.co.za/article/south-african-spatial-data-infrastructure-is-developing-but-not-as-fast-as-desired-2017-04-10>

Capricorn, D. M. (2010). Travel Demand Management Study. Accessed on 23/09/2020. Retrieved: <http://policyresearch.limpopo.gov.za/bitstream/handle/123456789/516/Travel%20Demand%20Management%20Study%20Capricorn%20District%20Municipality.pdf?sequence=1>

Castells, M., (2002). Local and global: cities in the network society. *Tijdschrift voor economische en sociale geografie*, 93(5), pp.548-558.

CDM [Capricorn District Municipality]. (2017). News: Congratulations to Polokwane for scooping the Greenest Municipality award. 30 August 2017 [online]. Accessed 26 August 2020, Retrieved from: <https://www.cdm.org.za/news/660-congratulations-to-polokwane-for-scooping-the-greenest-municipality-award>

- Chakwizira, J. and Mashiri, M. (2009). Contribution of transport governance to socio-economic development in South Africa. Sustainable Transport: 28th Annual Southern African Transport Conference (SATC) 2009, Pretoria, South Africa, 6-9 July 2009.
- Chakwizira, J., Bikam, P. And Adeboyejo, T.A. (2018). Restructuring Gauteng City Region in South Africa: Is a Transportation Solution the Answer?. In *An Overview of Urban and Regional Planning*. IntechOpen.
- Chipu, S. T. L. (2011). Institutional capacity of local municipalities in the delivery of services to communities: a case study of Polokwane Municipality in Limpopo Province. Dissertation. University of Limpopo.
- Christmann, G.B. (2014). Investigating Spatial Transformation Processes. An Ethnographic Discourse Analysis in Disadvantaged Neighbourhoods. *Historical Social Research/Historische Sozialforschung*, 39(2)148. pp.235-256.
- Christmann, G.B., (2014). Investigating Spatial Transformation Processes. An Ethnographic Discourse Analysis in Disadvantaged Neighbourhoods. *Historical Social Research/Historische Sozialforschung*, 39(2)148. pp.235-256.
- City of Polokwane Municipality (CoP). (2010). Spatial Development Framework (SDF).
- City of Polokwane Municipality (CoP). (2014). Presentation on the profile of the municipality 11Feb2014. Accessed on 17/12/2016. Retrieved from: https://www.polokwane.gov.za/CityDocuments/Shared%20Documents/Tenders/RFP/PRESENTATION_ON_THE_PROFILE_OF_THE_MUNICIPALITY11FEB2014_FM.PPTX
- City of Polokwane Municipality (CoP). (2016). Integrated Development Plan (IDP), 2016-2021.
- Clarke, D., (2011). Initiatives and challenges of SDI in South Africa. *Processing Technical: National Geo-spatial Information, South Africa. PositionIT_nov-dec11-Pro_33-35_2*.
- Clayton, M.J., (1997). Delphi: a technique to harness expert opinion for critical decision-making tasks in education. *Educational Psychology*, 17(4), pp.373-386.
- Cloete, J. S. and Massey, R. T. (2017). Seshego: an unexpected suburb, *South African Geographical Journal*, 99(2), pp. 152-165.
- Coetzee, M., Waldeck, L., Le Roux, A., Meiklejohn, C., Van Niekerk, W. and Leuta, T., (2014). Spatial policy, planning and infrastructure investment: Lessons from urban simulations in three South African cities. *Town and Regional Planning*, 64(1), pp.1-9.
- Cole, V., (2017). *Why landlords and investors love the Auckland Unitary Plan, and why you shouldn't. Economic and Social Research Aotearoa*.

- Collins, F.L., (2010). International students as urban agents: International education and urban transformation in Auckland, New Zealand. *Geoforum*, 41(6), pp.940-950.
- Connell, J.P. and Kubisch, A.C., (1998). Applying a theory of change approach to the evaluation of comprehensive community initiatives: progress, prospects, and problems. *New approaches to evaluating community initiatives*, 2(15-44), pp.1-16.
- Cooper, A. K. (2017). SASDI metadata elements. SASDI metadata course, Statistics South Africa, 7 June 2017; PowerPoint Presentation. CSIR.
- Cooper, A.K., Van Huyssteen, E., Das, S., Coetzee, M. and Mans, G., (2014). Assessment of spatial data infrastructures. *Town and Regional Planning*, 64, pp.65-75.
- Corbane, C. Florczyk, A. Pesaresi, M. Politis, P. and Syrris, V. (2018). GHS built-up grid, derived from Landsat, multitemporal (1975-1990-2000-2014), R2018A. European Commission, Joint Research Centre (JRC) doi:10.2905/jrc-ghsl-10007 PID: Retrieved from <http://data.europa.eu/89h/jrc-ghsl-10007>
- Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3), pp.297-334.
- CSIR BE [Council for Scientific and Industrial Research Built Environment]. (2015a). Indicator – Urban footprint. (Prepared in support of SACN – State of the Cities Report 2015). Retrieved from: http://stepsa.org/changing_urban_footprints.html
- CSIR BE [Council for Scientific and Industrial Research Built Environment]. (2015b). Indicator – energy poverty 2011. (Prepared in support of SACN – State of the Cities Report 2015). Retrieved from: http://stepsa.org/energy_poverty.html
- CSIR BE [Council for Scientific and Industrial Research Built Environment]. (2015c). Indicator – Population change – density per Hectare per subplace 1996-2011. (Prepared in support of SACN – State of the Cities Report 2015). Retrieved from: http://stepsa.org/population_growth_sub_city.html
- CSIR BE [Council for Scientific and Industrial Research Built Environment]. (2016). Creating a Remoteness Index for Local Municipalities in SA. Accessed on 07-08-2017. Retrieved from: http://stepsa.org/pdf/indicators/CSIR_RemotenessIndexDescription_Jan2016.pdf
- CSIR BE [Council for Scientific and Industrial Research Built Environment], (2015d). Indicator – Social vulnerability. Retrieved from: http://stepsa.org/social_vulnerability.html

- CSIR BE [Council for Scientific and Industrial Research Built Environment]. (2015e). Indicator – racial diversity 1996-2011. (Prepared in support of SACN – State of the Cities Report 2015). Retrieved from: http://stepsa.org/racial_diversity.html
- CSIR BE [Council for Scientific and Industrial Research Built Environment]. (2015f). Indicator – Employment and unemployment change. (Prepared in support of SACN – State of the Cities Report 2015). Retrieved from: http://stepsa.org/employment_unemployment.html
- CSIR BE [Council for Scientific and Industrial Research Built Environment]. (2015g). Indicator – population growth 1996-2011. (Prepared in support of SACN – State of the Cities Report 2015). Retrieved from: http://stepsa.org/population_growth.html
- CSIR BE [Council for Scientific and Industrial Research Built Environment]. (2015h). Indicator – Youth change. (Prepared in support of SACN – State of the Cities Report 2015).
- CSIR BE [Council for Scientific and Industrial Research Built Environment]. (2015i). Indicator – Human capital; Level of education 2011. (Prepared in support of SACN – State of the Cities Report 2015). Retrieved from: http://stepsa.org/human_capital_development.html
- CSIR BE [Council for Scientific and Industrial Research Built Environment]. (2015j). Indicator – Households poverty between 1996 and 2011. (Prepared in support of SACN – State of the Cities Report 2015). Retrieved from: http://stepsa.org/household_poverty.html
- Curran, J. (2013). September. Big data or 'big ethnographic data'? Positioning big data within the ethnographic space. In *Ethnographic praxis in industry conference proceedings (2013)*1, pp. 62-73.
- de la Rey, A. (2008). Enabling decision making with the SPOT 5 Building Count. GIS technical. PositionIT, pp.33-38.
- de Oliveira Cavalcanti, C., Limont, M., Dziedzic, M. and Fernandes, V. (2017). Sustainability of urban mobility projects in the Curitiba metropolitan region. *Land Use Policy*, 60, pp.395-402.
- de Villiers, A. and Kalema, R. (2005). Challenges and Opportunities for Local Government Development with Reference to the Polokwane Municipality in the Limpopo Province of South Africa. *Journal of Public Administration*. 40(1), pp.78-90.
- De Winter, J.C. and Dodou, D., (2016). Common factor analysis versus principal component analysis: a comparison of loadings by means of simulations. *Communications in Statistics-Simulation and Computation*, 45(1), pp.299-321.
- Delz, S., (2018). Towards an integrative approach to spatial transformation. *International Development Policy*, p.188-212.

- Department of Cooperative Government and Traditional Affairs (COGTA) RSA (2014) Integrated Urban Development Framework. Pretoria: COGTA.
- Donaldson, R. (2005). Intro/Retrospection on a Provincial Capital: Pietersburg/Polokwane Revisited. *Urban Forum*. 16(4), pp. 352- 368.
- Donaldson, R. and Kotze, N. (2006). Residential desegregation dynamics in the South African city of Polokwane (Pietersburg). *Tijdschrift voor Economische en Sociale Geografie*, 97(5), pp.567-582.
- Donaldson, S. E. (2001). Amalgamation of the former homeland border-township of Seshego and the conservative apartheid city Pietersburg during transition. *South African Geographical Journal*, 83(3) pp. 208–213.
- DoT [Department of Transport]. (2020). The Polokwane Eastern Ring-Road Retrieved from: Retrieved from: <https://twitter.com/Dotransport/status/1334419110902554626/photo/3>
- Dowall D, E. and Treffeisen P, A. (1991). Spatial transformation in cities of the developing world. *Regional Science and Urban Economics*, 21(2): 201–22
- DRDLR [Department of Rural and Land Reform]. (2019). Draft National Spatial Development Framework. DRDLR: Pretoria.
- DRDLR [Department of Rural Development and Land Reform]. (2019). Media Statement: Seshego Land Claim Community “Sit In” and Occupation of the Department of Rural Development and Land Reform Offices in Limpopo, Polokwane. 21 February 2019.
- Duarte, F. Firmino, R. and Prestes, O. (2011). Learning from failures: avoiding asymmetrical views of public transportation initiatives in Curitiba. *Journal of Urban Technology*. (18)3, pp.81-100. DOI: <http://dx.doi.org/10.1080/10630732.2011.615569>
- Early, L. Russell, M. Fougere, G. and Howden-Champoin P. (2015). What shapes our cities. pp.223-234. In Early, L. Howden-Chapman, P. and Russell, M. (eds). (2015). Drivers of Urban Change. PrintStop, Wellington.
- Early, L., Howden-Chapman, P. and Russel, M. (eds). (2015) Drivers of urban change. Wellington: Steele Roberts. Retrieved from: steeleroberts.co.nz/product/drivers-of-urban-change/.
- Eglin, R. (2015). Learning Brief #2 Spatial Transformation and the SDF. Afesis-corplan: promoting active citizenship and good governance.
- Fairclough, N. (2005). Discourse analysis in organizational studies: the case for critical realism Norman Fairclough. *Organization Studies*, 26(6), pp.915-939.

- Fairclough, N. (2012). Critical discourse analysis. *International Advances in Engineering and Technology (IAET)*. International Scientific Researchers (ISR) ISSN: 2305-8285 7, pp. 452-487.
- Fan, P. Yue, W. Messina, J. Huang, H. Li, X. Verburg P and Qi, J. (2012). Urban expansion in Asia: evaluation, spatial determinants, and future scenarios. Report. Asian Development Bank Project Urbanization in Asia.
- Fan, P., Yue, W., Zhang, J., Huang, H., Messina, J., Verburg, P.H., Qi, J., Moore, N. and Ge, J. (2020). The spatial restructuring and determinants of industrial landscape in a mega city under rapid urbanization. *Habitat International*, 95, p.102099.
- Field A. (2009). *Discovering statistics using SPSS*. 3 ed. London: SAGE publications Ltd. [ebook].
- FIFA [Federation of International Football Association]. 2010. Peter Mokaba Stadium in Polokwane. Accessed on 06-02-2021. Retrieved from: https://img.fifa.com/image/upload/t_11/nk0ivewkikjsgqkyiwxo.jpg
- Floater, G., Rode, P., Friedel, B. and Robert, A., (2014). Steering urban growth: Governance, policy and finance, *The New Climate Economy Cities*, pp 1-49.
- Fourie, H., (2015). The need for data custodians to capture meaningful metadata. *Geomatics Indaba Proceedings*, pp.19-26.
- Gariazzo, C., Pelliccioni, A., and Bogliolo M P. (2019). Spatiotemporal Analysis of Urban Mobility Using Aggregate Mobile Phone Derived Presence and Demographic Data: A Case Study in the City of Rome, Italy. *Data*; 4(8) pp. 1-25.
- Gee, J. P. (2011). *An introduction to discourse analysis theory and method*. 3rd ed. Routledge, New York.
- Gennaio, M.P., (2008). Political driving forces of urban change in the region Agglomeration Obersee (Doctoral dissertation, ETH Zurich).
- Gildenhuys, S. (2015). *Seshego urban hub: precinct plan status quo*. Polokwane: Polokwane LM.
- Gillham, B., (2000). *Case study research methods*. Bloomsbury Publishing, New York.
- Görgens, T. and Donk, M. van. (2011). From basic needs towards socio-spatial transformation: coming to grips with the “Right to the City” for the urban poor in South Africa’, Isandla Institute. Retrieved from: <http://isandla.org.za/publications/152/>.
- Gornig, M. and Häussermann, H. (2002). Berlin: Economic and spatial change. *European Urban and Regional Studies*, 9(4), pp.331-341.

- Gorrie F, Goodall K, Rush R, and Ravenscroft, J. (2019). Towards population screening for Cerebral Visual Impairment: Validity of the Five Questions and the CVI Questionnaire. *PLoS ONE* 14(3): pp. 1-34. DOI: 10.1371/journal.pone.0214290
- Grange, J. (1999). *The City: an urban cosmology*. State University of New York Press, Albany. [online]
- Grant, J. (2002). Mixed Use in Theory and Practice: Canadian Experience with Implementing a Planning Principle , *Journal of the American Planning Association*, 68:1, 71-84, DOI: 10.1080/01944360208977192.
- Grubbauer, M. (2012). Toward a More Comprehensive Notion of Urban Change: Linking Post-Socialist Urbanism and Urban Theory. In Grubbauer, M. and Kusiak, J. eds., 2012. *Chasing Warsaw: Socio-material dynamics of urban change since 1990* (Vol. 15). Campus Verlag.
- Grünbaum, N.N. (2007). Identification of ambiguity in the case study research typology: what is a unit of analysis?. *Qualitative Market Research: an international journal* (10)1. pp.78-98. DOI: 10.1108/13522750710720413
- Gu, C. and Shen, J. (2003). Transformation of urban socio-spatial structure in socialist market economies: the case of Beijing. *Habitat International*, 27(1), pp.107-122.
- Guldi, J. (n.d). What is the Spatial Turn? Retrieved from: <http://spatial.scholarslab.org/spatial-turn/what-is-the-spatial-turn/>
- Gülersoy, N.Z. and Gürler, E. (2011). Conceptual challenges on urban transformation. *ITU A| Z*, 8(1), pp.10-24.
- Guzman, E., Christie, J.J. and Bogdanovic, J. (2016). The spatial turn and political landscapes of Capital Cities. In Christie, J.J., Bogdanovic, J. and Guzmán, E. eds., (2016). *Political Landscapes of Capital Cities*. University Press of Colorado.
- Ha, N., Nguyen, T. L. H., Nguyen, T. P. L., and Nguyen, T. D. (2019). The effect of trust on consumers' online purchase intention: An integration of TAM and TPB. *Management Science Letters*, 9(9), pp.1451-1460.
- Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E. (2014). *Multivariate Data Analysis* (7th ed.). EdinBurgh: Prentice-Hall.
- Halvorsen, S. (2017). Spatial dialectics and the geography of social movements: the case of Occupy London. *Transactions of the Institute of British Geographers*, 42 (3), 445-457. Retrieved from: <https://doi.org/10.1111/tran.12179>
- Hammersley, M and Atkinson, P. (2007). *Ethnography: Principles in practice*. Routledge. London. [ebook].

- Harrison, P. and Todes, A. (2013). Spatial considerations in the development of urban policy in South Africa: A research paper as input into the preparation of the Integrated Urban Development Framework (IUDF).
- Harrison, P. and Todes, A. (2015). Spatial transformations in a “loosening state”: South Africa in a comparative perspective. *Geoforum* 61 (2015) pp.148–162.
- Harrison, P., Gotz, G., Todes, A. and Wray, C., (2014). Eds. Changing space, changing city: Johannesburg after Apartheid. Johannesburg: Wits University Press.
- Harrison, P., M. Huchzermeyer and M. Mayekiso. (2003). Confronting fragmentation: housing and urban development in a democratic society. University of Cape Town Press, Cape Town.
- Haščič, I. and Mackie, A. (2018). "Land Cover Change and Conversions: Methodology and Results for OECD and G20 Countries", OECD Green Growth Papers, No. 2018/04, OECD Publishing, Paris, <https://doi.org/10.1787/72a9e331-en>.
- Haywood, Q. (2013). Investigating changes in land cover patterns in the Richards Bay area, PositionIT, pp 36-42.
- Hettne, B. (2009). *Thinking about development*. Zed Books Ltd. London. [online]
- Hillier, B. and Hanson, J. (1984), *The Social Logic of Space*, Cambridge University Press: Cambridge. pp.108-109.
- Hodges, B. D., Kuper, A., and Reeves, S. (2008). Discourse analysis. *British Medical Journal*, 337(7669), pp. 570-572.
- Hsieh, H.F. and Shannon, S.E. (2005). Three approaches to qualitative content analysis. *Qualitative health research*, 15(9), pp.1277-1288.
- Hubbard, P. (2012). Thinking spaces, differently? *Dialogues in Human Geography*, 2(1), pp.23-26.
- Ibrahim, D. (2017). Growth and change in Toronto’s neighbourhoods: The challenges of planning for growth and density in the downtown and inner suburbs. Social Planning Toronto, Toronto.
- Jaipal-Jamani, K. (2014). Discourse analysis: a transdisciplinary approach to interpreting text data [online]. SAGE Research Methods Cases. <https://dx.doi.org/10.4135/978144627305014526824>.
- Jessop, B. (2006). *Spatial Fixes, Temporal Fixes and Spatio-Temporal Fixes* (pp. 142-166). Blackwell Publishing.
- Jevremovic, L. (2011). Urban identity of the city-the transformation of cities at the turn of two centuries. *Cities without limits*. Eura 2011 pp1-14.

- Kai Gu, Ye Li and Xi Zheng. (2019) A typological approach to planning. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*, (12)4, pp.373-392, DOI: 10.1080/17549175.2019.1626264.
- Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*. Vol. 39(1) pp. 31-36.
- Kamusoko, C., Gamba, J. and Murakami, H. (2013). Monitoring urban spatial growth in Harare Metropolitan province, Zimbabwe. *Advances in Remote Sensing*, 2013. 2 pp.322-331.
- Kitching A, Drimie, S, and van Donk, M. (2015). South Africa and the Right to the City: exploring the potential for, and limits to, the realisation of progressive urban rights, In Habitat International Coalition-HIC, *Moving toward the Implementation of the Right to the City in Latin America and Internationally* (p.135-152).
- Kollmorgen, R. (2010). Transformation theory and socio-economic change in Central and Eastern Europe. A conceptual framework. *Employment and economy in Central and Eastern Europe*, pp.1-17.
- Kotze, N. J. and Donaldson, S. E. (1998). Residential Desegregation in Two South African Cities : A Comparative Study of Bloemfontein and Pietersburg, *Urban Studies*, 35(3), pp. 467–477.
- Krippendorff, K. (1989). Content analysis. In E. Barnouw, G. Gerbner, W. Schramm, T. L. Worth, and L. Gross (Eds.), *International encyclopedia of communication* (Vol. 1, pp. 403-407). New York, NY: Oxford University Press. Retrieved from http://repository.upenn.edu/asc_papers/226
- Lance, K.T. (2003). Spatial data infrastructure in Africa: spotting the elephant behind trees. *GIS development: the global geospatial magazine*, (7)7, pp.35-41.
- Landman, K and Badenhorst, W. (2012). The impact of gated communities on spatial transformation in the Greater Johannesburg area. South African Research Chair in Development Planning and Modelling: University of the Witwatersrand [Report].
- Landman, K. (2006). Socio-spatial transformation in Africa: a framework to map the process and guide the planning of future cities. Paper delivered at the Conference: Planning Africa 2006, Cape Town, 22-24 March.
- Laufa, S. Haaseb, D. Hostertc, P. Lakesc, T. and Kleinschmita, B. (2011). Uncovering land-use dynamics driven by human decision-making-A combined model approach using cellular automata and system dynamics. *Environmental Modelling and Software* (27-28) 71-82.
- Lefebvre, H. (1991). *The production of space*. Oxford: Blackwell.

- Lefebvre, Henri, 1901-1991. (1996). *Writings on cities / Henri Lefebvre* ; selected, translated, and introduced by Eleonore Kofman and Elizabeth Lebas. Cambridge, Mass, USA : Blackwell Publishers.
- Lehner, A. and Blaschke, T. (2019). A generic classification scheme for urban structure types. *Remote Sensing*, 11(2), p.173.
- Lewin, M. Wilmoth, D. Oakley, C. Holden, M. James, P. Neilson, L. McCarthy, S. Snow, M. Sagar, P and Truter A. (2011). *Managing Urban Growth. Metropolis Commission 2 Report*. Accessed on 03052017. Retrieved from: https://www.metropolis.org/sites/default/files/c2_metropolis_urban_growth_-_english.pdf
- Limpopo Department of Economic Development Environmental and Tourism (LDEDET). (2013). *Provincial Air Quality Management Plan*. Polokwane: Limpopo Provincial Government RSA.
- Lindau, L.A., Hidalgo, D. and Facchini, D., (2010a). Curitiba, the cradle of bus rapid transit. *Built Environment*, 36(3), pp.274-282.
- Lindau, L.A., Hidalgo, D. and Facchini, D., (2010b). Bus rapid transit in Curitiba, Brazil: A look at the outcome after 35 years of bus-oriented development. *Transportation Research Record*, 2193(1), pp.17-27.
- Liu Y. Yue W and Fan, P. (2011). Spatial determinants of urban land conversion in large Chinese cities: a case of Hangzhou. *Environment and Planning*, (38) pp.706 – 725.
- Liu, T. et al. (2015). Spatial patterns, driving forces, and urbanization effects of China's internal migration: County-level analysis based on the 2000 and 2010 censuses, *Journal of Geographical Sciences*, 25(2), pp. 236–256. doi: 10.1007/s11442-015-1165-z.
- Long, K. J. (2011). Unit of Analysis. In Lewis-Beck, M.S, Bryman, A., and Futing Liao, T. (ed). *The sage encyclopedia of social science research methods*, Sage Publications, Inc., Thousand Oaks, CA, DOI: 10.4135/9781412950589.
- Lukhele, T, M. (2015). *The contribution of mixed-income housing towards social cohesion in Serala View Residential Development, Polokwane City, Limpopo Province*. Masters Dissertation. University of Limpopo.
- Mackenzie, N. and Knipe, S., (2006). Research dilemmas: Paradigms, methods and methodology. *Issues in educational research*, 16(2), pp.193-205.
- Macrotrends (2020). Curitiba, Brazil Population 1950-2020. Retrieved from: <https://www.macrotrends.net/cities/20205/curitiba/population>

- Madden, R., (2017). Being ethnographic: A guide to the theory and practice of ethnography. 2nd Ed. Sage Publication Ltd, London.[ebook].
- Mans, G., Le Roux, A., Maritz, J., Van Huyssteen, E., (2016). Creating a Remoteness Index for Local Municipalities in SA.
- Mans, G., Maritz, J., McKelly, D., le Roux, A., Ngidi, M., van Huyssteen, E., Green, C. (2015). Spatial indicators: socio-economic indicators.
- Marais, L. and Nel, V. (eds). (2019). Space and Planning in Secondary Cities: Reflections from South Africa. Bloemfontein: SUN PRESS.
- Marais, L. and Visser, G. eds., (2008). Spatialities of urban change: Selected themes from Bloemfontein at the beginning of the 21st century. AFRICAN SUN MeDIA.
- Marais, L. du Plessis, D. Nel V and Cloete, J. (2019). Secondary cities and spatial transformation in South Africa. In Marais, L. and Nel, V. (eds). Space and Planning in Secondary Cities: Reflections from South Africa. Bloemfontein: SUN PRESS.
- Marcuse, P. (2009) 'From critical urban theory to the right to the city', *City*, 13(2–3), pp. 185–197. doi: 10.1080/13604810902982177.
- Marcuse, P. (2010). Rights in Cities and the Right to the City? In A. Sugranyes and C. Mathivet (eds.), *Cities for All: Proposals and Experiences towards the Right to the City* (p. 21-27). Santiago: Habitat International Coalition (HIC).
- Marcuse, P. (2012). Whose right(s) to what city?, In Brenner, N., Marcuse, P., and Margit, M. (eds) *Cities for people, not for profit*.
- Maritz J., le Roux A., and Mans G. (2017). Developing Spatial Indicators Using a Uniform Tessellation to Measure Urban Transformation. In: Gervasi O. et al. (eds) *Computational Science and Its Applications – ICCSA 2017*. ICCSA 2017. Lecture Notes in Computer Science, vol 10407. Springer, Cham.
- Maritz, J., Van Huyssteen, E., Le Roux, A., Pieterse, A., Ndaba, D., Mans, G. and Ngidi, M., (2016). Are we achieving spatial transformation In South Africa? Can sub-city spatial indicators make a contribution?
- Maronedze, A.K. and Schütt, B. (2018). Dynamics of Land Use and Land Cover Changes in Harare, Zimbabwe: A Case Study on the Linkage between Drivers and the Axis of Urban Expansion. *Land*, 8(10), p.155.
- Martín, L., and March, L.D. (1972). *Urban Space and Structures*. Cambridge: University Press.

- Mashiri, M., Njenga, P., Njenga, C., Chakwizira, J. and Friedrich, M. (2017). Towards a Framework for Measuring Spatial Planning Outcomes in South Africa. *Sociology and Anthropology*, 5(2), pp.146-168.
- Mathivet, C. (2010). The Right to the City: Keys to Understanding the Proposal for “Another City is Possible”. In A. Sugranyes and C. Mathivet (eds.), *Cities for All: Proposals and Experiences towards the Right to the City* (p. 21-27). Santiago: Habitat International Coalition (HIC).
- Mathonsi, E. J. (2016). The role of social cohesion in the implementation of a local economic development (LED) programme: A case study for the Polokwane area. Dissertation. University of Limpopo.
- Mathonsi, E. J. (2016). The role of social cohesion in the implementation of a local economic development (LED) programme: A case study for the Polokwane area. Dissertation. University of Limpopo.
- Mazur, E. (1983). Space in geography. *GeoJournal*, 7(2) pp.139-143.
- McAdams, M. A. (n.d). Complexity Theory and Urban Planning. Fatih University, Istanbul, Türkiye
- Mei, Q. (2019). Transformation mechanism of historical urban fabric in Hankou, Wuhan. *Historical urban fabric*. pp.129-137.
- Merriman, P., Jones, M., Olsson, G., Sheppard, E., Thrift, N. and Tuan, Y.F. (2012). Space and spatiality in theory. *Dialogues in Human Geography*, 2(1), pp.3-22.
- Michael, R. Murray and William J. V. Neill. (2011) Strategic Spatial Planning in Berlin–Brandenburg: A Requiem for Balanced Development?, *Planning Practice and Research*, (26)1 pp.107-121, DOI: 10.1080/02697459.2011.542067
- Mierzejewska, L., (2017). Urban structures and substructures. *Bulletin of Geography. Socio-economic Series*, 36(36), pp.117-125.
- Mills, A and Mills, J. (2018), 'Archival research', in *The sage handbook of qualitative business and management research methods: methods and challenges*, SAGE Publications Ltd, London, pp. 32-45, doi: 10.4135/9781526430236.
- Mills, A.J., Durepos, G. and Wiebe, E. eds., (2010). *Encyclopedia of case study research*. Volume 1 and 2. Sage Publications, California.[ebook].
- Milojevic, B. and Region, B. (2012). Influential Factors on the Urban Transformation of Cities in Bosnia and Herzegovina in the Period of Transition, 48th ISOCARP Congress 2012, pp. 1–11.

- Mitchell, W.J., (2012). Image, space, revolution: The arts of occupation. *Critical Inquiry*, 39(1), pp.8-32.
- Mohammed, A. and Howard, D. (2013). Strengthening the Development and Application of Urban Profiling Methodologies : A Review of Urban Profiling in the Caribbean Table of Contents List of Acronyms Executive Summary Introduction Urban Assessment and Profiling Methodologies Urban Assessment.
- Mubiwa, B. and Annegarn, H. (2013). Historical spatial change in the Gauteng City-Region, GCRO Occasional Paper 4.
- Muchadenyika, D., and Williams, J. J. (2017). Politics and the practice of planning: The case of Zimbabwean cities. *Cities*, 63, pp.33-40. DOI. <http://dx.doi.org/10.1016/j.cities.2016.12.022>
- Mudau, N. (2010). SPOT Building Count supports informed decisions. Visualisation technical. PositionIT, pp.50-51.
- Muhammed, B.S. and Onuche, O.I., (2017). The Effect of Urbanization on the Living Condition of Mpape Residents in Bwari Area Council of the Federal Capital Territory. *Kaduna Journal of Sociology*, 5(1), pp.164-172.
- Muhammed-Lawal, A.A. and Rashid, A.A., (2019). An exploratory factor analysis (EFA) in determining dimensions of school culture in morality of secondary school students south-western Nigeria. *Asian Journal of Management Sciences and Education*, 8(1) pp. 66-71.
- Müller, M. (2019). Goodbye, Postsocialism!. *Europe-Asia Studies*, 71(4), pp.533-550.
- Munzwa, K. and Wellington, J., (2010). Urban development in Zimbabwe: A human settlement perspective. *Theoretical and Empirical Researches in Urban Management*, 5(14), pp.120-146.
- Muronda, T. (2008). Evolution of Harare as Zimbabwe's capital city and a major central place in southern Africa in the context of by Byland's model of settlement evolution. *Journal of Geography and Regional Planning*, 1(2), p.34-40.
- Mwungu, C.M. (2017). *Spatial Data Infrastructure in Africa: A Technical and Institutional Analysis* (Doctoral dissertation, University of Nairobi).
- Næss, P. (2006). Urban structure matters: residential location, car dependence and travel behaviour. Routledge, Oxfordshire.[ebook].
- National Planning Commission (NPC) (2012). National Development Plan 2030. Pretoria: NPC.

- National Research Council, (NRC). (2002). *Down to Earth: Geographic Information for Sustainable Development in Africa*. Washington, DC: The National Academies Press. Retrieved from: <https://doi.org/10.17226/10455>.
- Nel, V. (2019). Planning in complex space: an orderly and predictable world. In Marais, L. and Nel, V. (eds). *Space and Planning in Secondary Cities: Reflections from South Africa*. Bloemfontein: SUN PRESS.
- Nemukula, N. L. (2013). *An evaluation of urban and rural land use, change, conflict and competition: Polokwane City and rural land restitutive areas of Limpopo Province, South Africa*. PhD Thesis. University of Venda.
- Neuendorf, K. A. (2019). Content analysis and thematic analysis. In Brough, P, (ed). *Advanced Research Methods for Applied Psychology: Design, Analysis and Reporting*. Routledge, New York (NY).
- Newton, P. (2001). Urban Indicators and the Management of Cities, in Westfall, M. S. and de Villa, V. A. (eds) *Urban Indicators for Managing Cities: Cities Data Book*. Asian Development Bank, pp. 15–36. Retrieved from: <http://www.kas.de/upload/dokumente/megacities/ADB.pdf>.
- OECD (2020), Built-up area (indicator). doi: 10.1787/7c06b772-en. Accessed on 12 July 2020. Retrieved from: https://stats.oecd.org/Index.aspx?DataSetCode=BUILT_UP#
- Oranje, M. (2014). Spatial Transformation and Urban Restructuring: Lessons for the 20-year old post-apartheid South African city? *Spatial transformation of cities conference report*. 4-6 March 2014. pp 35-72.
- Oranje, M. and Van Huyssteen, E. (2011). Nestling national ‘transformation’ imperatives in local ‘servicing’ space: Critical reflections on an inter-governmental planning and implementation project. *Town and Regional Planning*, 58, pp.6-16.
- Oxford. (2019). *Oxford Dictionary of English*. Oxford: Oxford University Press (android app. Version 11.7.712).
- Ozturk, I. (2008). The role of education in economic development: a theoretical perspective. *Journal of Rural Development and Administration*, (XXXIII) 1, pp. 39-47.
- Paina, L., Wilkinson, A., Tetui, M., Ekirapa-Kiracho, E., Barman, D., Ahmed, T., Mahmood, S.S., Bloom, G., Knezovich, J., George, A. and Bennett, S. (2017). Using Theories of Change to inform implementation of health systems research and innovation: experiences of Future Health Systems consortium partners in Bangladesh, India and Uganda. *Health research policy and systems*, 15(2).

- Parker-Jenkins, M. (2018). Problematizing ethnography and case study: reflections on using ethnographic techniques and researcher positioning, *Ethnography and Education*, (13)1, pp.18-33. DOI: 10.1080/17457823.2016.1253028.
- Parnell, S. and Oldfield, S. eds., (2014). *The Routledge handbook on cities of the global south*. New York: Routledge.
- Patel, S. (2015). The research paradigm – methodology, epistemology and ontology explained in simple language. Accessed on 19-01-2020. Retrieved from; <http://salmapatel.co.uk/academia/the-research-paradigm-methodology-epistemology-and-ontology-explained-in-simple-language/>
- Peck, J., Theodore, N. and Brenner, N. (2009). Postneoliberalism and its Malcontents, *The Point is to Change it: Geographies of Hope and Survival in an Age of Crisis*, 41(April 2009), pp. 94–116. doi: 10.1002/9781444397352.ch5.
- Permanent Committee For Geospatial Data Infrastructure of the Americas (PC-IDEA). (2013). *Spatial Data Infrastructure (SDI) Manual for the Americas*. Tenth United Nations Regional Cartographic Conference for the Americas. E/CONF.103/14. New York, 19-23, August 2013.
- Pesaresi, M., Melchiorri, M., Siragusa, A. and Kemper T. (2016). *Atlas of the Human Planet: Mapping Human Presence on Earth with the Global Human Settlement Layer*; EUR 28116 EN; doi:10.2788/582834.
- Philippopoulos-Mihalopoulos, A. (2011). Law's Spatial Turn: Geography, Justice and a Certain Fear of Space. *Law, Culture and the Humanities*, 7(2) pp.187–202.
- Phillips, T. and Keen, M. E. G. (2016). *Sharing the City : Urban Growth and Governance in Suva , Fiji*.
- Pieterse, A., Van Huyssteen, E and Waldeck, L. (2015). *Viability study for the development and implementation of a national Land Use Change Monitoring Tool Set: Section 2.2:*
- Pieterse, A., Van Huyssteen, E and Waldeck, L. (2015). *Viability study for the development and implementation of a national Land Use Change Monitoring Tool Set: Section 2.2: The value of using urban simulation for land use management and planning – A case study of the Nelson Mandela Bay Metro*. Unpublished CSIR Client Research Report.
- Pieterse, A., Van Niekerk, C.W., Van Huyssteen, E., Maritz, J., Le Roux, A. and Mans, G.G. (2016). *Spatial change as drivers of risk and vulnerability in South African cities: Spatial trends in the three metropolitan cities of Gauteng*. CSIR.
- Polokwane (2001). *Short study and policy pertaining to the provision of medical and related land uses within the jurisdiction area of Polokwane municipality*.

Polokwane (2005). Polokwane CBD Development Plan Final Report.

Polokwane (2008a). Polokwane CBD Business Zoning: Market demand Model for retail and office markets in the Polokwane CBD.

Polokwane (2015). Seshego Precinct Plan Final.

Polokwane LM (2019a). City of Polokwane, General Valuation Roll 2019-2024. Suburbs A-M. Set 1 Volume 1.

Polokwane LM (2019b). City of Polokwane, General Valuation Roll 2019-2024. Suburbs N-P. Set 1 Volume 1.

Polokwane LM (2019c). City of Polokwane, General Valuation Roll 2019-2024. Suburbs S-W. Set 1 Volume 1.

Polokwane LM. (2005). Polokwane CBD Development Plan: Final Report November 2005.
Polokwane: Polokwane LM.

Polokwane LM. (2007a). Framework Plan for Strategic Development Area 1. Polokwane:
Polokwane LM.

Polokwane LM. (2007b). Framework Plan for Strategic Development Area 3. Polokwane:
Polokwane LM.

Polokwane LM. (2008a). Polokwane Integrated Development Plan 2008-2011. Polokwane:
Polokwane LM.

Polokwane LM. (2008b). Feasibility Study for the Development of Business Zoning on the Southern Part of Marshall street in Polokwane Central Business District. 1st Draft Report May 2008.
Polokwane: Polokwane LM.

Polokwane LM. (2009). Framework Plan for Strategic Development Area 2. Polokwane: Polokwane LM.

Polokwane LM. (2012). Policy on subdivision and densification of agricultural land in Polokwane Local Municipality: Final Draft Document. Polokwane, Polokwane LM.

Polokwane LM. (2014a). Presentation on the profile of the municipality. Retrieved from: 07/04/2017.
Retrieved from: https://www.polokwane.gov.za/City-Documents/Shared%20Documents/Tenders/RFP/PRESENTATION_ON_THE_PROFILE_OF_THE_MUNICIPALITY11FEB2014_FM.PPTX

Polokwane LM. (2014b). Operational Plan for the Implementation of the Integrated Rapid Transit System Polokwane Local Municipality. Polokwane: Polokwane LM.

- Polokwane LM. (2016b). Integrated Waste Management Plan. Polokwane, Polokwane LM.
- Polokwane LM. (2020). Integrated Development Plan 2020-2021. Polokwane: Polokwane LM.
- Polokwane LM. (2001). Short Study and Policy Pertaining to the Provision of Medical and Related Land Uses within the Jurisdiction Area of Polokwane Municipality: Policy Document on Land Use Management. Polokwane: Polokwane LM.
- Polokwane LM. (2010a). Spatial Development Framework. Polokwane: Polokwane LM
- Polokwane LM. (2013a). Sebayeng Framework Plan. Polokwane: Polokwane LM.
- Polokwane LM. (2013b). Mankweng-Badimong Framework Plan. Polokwane: Polokwane LM.
- Polokwane LM. (2013c). Polokwane Densification Policy for Urban Areas. Polokwane: Polokwane LM.
- Polokwane LM. (2013d). Polokwane 2030 Economic Growth and Development plan: Research Report. Polokwane: Polokwane LM.
- Polokwane LM. (2016a). Polokwane Integrated Development Plan 2016-2021. Polokwane: Polokwane LM.
- Polokwane LM. (2016c). Polokwane CBD Development Plan and Urban Renewal Strategy. Polokwane: Polokwane LM.
- Polokwane LM. (2016d). Polokwane: safety and emergency. [online]. Accessed on 31 August 2020. Retrieved from: <https://www.polokwane.gov.za/City-Visitors/Pages/Safety-and-Emergency.aspx>
- Polokwane LM. (2017). Polokwane Municipal Planning By-Law. Polokwane: Polokwane LM.
- Powell, C., (2003). The Delphi technique: myths and realities. *Journal of advanced nursing*, 41(4), pp.376-382.
- Prasad, B, D. (2008). Content Analysis A method in Social Science Research. In Lal Das, D.K and Bhaskaran, V (eds.). *Research methods for Social Work*, New Delhi: Rawat, pp.173-193.
- Qian, Z. (2012). Post-reform urban restructuring in China: the case of Hangzhou 1990-2010. *Town Planning Review*, 83(4), pp.431-456.
- Rabinovitch, J. and Leitman, J. (1996). Urban planning in Curitiba. *Scientific American*, 274(3), pp.46-53.

- Rahmani, F, and Leifels, K. (2018). Abductive Grounded Theory: a worked example of a study in construction management, *Construction Management and Economics*, (36)10, pp.565-583, DOI: 10.1080/01446193.2018.1449954.
- Raosoftware. (2018). Sample size calculator. Retrieved from: <http://www.raosoftware.com/samplesize.html>. .
- Reeves, S. Peller, J. Goldman J and Kitto J (2013). Ethnography in qualitative educational research: AMEE Guide No. 80, *Medical Teacher*, (35)8, pp.e1365-e1379, DOI:10.3109/0142159X.2013.804977.
- Republic of South Africa (RSA). (1996). National Youth Commission Act No.19 of 1996.
- Republic of South Africa (RSA). (2003). Spatial Data Infrastructure Act No. 54 of 2003. Government Gazette.
- Republic of South Africa, (2013). Spatial Planning and Land Use Management Act, Act 16 of 2013. Cape Town: The Presidency.
- Robinson, J. (2006). Inventions and interventions: transforming cities: an introduction. *Urban Studies*. Vol42(2) pp.251-258.
- Rogers, P. (2014). Theory of Change, Methodological Briefs: Impact Evaluation 2, UNICEF Office of Research, Florence Italy. Retrieved from: https://www.betterevaluation.org/sites/default/files/Theory_of_Change_ENG.pdf
- Roitman, S. Webster, C and Landman, K. (2010). Methodological Frameworks and Interdisciplinary Research on Gated Communities. *International Planning Studies*, 15(1), pp.3-23. DOI: 10.1080/13563471003736886.
- Romeiro, P., Guimaraes, I. and Koetz, V. (2015). Moving toward the Implementation of the Right to the City in Latin America and Internationally. Sao Paulo, SP, Brazil: Global Platform for the Right to the City; 2015.
- Rosário, M.D.R. (2016). Curitiba Revisited: Five Decades of Transformation. *Architectural Design*, 86(3), pp.112-117.
- Roy, A. (2015). What is urban about critical urban theory? DOI: 10.1080/02723638.2015.1105485.
- RSA [Republic of South Africa]. (1994). Reconstruction and Development Programme: A Policy Framework. Pretoria: The Presidency.
- RSA [Republic of South Africa]. (1995). Development Facilitation Act 67 of 1995. Pretoria: The Presidency.

- RSA [Republic of South Africa]. (1997). Urban Development Framework. Pretoria: Department of Housing
- RSA [Republic of South Africa]. (1998). Local Government Municipal Demarcation Act No.27 of 1998. Cape Town: Government Gazette.
- RSA [Republic of South Africa]. (2006). National Spatial Development Perspective. Pretoria: The Presidency.
- RSA [Republic of South Africa]. (2013). Spatial Planning and Land Use Management Act 16 of 2013. Pretoria: The Presidency.
- RSA [Republic of South Africa]. (2019). Draft National Spatial Development Framework. Pretoria: Department of Rural and Land Reform.
- RSA [Republic of South Africa]. Department of Housing. (2004). Breaking New Ground: A Comprehensive Plan for the Development of Sustainable Human Settlements. Pretoria: Department of Housing.
- RSA [Republic of South Africa]. National Planning Commission. (2012). National Development Plan 2030 Our Future Make it Work. Pretoria: The Presidency.
- RSA [Republic South Africa] The Presidency. (2014). Twenty Year Review South Africa 1994 – 2014. The Presidency, RSA.
- RSA CoGTA [Republic of South Africa. Department of Cooperative Government And Traditional Affairs]. (2016). Integrated Urban Development Framework (IUDF): A New Deal for South African Cities and Towns. Pretoria: CoGTA.
- RSA DRDLR [Republic of South Africa Department of Rural and Land Reform]. (2019). Media Statements: Victims of forced eviction to receive serviced sites in Polokwane town as part of land claim settlement. Accessed on 04July2020. Retrieved from: https://www.drdlr.gov.za/sites/Internet/Newsroom/media_statements/Pages/Victims-of-forced- eviction-to-receive-serviced-sites-in-Polokwane-town-as-part-of-land-claim-settlement.aspx
- RSA DRDLR [Republic of South Africa Department of Rural Development and Land Reform]. (2011). Guidelines for the Development of Municipal Spatial Development Frameworks. Pretoria: DRDLR.
- RSA DRDLR and DAFF [Republic of South Africa, Department of Rural and Land Reform, and Department of Agriculture Forest and Fisheries]. (2015). One Pager Executive Summaries – AGRI-HUBS as on 6 November 2015 Agri-Hubs Identified by the Province; Limpopo Province.

- RSA MDB [Republic of South Africa Municipal Demarcation Board]. (2020). Types of Boundary Redeterminations. Accessed on 06July2020. Retrieved from: http://www.demarcation.org.za/site/?page_id=473
- RSA MDB [Republic of South Africa Municipal Demarcation Board]. (2018). Municipal capacity assessment 2018: Polokwane LIM354. Accessed 07July2020. Retrieved from: <http://www.demarcation.org.za/site/wp-content/uploads/2019/04/PolokwaneLIM354-1.docx>
- RSA MDB [Republic of South Africa Municipal Demarcation Board]. (2000). Municipal Demarcation Board Annual Report: 1999/2000. Accessed on 06July2020. Retrieved from: <http://www.demarcation.org.za/site/wp-content/uploads/2015/11/1999-2001.pdf>
- SACN [South African Cities Network]. (2015). SPLUMA As a Tool for Spatial Transformation. Accessed on 07 July 2017. Retrieved from: http://sacitiesnetwork.co.za/wp-content/uploads/2015/04/spluma-_as_a_tool_for_spatial_transformation_final.pdf.
- SACN [South African Cities Network]. (2004). State of Cities Report. Pretoria: SACN.
- SACN [South African Cities Network]. (2006). State of Cities Report. Pretoria: SACN.
- SACN [South African Cities Network]. (2011). State of Cities Report. Pretoria: SACN.
- SACN [South African Cities Network]. (2012). Secondary cities in South Africa: The start of a conversation, The Background Report. Pretoria: SACN.
- SACN [South African Cities Network]. (2014). Outside the core: Towards an understanding of intermediate Cities in South Africa. Pretoria: SACN.
- SACN [South African Cities Network]. (2016). State of Cities Report. Pretoria: SACN.
- SACN [South African Cities Network]. (2017a). Spatial Transformation: Are Intermediate Cities Different? South African Cities Network: Johannesburg.
- SACN [South African Cities Network]. (2017b). Polokwane: City of resilience and middle class 'bling'? South African Cities Network: Johannesburg.
- Sadiki, P. and Ramutsindela, M. (2002) 'Peri-urban transformation in South Africa : Experiences from Limpopo Province', *GeoJournal*, 57(1), pp. 57–63.
- SAHO [South African History Online]. (2016). Colonial history of Polokwane.[online]. Accessed on 31 August 2020. Retrieved from: <https://www.sahistory.org.za/article/colonial-history-polokwane>
- Salmon, G. (2015). Auckland. pp.16-54. In Early, L. Howden-Chapman, P. and Russell, M. (eds). (2015). *Drivers of Urban Change*. PrintStop, Wellington

- Saunders, M., Lewis, P. and Thornhill, A. (2009). *Research methods for business students*. 5th Ed. Pearson education. Harlow, England.
- Schensul, D. and Heller, P. (2010). 'Legacies, Change and Transformation in the Post-Apartheid City: Towards an Urban Sociological Cartography', *International Journal of Urban and Regional Research*, 35(1), pp. 1–32. doi: 10.1111/j.1468-2427.2010.00980.x.
- Shaw, S. E. and Bailey, J. (2009). Discourse analysis: what is it and why is it relevant to family practice? *Family practice*, 26(5), pp.413-419.
- Siebritz, L.A. and Fourie, H., (2015). The South African spatial data infrastructure: A collaborative SDI. *Geomatics Indaba, General Paper*, 1, pp.2-10.
- Sihlongonyane F M and Lewis M. (2016) 'Urban transformation in South Africa' In *Envisioning future cities*. International Society of City and Regional Planners. pp252-267.
- Sihlongonyane, F, S and Lewis, M. (2016). Urban transformation in South Africa. In Nan, S. Reilly, J. and Klass, F. eds. (2016). *Envisioning future cities ideas and example: ISOCARP Conference Proceedings*.
- Skalski, P.D., Neuendorf, K.A. and Cajigas, J.A., (2017). Content analysis in the interactive media age. In Neuendorf, K.A. *The content analysis guidebook* (2ND ed). Cleveland State University, USA. pp.201-403.
- Šlaus, I. and Jacobs, G. (2011). Human Capital and Sustainability. *Sustainability*, 3, 97-154.
- South African Cities Network (SACN) (2013), Reflections on the “Spatial Transformation of the City” 29th January 2013. Social Dialogue Knowledge Network Session Report. Accessed on 16 January 2020. Retrieved from: <http://www.economic.gov.za/spatial-planning/404-reflections-on-the-spatial-transformation-of-the-city-report/download>
- South African Cities Network (SACN). (2016). *State of South African Cities Report 2016*. Johannesburg: SACN
- Spatial transformation of Cities (STC). (2014). *Spatial transformation of cities: Conference Report*. 4-6 March 2014.
- Statistics Canada (Stats Canada). (2016). *The changing landscape of Canadian metropolitan areas: Human Activity and the Environment 2015*. Retrieved from: <https://www150.statcan.gc.ca/n1/en/pub/16-201-x/16-201-x2016000-eng.pdf?st=kfXCq2FH>
- Statistics South Africa (Stats SA). (2010). *Concepts and Definitions for Statistics South Africa*. v.3.

- StatsSA [Statistics South Africa]. 2016. Community Survey 2016, Statistical release P0301 / Statistics South Africa. Pretoria: Statistics South Africa.
- StatsSA [Statistics South Africa]. (2012). Simulating key estimates for local municipality socio-economic development models: applications of the rank-size rule from 2007 to 2012: Discussion document D9129. Pretoria: StatsSA.
- StatsSA [Statistics South Africa]. 2007. Using the 2001 Census: Approaches to analysing data / Statistics South Africa. Pretoria: Statistics South Africa.
- StatsSA [Statistics South Africa]. 2012. Post-enumeration Survey (PES) / Statistics South Africa. Pretoria: Statistics South Africa.
- StatsSA [Statistics South Africa]. 2016. Provincial profile: Limpopo Community Survey 2016 Report number 03-01-15. Pretoria: StatsSA.
- StatsSA [Statistics South Africa]. 2018. Media release: Quarterly Labour Force Survey – QLFS Q4:2016. Retrieved on 01 July 2020. Retrieved from: <http://www.statssa.gov.za/?p=9561>
- StatsSA [Statistics South Africa]. 2020. SuperCross, Spacetime Research. [Software]. Accessed 23 June 2020.
- Steel, G. 2013. Mining and Tourism: Urban Transformations in the Intermediate Cities of Cajamarca and Cusco, Peru. *Latin American Perspectives*, Issue 189 40(2), pp.237-249. DOI: 10.1177/0094582X12468866
- STEPSA [Spatial Temporal Evidence Planning for South Africa]. (2016a). Spatial Indicators. Accessed on 05-04-2017. Retrieved from: http://stepsa.org/spatial_indicators.html.
- STEPSA, (2016). Spatial indicators: Household poverty. Retrieved from: http://stepsa.org/household_poverty_sub_city.html
- STEPSA, (2016). Spatial indicators: Household poverty. Retrieved from: http://stepsa.org/household_poverty.html
- STEPSA, (2016b). Spatial indicators: Changing urban footprint. Retrieved from: http://stepsa.org/changing_urban_footprints.html
- STEPSA, (2016c). Spatial indicators: Energy poverty. Retrieved from: http://stepsa.org/energy_poverty.html
- STEPSA, (2016d). Spatial indicators: Change in settlement density. Retrieved from: http://stepsa.org/population_growth_sub_city.html

- STEPSA, (2016e). Spatial indicators: Remoteness/accessibility index. Retrieved from: http://stepsa.org/accessibility_index.html
- STEPSA, (2016f). Spatial indicators: Social vulnerability. Retrieved from: http://stepsa.org/social_vulnerability.html
- STEPSA, (2016g). Spatial indicators: Change in racial diversity. Retrieved from: http://stepsa.org/racial_diversity.html
- STEPSA, (2016h). Spatial indicators: Change in percentage unemployment. Retrieved from: http://stepsa.org/employment_unemployment.html
- STEPSA, (2016i). Spatial indicators: Population growth. Retrieved from: http://stepsa.org/population_growth.html
- STEPSA, (2016j). Spatial indicators: Change in percentage youth. Retrieved from: http://stepsa.org/percentage_youth.html
- STEPSA, (2016k). Spatial indicators: Human capital development. Retrieved from: http://stepsa.org/human_capital_development.html
- Štreimikienė, D. (2015). Environmental indicators for the assessment of quality of life. *Intelektinė ekonomika*, 9(1), pp.67-79.
- Streiner, D.L. (1993). An introduction to multivariate statistics. *The Canadian Journal of Psychiatry*, 38(1), pp.9-13.
- Suzuki, H., Cervero, R and Luchi, K. (2013). *Transforming Cities with Transit: Transit and Land-Use Integration for Sustainable Urban Development*. The World Bank, Washington DC.[ebook].
- Tacoli, C and Satterthwaite, D. (2002). *The Urban Part of Rural Development: the Role of Small and Intermediate Urban Centres in their Regional and Local Economies, Including Rural Development and Poverty Reduction*. Working paper for the working group on secondary towns and rural growth European Forum on Rural Development Cooperation Montpellier, 4-6 September 2002.
- Teerarojanarat, S., Fairbairn, D. and Chunithipaisan, S. (2004). 'Urban Growth Simulation with UrbanSim', The FOSS/GRASS User Conference, (September), pp. 12–14.
- Teklenburg, J.A.F., Timmermans, H.J.P. and Van Wagenberg, A.F., (1993). Space syntax: standardised integration measures and some simulations. *Environment and Planning B: Planning and Design*, 20(3), pp.347-357.

- Terama, E., Clarke E., Rounsevelle M D A., Fronzek, S., and Carter, T R. (2017). Modelling population structure in the context of urban land use change in Europe. *Reg Environ Change*; 19(3) pp. 667–677. Retrieved from: <https://doi.org/10.1007/s10113-017-1194-5>.
- Terruhn, J. (2020). Urban diversity and inequality in Auckland. In *Intersections of Inequality, Migration and Diversification* (pp. 131-151). Palgrave Pivot, Cham.
- The African Union Commission. (2015). Agenda 2063: The Africa We Want, A Shared Strategic Framework for Inclusive Growth and Sustainable Development. First Ten-Year Implementation Plan 2014-2023.
- The Local Government of South Africa. (2017). 4th ed. [ebook] Yes! Media. Retrieved from: <https://municipalities.co.za/> [Accessed 29 Oct. 2017].
- Thornhill, A., Saunders, M. and Lewis, P. (2009). *Research methods for business students*. Prentice Hall: London.
- Thorns, D.C. (2012). *The transformation of cities: urban theory and urban life*. Macmillan International Higher Education. New York.
- Thrift, N. (2003). Space: The Fundamental Stuff of Human Geography. In Holloway, S. L, Rice, S. P. and Valentine, G. eds., 2003. Key concepts in geography. London: SAGE Publications.
- Tosics, I. (2005). City developments in Central and Eastern Europe since 1990: The impacts of internal forces, in Hamilton, F. I., Andrews, K. D., and Pichler-Milanović, N. (eds) Transformation of cities in central and Eastern Europe: Towards globalization. United Nations University Press. Retrieved from: https://chisineu.files.wordpress.com/2012/08/biblioteca_hamilton_transformation.pdf.
- Trochim, W.M. (2020). Research methods knowledge base. Web version. Retrieved from: <https://socialresearchmethods.net/kb/>
- Turok, I. (2014). Settlement Planning and Urban Transformation. In Spatial transformation of Cities Conference Report 4-6 March 2014. Pretoria: South African Cities Network.
- Turok, I. (2016). Planning for spatial transformation. Land use planning law reform in the Western Cape: The road to transformation. Western Cape Government.
- UCL [University College of London]. (2020). Integration. Accessed on 23July2020. Retrieved from: <https://www.spacesyntax.online/term/integration/>
- UN [United Nations]. (1976). Special Environmental Report No.7: Weather, Climate and Human Settlements. World Meteorological Organization, Geneva. Accessed on 26 August 2020. Retrieved from: https://library.wmo.int/doc_num.php?explnum_id=8248

United Nations (2016). Habitat III Policy Paper. 1- Right to the city and cities for all.

United Nations (UN), Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352).

United Nations (UN). (2007). Indicators of Sustainable Development: Guidelines and Methodologies –Third edition. Methodology sheets. Accessed on 29-03-2020. Retrieved from: https://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets.pdf

United Nations (UN). (2019b). World Economic Situation and Prospects. Accessed on 08/04/2020. Retrieved from: https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/WESP2019_BOOK-ANNEX-en.pdf

United Nations (UN). (2015). Transforming our world: the 2030 Agenda for Sustainable development. [online]. [A/RES/70/1]. United Nations.

United Nations (UN). (2018). Department of Economic and Social Affairs, Population Division. World Urbanization Prospects: The 2018 Revision, custom data acquired via website. [online].

United Nations [UN], Department of Economic and Social Affairs, Population Division (2019a). World Urbanization Prospects: The 2018 Revision (ST/ESA/SER.A/420). New York: United Nations.

United Nations Economic Commission for Africa (UNECA), Global Spatial Data infrastructure Association (GSDI) and EIS-Africa, International Institute for Geoinformation Science and Earth Observation (ITC). (2003). SDI-Africa: an implementation guide. UN Economic Commission for Africa. Development Information Services Division, Addis Ababa, Ethiopia. Retrieved from: http://gsdiassociation.org/images/publications/cookbooks/SDI_Africa_Guide_full_text.pdf

United Nations UN. (2016). The United Nations Conference on Housing and Sustainable Urban Development (Habitat III) QUITO 17-20 October 2016. [online].

United Nations, (2016). Guide on Measuring Human Capital. United Nations Geneva, Switzerland. Accessed on 2019/05/14. Retrieved from: <https://unstats.un.org/unsd/nationalaccount/consultationDocs/HumanCapitalGuide.web.pdf>

United Nations, Department of Economic and Social Affairs, Population Division (2018). The World's Cities in 2018-Data Booklet (ST/ESA/SER.A/417). Retrieved from: https://www.un.org/en/events/citiesday/assets/pdf/the_worlds_cities_in_2018_data_booklet.pdf


United Nations, Department of Economic and Social Affairs, Population Division (2019). World Urbanization Prospects: The 2018 Revision (ST/ESA/SER.A/420). New York: United Nations.

- United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352).
- URBS – Urbanization Company of Curitiba (2020). URBS Official Website (in Portuguese). Retrieved from; www.urbs.curitiba.pr.gov.br. Accessed 20 February 2020.
- van der Toorn Vrijthoff. (2006). History integrated urban transformation. WIT Press, vol 93 pp.61-70.
- Van Dijk, T. A. (1993). Principles of critical discourse analysis. *Discourse and society*, 4(2), pp.249-283.
- Van Huyssteen, E., Mans, G., le Roux, A., Maritz, J., Ngidi, M. and Maditse, K. (2016). Profiling SA's system of towns - Introducing the CSIR/SACN South African Settlement Typology. CSIR document.
- Wachter, S. (2005) 'The Determinants of Neighborhood Transformations in Philadelphia Identification and Analysis: The New Kensington Pilot Study', pp. 1–18. Retrieved from: http://phsonline.org/media/resources/The_Determinants_of_Neighborhood_Transformations_in_Philadelphia_Identification_and_Analysis-The_New_Kensington_Pilot_Study.pdf.
- Walks, R.A., (2001). The social ecology of the post-Fordist/global city? Economic restructuring and socio-spatial polarisation in the Toronto urban region. *Urban Studies*, 38(3), pp.407-447.
- Wang, Y and Liu, K. (2017). Evolution of Urban Socio-Spatial Structure in Modern Times in Xi'an, China. *Sustainability*, 9(1935) pp.1-22.
- Watkins, C. (2005). Representations of Space, Spatial Practices and Spaces of Representation: An Application of Lefebvre's Spatial Triad. *Culture and Organization*, 11(3), pp.209-220.
- Wei, Y. and Wang, X. (2014). Interpretation of Urban Texture from the Perspective of Ecoaesthetics: Case Study in China. *Urban Planning and Design Research*, 2, pp.32-40.
- Weiner, C. (2006). The History of the Pietersburg [Polokwane] Jewish Community. Masters Dissertation. University of South Africa.
- Weir-Smith, G. (2016). Changing boundaries: Overcoming modifiable areal unit problems related to unemployment data in South Africa. *South African Journal of Science*, 112(3-4), pp.1-8.
- Wheeler, S.M. (2003). The evolution of urban form in Portland and Toronto: Implications for sustainability planning. *Local Environment*, 8(3), pp.317-336.
- White, M. D. and Marsh, E. E. (2006). Content analysis: A flexible methodology. *Library trends*, 55(1), pp. 22-45.

- Williams, B., Onsman, A., and Brown, T. (2016). Exploratory factor analysis: A five-step guide for novices. *Journal of Emergency Primary Health Care (JEPHC)*, Vol. 8(3). Pp. 1-13.
- Williams, J. J. (2000). South Africa: Urban transformation. *Cities*, 17(3), pp. 167–183.
- Winkler, K., Seifert, K. and Detering, H. (2012). Literary studies and the spatial turn. *JLT Articles*, 6(1).
- World Bank (2017) World Development Report 2017: Governance and the law. Washington, DC: World Bank. doi: 10.1596/978-1-4648-0950-7.
- Wray, C, Musango, J, Damon, K, and Cheruiyot, K. (2013). Modelling urban spatial change: a review of international and South African modelling initiatives, 146.141.12.21.
- Wray, C. and Cheruiyot, K., (2015). Key Challenges and Potential Urban Modelling Opportunities in South Africa, with Specific Reference to the Gauteng City-Region. *South African Journal of Geomatics*, 4(1), pp.14-35.
- Yousuf, M.I., (2007). Using experts' opinions through Delphi technique. Practical assessment, research and evaluation, 12(4), pp.1-8.
- Yu, W. (2011) 'Analyzing and modeling land use land cover change (LUCC) in the Daqing City, China', *Applied Geography*. Elsevier Ltd, 31(2), pp. 600–608. doi: 10.1016/j.apgeog.2010.11.019.
- Zari, M.P., (2018). Regenerative urban design and ecosystem biomimicry. Routledge. New York.
- Zhang, L., Yue, W., Liu, Y., Fan, P. and Wei, Y.D. (2018). Suburban industrial land development in transitional China: Spatial restructuring and determinants. *Cities*, 78, pp.96-107.

APPENDICES

Appendix A: Raosoft sample size calculator



Sample size calculator

What margin of error can you accept? %
5% is a common choice

The margin of error is the amount of error that you can tolerate. If 90% of respondents answer *yes*, while 10% answer *no*, you may be able to tolerate a larger amount of error than if the respondents are split 50-50 or 45-55.
Lower margin of error requires a larger sample size.

What confidence level do you need? %
Typical choices are 90%, 95%, or 99%

The confidence level is the amount of uncertainty you can tolerate. Suppose that you have 20 yes-no questions in your survey. With a confidence level of 95%, you would expect that for one of the questions (1 in 20), the percentage of people who answer *yes* would be more than the margin of error away from the true answer. The true answer is the percentage you would get if you exhaustively interviewed everyone.
Higher confidence level requires a larger sample size.

What is the population size?
If you don't know, use 20000

How many people are there to choose your random sample from? The sample size doesn't change much for populations larger than 20,000.

What is the response distribution? %
Leave this as 50%

For each question, what do you expect the results will be? If the sample is skewed highly one way or the other, the population probably is, too. If you don't know, use 50%, which gives the largest sample size. See below under **More information** if this is confusing.

Your recommended sample size is **588**

This is the minimum recommended size of your survey. If you create a sample of this many people and get responses from everyone, you're more likely to get a correct answer than you would from a large sample where only a small percentage of the sample responds to your survey.

Online surveys with Vovici have completion rates of 66%!

Alternate scenarios

With a sample size of	<input style="width: 30px;" type="text" value="100"/>	<input style="width: 30px;" type="text" value="200"/>	<input style="width: 30px;" type="text" value="300"/>	With a confidence level of	<input style="width: 30px;" type="text" value="90"/>	<input style="width: 30px;" type="text" value="95"/>	<input style="width: 30px;" type="text" value="98"/>
Your margin of error would be	12.15%	8.59%	7.01%	Your sample size would need to be	270	383	538

Save effort, save time. Conduct your survey online with Vovici.

More information

If 50% of all the people in a population of 20000 people drink coffee in the morning, and if you were repeat the survey of 377 people ("Did you drink coffee this morning?") many times, then 95% of the time, your survey would find that between 45% and 55% of the people in your sample answered "Yes".
The remaining 5% of the time, or for 1 in 20 survey questions, you would expect the survey response to more than the margin of error away from the true answer.
When you survey a sample of the population, you don't know that you've found the correct answer, but you do know that there's a 95% chance that you're within the margin of error of the correct answer.
Try changing your sample size and watch what happens to the *alternate scenarios*. That tells you what happens if you don't use the recommended sample size, and how M.O.E and confidence level (that 95%) are related.
To learn more if you're a beginner, read **Basic Statistics: A Modern Approach** and **The Cartoon Guide to Statistics**. Otherwise, look at the **more advanced books**.

In terms of the numbers you selected above, the sample size n and margin of error E are given by

$$x = Z^2 \frac{r(1-r)}{n}$$

$$n = N \frac{x}{(N-1)E^2 + x}$$

$$E = \text{Sqrt}[\frac{(N-n)x}{n(N-1)}]$$

Appendix B : Snowball sampling



F Moffat <moreblessing.moffat@gmail.com>

Introducing PhD student Frank Moffat who will be contacting you about his PhD on urban spatial transformation of Polokwane

4 messages

Marie Huchzermeyer <Marie.Huchzermeyer@wits.ac.za> Mon, Aug 6, 2018 at 11:37 AM

To: Philip Harrison <Philip.Harrison@wits.ac.za>
Cc: Gemey Abrahams <ga24@mweb.co.za>, Stacey-Leigh Joseph <stacey-leigh@sacities.net>, Kecia Rust CAHF <kecia@housingfinanceafrica.org>, Richard Ballard <Richard.Ballard@wits.ac.za>, F Moffat <moreblessing.moffat@gmail.com>, "Emaculate E. Ingwani" <Emaculate.Ingwani@univen.ac.za>, James Chakwizira <James.Chakwizira@univen.ac.za>, "jameschakwizira@gmail.com" <jameschakwizira@gmail.com>, emmaculate Ingwani <ingwani@gmail.com>

Dear Phil, Gemey, Stacey-Leigh, Richard and Kecia

This is to briefly introduce PhD student Frank Moffat, who will be in touch over the next days to enquire about your availability to meet with him. Frank is part of the Collaborative Postgraduate Training project funded by the NRF, that involves a group of us in the School of Architecture and Planning at Wits University collaborating with University of Venda's Dept of Urban and Regional Planning and Durban University of Technology's Urban Futures Centre in supervising and supporting 8 PhD students across the three institutions. The project is in its second year, the cohort of 8 students all having defended their proposals and now at various stages of carrying out the research.

Frank is registered at University of Venda, and his supervisors (copied above) are Prof James Chakwizira and Dr Emaculate Ingwani. Frank's research focuses on spatial change of a section of Polokwane. The title of his study is 'Spatial transformation in City of Polokwane of South Africa, (1996-2016)'.

At our last student-supervisor workshop in June, we decided that it would be important for Frank to meet a few scholars and consultants working in this field, so as to discuss existing spatial analyses of Polokwane where these have been done, and of other cities where this provides relevant understanding for him to build on.

Knowing how busy everyone is, we'd be most grateful if you could meet with Frank. As we have budgeted for him to come to Johannesburg for just one week, perhaps where not all this can be accommodated in one week due to your availability, Frank could follow up with one or other of you via Skype.

Many thanks and all the best

Marie


Marie Huchzermeyer
Professor, School of Architecture and Planning
Room 223, John Moffat Building, University of the Witwatersrand
Private Bag 3, Wits 2050, Tel: +27-11-7177688; Cell: +27-83 424 2457

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F Moffat <moreblessing.moffat@gmail.com> Mon, Aug 6, 2018 at 12:11 PM

To: Marie Huchzermeyer <Marie.Huchzermeyer@wits.ac.za>
Cc: Philip Harrison <Philip.Harrison@wits.ac.za>, Gemey Abrahams <ga24@mweb.co.za>, Stacey-Leigh Joseph <stacey-leigh@sacities.net>, Kecia Rust CAHF <kecia@housingfinanceafrica.org>, Richard Ballard <Richard.Ballard@wits.ac.za>, "Emaculate E. Ingwani" <Emaculate.Ingwani@univen.ac.za>, James Chakwizira <James.Chakwizira@univen.ac.za>, "jameschakwizira@gmail.com" <jameschakwizira@gmail.com>, emmaculate Ingwani <ingwani@gmail.com>

Appendix C: Spatial transformation survey questionnaire

 University of Venda	QUESTIONNAIRE FOR CITY OF POLOKWANE COMMUNITY	Questionnaire number.....
--	--	------------------------------

My name is Moffat Frank student number (11616958) a PhD in Urban and Regional Planning student in the School of Environmental Sciences at University of Venda. I am undertaking a research titled, "**Spatial transformation in City of Polokwane, South Africa (1996-2016).**" This questionnaire is targeted at the City of Polokwane Community and Key Stakeholders.

Motivation

I humbly request your objective assistance by completing this questionnaire. Your responses will be solely used for academic purposes only and information collected will be treated with utmost confidentiality

Tick

I confirm that I have read and understood the information above. I agree to take part in this study.

Name of Participant _____ Date _____ Signature _____

Instruction: Please complete the following questions by ticking or cross on your response.

Section A: Demographic information

1. Gender 1 Male 2 Female

2. Age 1 18-25 2 26-35 3 36-45 4 46-55 5 56 +

3. What is your highest qualification

1 Below Matric 2 Matric 3 Certificate/Diploma 4 Degree/Postgraduate

4. Employment status 1 unemployed 2 employed 3 self employed

5. If you are employed, indicate your employment sector.....

6. Where do you live? 1 Polokwane CBD 2 Seshego 3 Other (specify) _____

7. How long have you been staying were you indicated in question 6? years.

8. Are you originally from City of Polokwane? 1 Yes 2 No

9. If answer is no to question 8, please provide place of origin?
.....

10. Please provide your reasons for moving from place mentioned in question 9, to the City of Polokwane?
.....

11. In what ways do you think the area you are living in is changing?
.....

SECTION B: DRIVERS OF SPATIAL TRANSFORMATION

Please use the following scale to indicate your most appropriate response to answer question 11

1=strongly disagree	2=disagree	3=neutral	4=agree	5=strongly agree
---------------------	------------	-----------	---------	------------------

12. To what extent do you strongly disagree or strongly agree that the following factors are influencing spatial changes in your area?

Drivers of spatial transformation						
Governance/ political (GPD)	1. Government control on land ownership	1	2	3	4	5
	2. Control by municipality on how land is used	1	2	3	4	5
	3. Traditional authorities allowing unplanned land development	1	2	3	4	5
	4. Land markets favour the rich	1	2	3	4	5
	5. Free movement of people in to the area after apartheid	1	2	3	4	5
	6. Government spending on construction of roads	1	2	3	4	5
	7. Government spending on housing construction	1	2	3	4	5
	8. Municipality decision making processes	1	2	3	4	5
	9. National government development directives	1	2	3	4	5
	10. Provincial government development directives	1	2	3	4	5
	11. Polokwane municipality development directives	1	2	3	4	5
	12. Uncontrolled allocation of land	1	2	3	4	5
	13. Government authority to direct development	1	2	3	4	5
	14. Implementation of land use policies	1	2	3	4	5
	15. Political organizations giving people land to build	1	2	3	4	5
	16. Community based organizations controlling land development	1	2	3	4	5
	17. Land restitution	1	2	3	4	5
Spatial characteristics/ biophysical factors (SCPD)	1. The area is favourable for building	1	2	3	4	5
	2. Availability of vacant developable land within the area	1	2	3	4	5
	3. The area is flat, easy for development	1	2	3	4	5
	4. Underdeveloped land open for infill developments,	1	2	3	4	5
	5. Natural environment makes the area good to live in	1	2	3	4	5
	6. Soil condition in this area is favourable for development	1	2	3	4	5
	7. Availability of natural resources and drainage patterns,	1	2	3	4	5
	8. Weather and climate is good in this area,	1	2	3	4	5
	9. The air quality is good in this area	1	2	3	4	5
Social and cultural norms (SCND)	1. People moved from rural areas to Polokwane city	1	2	3	4	5
	2. Natural increase of population in the city	1	2	3	4	5
	3. People moved from other towns and cities to Polokwane city	1	2	3	4	5
	4. People prefer to live in this area of the city	1	2	3	4	5
	5. Presence of religious institutions such as churches	1	2	3	4	5
	6. This place is located in a good environment	1	2	3	4	5
	7. This area is affordable because of the money people can get	1	2	3	4	5
	8. This area is closer to employment opportunities	1	2	3	4	5
	9. Influence of the public attract people to this area	1	2	3	4	5
	10. Controlled developments by community organizations	1	2	3	4	5
	11. Availability of social amenities such as churches in this area	1	2	3	4	5
	12. Housing development by the government	1	2	3	4	5
	13. This city is safe than other cities	1	2	3	4	5
Economic (Eco. D)	1. Availability of employment opportunities in Polokwane city	1	2	3	4	5
	2. Technological improvements such as internet live & work from home	1	2	3	4	5

	3.The property prices are affordable around this area	1	2	3	4	5
	4.People are moving from staying in Polokwane CBD to this area	1	2	3	4	5
	5.Easy access to public services,	1	2	3	4	5
	6.This place is attractive than surrounding areas	1	2	3	4	5
	7.Changing economic functions of Polokwane creating employment	1	2	3	4	5
	8.There are financial institutions and investment opportunities	1	2	3	4	5
	9.Development of road infrastructure by the government	1	2	3	4	5
	10.Industrial developments attracting people this area	1	2	3	4	5
	11.There is easy access to education and health facilities	1	2	3	4	5
	12.Redevlopment projects in this area	1	2	3	4	5
	13.Real estate developments by private sector	1	2	3	4	5

13. What other factors are causing the changes in the area you are living?

.....

14. Whom do you think is causing these spatial changes in your area?

.....

SECTION C: IMPLICATIONS OF SPATIAL TRANSFORMATION

Please use the following scale to indicate your most appropriate response to answer question 12

1=strongly disagree	2=disagree	3=neutral	4=agree	5=strongly agree
---------------------	------------	-----------	---------	------------------

15. To what extent do you strongly agree or strongly disagree that spatial changes in your area has caused the following impacts?

Implications of spatial transformation		1	2	3	4	5
Environmental (Env.l)	1.Loss of wetlands	1	2	3	4	5
	2.Municipality no-longer have capacity to collect waste regularly	1	2	3	4	5
	3.More waste being dumped indiscriminately	1	2	3	4	5
	4.Environmental destruction by developments taking place	1	2	3	4	5
	5.Loss of habitat for animal species	1	2	3	4	5
	6.Loss of vegetation to developments taking place	1	2	3	4	5
	6.Smoke pollution emitted by increasing cars moving around this area	1	2	3	4	5
	7.Pollution of rivers by increasing dirt from increasing population	1	2	3	4	5
	8.More solid waste being washed into water bodies	1	2	3	4	5
	9.More soil being washed into water bodies	1	2	3	4	5
Economic (Eco.l)	10.Increased paved surfaces in the city	1	2	3	4	5
	1.Traffic congestion because of more cars in this place	1	2	3	4	5
	2.Long travel hours to get to places with opportunities	1	2	3	4	5
	3.Increasing transport costs	1	2	3	4	5
	4.Shortage of transport services	1	2	3	4	5
	5.Municipality not able to meet infrastructure demands by the people,	1	2	3	4	5
	6.Water supply infrastructure breakdowns	1	2	3	4	5
	7.Increasing pressure on public services and facilities	1	2	3	4	5
	8.Redevlopment of properties to meet needs of people	1	2	3	4	5
	9.Decline of CBD as business move out to other new shopping malls	1	2	3	4	5
	10.Property values are becoming expensive	1	2	3	4	5
11.Increasing unemployment due to lack of jobs	1	2	3	4	5	

	12.Loss of urban agricultural land	1	2	3	4	5
	13.Loss of vacant land to developments	1	2	3	4	5
	14.Economic activities concentrated in urban areas than rural areas	1	2	3	4	5
Social (Soc.I)	1.Increasing separation between the poor and the rich	1	2	3	4	5
	2.Public health risks	1	2	3	4	5
	3.increasing demand of basic service provision such as water	1	2	3	4	5
	4.Informal settlements development	1	2	3	4	5
	5.Loss of open spaces to illegal developments	1	2	3	4	5
	6.Poor service provision in certain areas than others	1	2	3	4	5
	7.People living in poverty are increasing	1	2	3	4	5
	8.Housing shortages	1	2	3	4	5
	9.Poor interaction with neighbours	1	2	3	4	5
	10.Increasing criminal activities	1	2	3	4	5
	11.increasing demand of student accommodation	1	2	3	4	5
	12.Restriction of movement people to other areas, gated communities	1	2	3	4	5
Governance/ policy (GP.I)	1.Land use challenges	1	2	3	4	5
	2.Conflicts between municipality and traditional authorities over land	1	2	3	4	5
	3.Lack of transfer of powers from government to municipality	1	2	3	4	5
	4.Development conflicts between municipality & traditional authorities	1	2	3	4	5
	5.Municipality has inadequate capacity to control developments	1	2	3	4	5
	6.Corruption on distribution of resources and opportunities	1	2	3	4	5
	7.Poor control of property markets	1	2	3	4	5
	8.Exclusion of people in municipal decision making processes	1	2	3	4	5
	9.Inadequate government infrastructure development funding	1	2	3	4	5
	10. Community organizations fighting for illegal settlers	1	2	3	4	5
Spatial planning, monitoring, evaluation (SPME.I)	1.Houses spaced far from each other	1	2	3	4	5
	2.Outward expansion of developments on edges of the city	1	2	3	4	5
	3.Many service malls are being developed around the city	1	2	3	4	5
	4.Loss of agricultural land to urban developments	1	2	3	4	5
	5.The place is separated far from other areas	1	2	3	4	5
	6.The places are not easy to get access to	1	2	3	4	5
	7.Uneven developments around	1	2	3	4	5
	8.Developments not compliant to land use plans	1	2	3	4	5
	9.Inadequate technical resources to manage spatial changes	1	2	3	4	5

15. How has spatial changes taking place affected you and or your business?

.....

.....

SECTION D: FRAMEWORK FOR TRACKING SPATIAL TRANSFORMATION

16. What do you think the municipality should look at to understand spatial changes taking place?

.....

.....

17. What other issues would you like to bring to the attention of the researcher?

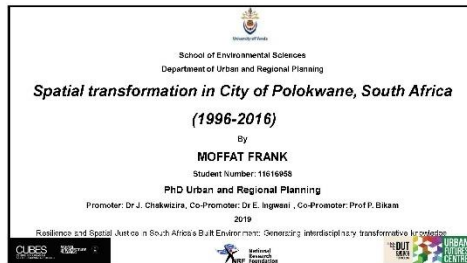
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THANK YOU FOR PARTICIPATING!!!

Appendix D: Semi-structured interview guide

2020/03/05



School of Environmental Sciences
Department of Urban and Regional Planning

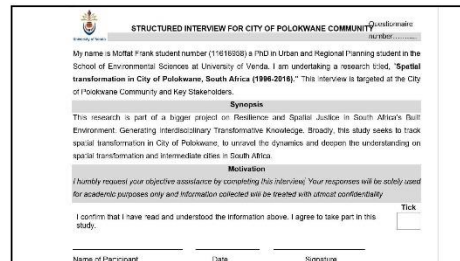
**Spatial transformation in City of Polokwane, South Africa
(1996-2016)**

By
MOFFAT FRANK
Student Number: 11614958
PhD Urban and Regional Planning

Promoter: Dr. J. Chakwira, Co-Promoter: Dr. E. Ingeval, Co-Promoter: Prof F. Bikaa

Resilience and Spatial Justice in South Africa's Built Environment: Generating Interdisciplinary Transformative Knowledge

1



STRUCTURED INTERVIEW FOR CITY OF POLOKWANE COMMUNITY

My name is Moffat Frank student number (11614958) a PhD in Urban and Regional Planning student in the School of Environmental Sciences at University of Venda. I am undertaking a research titled, "Spatial transformation in City of Polokwane, South Africa (1996-2016)." This interview is targeted at the City of Polokwane Community and Key Stakeholders.

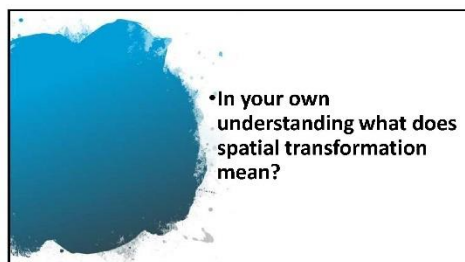
Synopsis
This research is part of a bigger project on Resilience and Spatial Justice in South Africa's Built Environment: Generating Interdisciplinary Transformative Knowledge. Broadly, this study seeks to track spatial transformation in City of Polokwane, to unravel the dynamics and deepen the understanding on spatial transformation and intermediate cities in South Africa.

Motivation
I humbly request your objective assistance by completing this interview. Your responses will be solely used for academic purposes only and information collected will be treated with utmost confidentiality.

I confirm that I have read and understood the information above. I agree to take part in this study.

Name of Participant _____ Date _____ Signature _____

2



•In your own understanding what does spatial transformation mean?

3



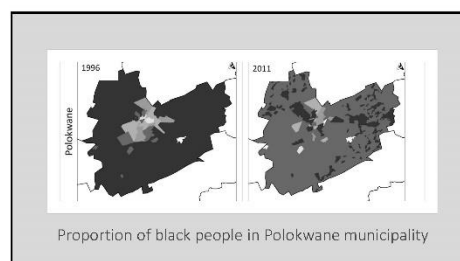
•In what ways do you think city of Polokwane has been spatially changing?

4



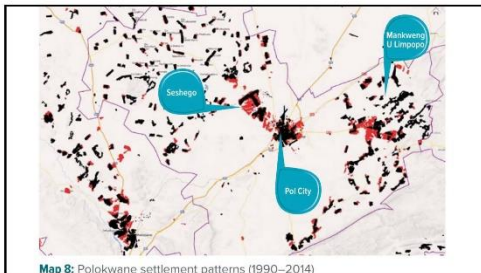
•Is this change spatially just, sustainable, efficient, resilient?

5



6

1



7

In your own words, what are the factors driving these spatial changes in City of Polokwane?

8

What are the implications of such spatial changes in City of Polokwane?

9

What aspects do you think we should look at to fully understand spatial transformation of cities?

10

Thank You!

11

Appendix E: GIS CD Census data request



F Moffat <moreblessing.moffat@gmail.com>

GIS CD census data 1996-2016

2 messages

F Moffat <moreblessing.moffat@gmail.com>

Mon, Aug 12, 2019 at 8:29 PM

To: Anneline Bezuidenhout <AnnelineB@statssa.gov.za>

Dear Anneline Bezuidenhout

Will you be in the office on Wednesday 14 August? I am going to travel from University of Venda in Limpopo to Pretoria. I would like to come and collect the GIS CD census data for my research study in person.

May you kindly assist with the details of your office or any details of the person who might be able to assist in this regard.

Thank you for your time.

--

Kind Regards 

Moffat Frank

PhD student, Dept. Urban and Regional Planning University of Venda
Master of Urban and Regional Planning (Distinction) University of Venda (2015-2016)
Bachelor of Urban and Regional Planning University of Venda (2011-2014)
Candidate Town Planner Reg no. C/7588/2013 South African Council for Planners (SACPLAN)

Anneline Bezuidenhout <AnnelineB@statssa.gov.za>

Tue, Aug 13, 2019 at 7:17 AM

To: moreblessing.moffat@gmail.com

Dear Frank

Our address is:

Stats SA
ISibalo House
Koch Street
Salvokop
Pretoria
0002

Regards

Anneline Bezuidenhout

Reprographics

GFW526

Tel: (012) 310-8251

Fax to email: 086-5944087

www.statssa.gov.za - info@statssa.gov.za

Private Bag x44, Pretoria, 0001, South Africa

ISibalo House, Koch Street, Salvokop, Pretoria, 0002

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>>> F Moffat <moreblessing.moffat@gmail.com> 12/08/2019 8:29 PM >>>

[Quoted text hidden]

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Appendix F: Exploratory Factor Analysis (EFA) procedures

1 Polokwane_Community_2019_507_cases_questionnaire_survey_data.sav [DataSet1] - IBM SPSS Statistics Data Editor

2 Polokwane_Community_2019_507_cases_questionnaire_survey_data.sav [DataSet1] - IBM SPSS Statistics Data Editor

3 Polokwane_Community_2019_507_cases_questi...

4 Polokwane_Community_2019_507_cases_questionnaire_survey_data.sav [DataSet1]

5 Polokwane_Community_2019_507_cases_questionnaire_survey_data.sav [DataSet1]

6 Polokwane_Community_2019_507_cases_questi...

7 Polokwane_Community_2019_507_cases_questionnaire...

Appendix G: GEOTERRAIMAGE data use application



University of Venda

School of Environmental Sciences

Department of Urban and Regional Planning

University Road, Thohoyandou, Limpopo
Private Bag X5050, Thohoyandou, 0950
Limpopo, South Africa

+27 15 962 8585

+27 15 962 8597

james.chakwizira@univen.ac.za

azwidowi.mashangu@univen.ac.za

GEOTERRAIMAGE (Pty) Ltd
The Grain Building
477b Witherite street
Willows
Pretoria
South Africa
0184

21-02-2019

REF: Data use application for academic research purposes

To whom it may concern

Mr Moffat Frank of student number 11616958, is a registered PhD student in Urban and Regional Planning at the University of Venda. His research is titled: *Spatial transformation in City of Polokwane of South Africa (1996-2016)*. This research is part of a bigger project on Resilience and Spatial Justice in South Africa's Built Environment: Generating Interdisciplinary Transformative Knowledge. This research was approved by all the relevant university research approval structures namely School of Environmental Sciences Higher Degrees Committee, the University of Venda Higher Degrees Committee and the Ethical Clearance Committee. He was also granted permission to conduct this research by City of Polokwane.

He selected City of Polokwane as a case study area to unravel and deepen spatial transformation dynamics in small and intermediate cities in South Africa. In my capacity as his supervisor, I humbly request GEOTERRAIMAGE to give him the necessary spatial data sets he may require complete his research.

Thank you for your consideration

Yours faithfully

Promoter



Dr James Chakwizira

Head, Department of Urban and Regional Planning



GEOTERRAIMAGE (Pty) Ltd
The Grain Building
477 Witherite Street | Willows | Pretoria | South Africa | 0184
Tel: +27 (0)12 807 9480 | Fax: +27 (0)12 807 9481
marketing@geoterraimage.com
www.geoterraimage.com

ISO9001: OP02	DATA USE APPLICATION FOR ACADEMIC RESEARCH PURPOSES
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Name of Applicant	Moffat Frank
Staff / Student nr	11616958
Applicant Email	moreblessing.moffat@gmail.com

University Name	University of Venda
Course nr	URP7990
Applicant Contact number	079 638 6548

Name of Supervisor	Dr James Chakwizira
Supervisor email	james.chakwizira@univen.ac.za

Supervisor Contact number	+27 76 387 7814
---------------------------	-----------------

Name of Department Head	Dr James Chakwizira
Department Head email address	james.chakwizira@univen.ac.za

Department Contact number	+27 15 962 8585
---------------------------	-----------------

Short description of research question & data sets required (GTI *****-*****DOP (photography) – ****DOR (Release)

Research question: What are the post apartheid spatial transformation dynamics that occurred in City of Polokwane between 1996 and 2016?

Data sets required specific to City of Polokwane are GTI DOR 1996 to GTI DOR 2016 on i) building base land use (historical land use changes), ii) Land cover (Urban extent land cover),

iii) Buildings (Building square metres), iv) Height data (Digital surface model, digital terrain models), v) Demographics (living standard measure, poverty index, demographic estimates),

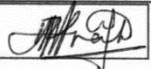
vi) Population (population distribution, day time population), vii) Development (demand forecasting, growth potential)

Software packages to be used	ArcMap 10.5
------------------------------	-------------

Briefly describe your proposed methodology / how will the data be used: *attach pages if necessary*

The clusters for each spatial indicator will be visually presented through choropleth mapping technique using ArcGIS, to depict spatial transformation dynamics in City of Polokwane between 1996 and 2016.

Please check attached table of possible indicators that the researcher seeks to generate for City of Polokwane that are linked to key literature on spatial transformation dynamics.

Sign 

Please provide a copy of your **registration letter** or **staff / student card** at the University as an attachment to this application form, as well as a copy of your **ID & a letter** from the Supervisor / Head of the School, stating your intention to do research using **GEOTERRAIMAGE (Pty) Ltd** data.

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The data remains the property of **GEOTERRAIMAGE**, as is protected by copyright and intellectual property laws.

2. Permitted & Intended Data Use

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The data may not be distributed, sold, leased, or lent to any other persons, academic institutions or organisations or any other entity or individual not listed here. Should the academic candidate wish to supply any data or part of it to any third party, the academic candidate shall inform **GEOTERRAIMAGE** in writing and accept the conditions and financial consequences of the license “third party”, which shall be proposed on a case-by-case basis, **before** the distribution of the data takes place. Additional royalties could be payable and all third parties must be disclosed.

The data may not be made available, in its original format in part or in full, on an internet website for download; however may be published within an internet map service. The data in its original format refers to the physical format and structure of the data as well as any data formats which closely resembles the dataset through equivalent or comparable information content.

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Sign 

008 Data Use Application Academic Research 2018.doc

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3. Data Releases

No data updates, maintenance contracts, or new releases are included in this agreement.

4. Liability

The academic candidate has to verify prior to his / her commitment, the adequacy of GEOTERRAIMAGE data sets and products to the specific data and analyses needs as set out by the academic candidate. GEOTERRAIMAGE will in no event be liable for any direct, indirect, incidental or consequential loss or damages including but not limited to failed academic results, whether or not GEOTERRAIMAGE has been advised of the possibility of such damage. This includes damages incurred by the academic candidate or any third party. GEOTERRAIMAGE data sets and products are processed from sources like topographic maps and satellite images. The quality of these sources is not the responsibility of GEOTERRAIMAGE. The data and data products are provided "as is", without warranty of any kind, either express or implied, including, but not limited to, the implied warranties of fitness for a particular purpose.

5. Financial Conditions of sale

The use of the data is provided to the academic candidate at no cost, based on the terms and conditions of this agreement. In the case of any breach of this agreement, the academic candidate will be held financially liable and or be faced with legal actions.

6. Acceptance of Proposal

This agreement must be signed and returned to GEOTERRAIMAGE with the data use application and required documentation before the data can be released.

Sign 

Directors: SL Ferreira | P Sevenhuysen | MW Thompson | Registration no: 1999/11006/07 | Vat no: 4440185140

008 Data Use Application Academic Research 2018.doc

I have read and agreed to the terms and conditions for the use of GEOTERRAIMAGE (Pty) Ltd data.

Date: 20/02/2019
Candidate Name: MOFFAT FRANK
Signature: [Handwritten Signature]

In the case of more than one student / staff member using the data in a research project, a separate form is to be filled in for each candidate.

Date: 21/02/2019
Witness Name: MAWOKOMAYI BETINA
Signature: [Handwritten Signature]

FOR GEOTERRAIMAGE (Pty) Ltd

Date: _____
Name: _____
Signature: _____

Date: _____
Witness Name: _____
Signature: _____

In the case of data being issued to academic candidates by a current data license holder, the license holder signs this form on behalf of GEOTERRAIMAGE, under the conditions of a separate licensing agreement between GEOTERRAIMAGE and the license holder, in which such issuing of data is permitted.

Sign [Handwritten Signature]

Directors: SL Ferreira | P Sevenhuysen | MW Thompson | Registration no: 1999/11006/07 | Vat no: 4440185140

In summary, the pattern that can be identified from the literature indicates that there are three main broad aspects to consider when dealing with spatial transformation dynamics namely demographic distribution, urban structure and urban texture. Table 2.1 summarises the aspects, factors and indicators of spatial transformation.

Table 2.1 Aspects, factors and indicators for mapping spatial transformation

Aspects	Indicators (change in..)	Indicators (% Change in :) if x then y measurement criteria	Sources
Demographic distribution	Race	Black, White, Indian, Coloured and other	Maritz et al., 2016; Harrison et al., 2015; CSIR 2015c,
	Employment	Unemployment, employment, number of employees per km ² ,	Harrison et al., 2015; CSIR 2015f;
	Deprivation-index	Income, employment, transport, qualifications, owned home,	Harrison et al., 2015;
	Population scale	sex ratio, Mean family size, total population	Wang & Liu, 2017; CSIR 2015i,
	Household registration types	(%) Rural population, Urban population	Wang & Liu, 2017;
	Age distribution	% ≤ 14; % 14-59; % ≥ 60; change in youth	Wang & Liu, 2017; CSIR 2015g; Najib 2017;
	Educational background/ human capital development,	(%) illiterate or semiliterate, primary education, junior education, senior education, university education, postgrad education	Wang & Liu, 2017; CSIR 2015h,
	Change in poverty	Household poverty, change in % living in poverty	CSIR 2015d, 2015k;
	Occupation	Artisans, traders, entrepreneurs, executives, professionals, retirees,	Najib 2017;
City structure	Urban footprint,	Built environment change, urban extent land cover.	Maritz et al., 2016; Harrison et al., 2015; CSIR 2015b
	Boundary	Change in city boundary, urban edge,	Harrison et al., 2015;
	Determinants of urban form	Roads, physical environment	Harrison et al., 2015;
	Site of economic development	Business districts, industrial estates, commercial, number of businesses per km ² , (manufacturing firms, finance, insurance, real-estate sector firms, wholesale, retail trade, catering, accommodation, construction firms,) industrial building by type, commercial building by type, new industrial buildings, disappearance of industrial buildings, new commercial buildings, disappearance of commercial buildings, communication, social services, health, sports and social welfare, education, culture and arts, scientific research and comprehensive technical services, estate, political parties, state, organizations.	Turok 2014; Harrison et al., 2015; Wang & Liu, 2017;
	Residential sites / housing	Residential neighbourhood, (formal houses, Townhouse units, Estate and Security village housing), gated communities, new township, informal settlements, (flats, single detached, owner occupied, private rented, social rented.	Turok 2014; Harrison et al., 2015; Najib 2017;
	Development	Properties built before 1994, built between 1994 and 2006, between 2006 and 2016.	Najib 2017;
	Land use pattern	Residential, Commercial, Industrial, Agricultural, institutional,	Mierzejewska 2017;
City texture (neighbourhood scale)	Transport networks	Public roads, private roads,	Turok, 2014;
	Utility facilities	Energy, water, sanitation infrastructure	Turok 2014; CSIR 2015i,
	Urban land cover change	Growth per km ² ,	Harrison et al., 2015;
	Poly-centricity (clusters)	Employment density, population density	Anas et al., 1998;
	Property value	Property prices bands,	Harrison et al., 2015;
	Occupation distribution	Production & transport, fishery, herding, forestry, farming; commercial, clerical and related, technical and professional, enterprise managers, managers/officers, institution, government.	Wang & Liu, 2017;
	density,	Population, houses, jobs, settlement density	Turok, 2014; CSIR 2015e,
	diversity,	Social and economic activity	Turok, 2014;
	proximity and access,	Access to public services and other facilities,	Turok, 2014; CSIR 2015a
	quality of public realm,	Quality of public spaces and opportunities for social interaction	Turok, 2014;
	safety	Risks of fires, flooding, and other hazards, settlements at risk, social vulnerability	Turok, 2014; CSIR 2015j
	connectedness	Links with other localities	Turok, 2014;
	Housing environment	Mean Building area per household, mean number per household	Wang & Liu, 2017;

Source: Author own compilation 2018

Appendix H: Univen Higher Degrees Committee Approval letter

UNIVERSITY OF VENDA

OFFICE OF THE DEPUTY VICE-CHANCELLOR: ACADEMIC

TO : MR/MS F MOFFAT
SCHOOL OF ENVIRONMENTAL SCIENCES

FROM: SENIOR PROF L.B KHOZA
ACTING DEPUTY VICE-CHANCELLOR: ACADEMIC

DATE : 09 OCTOBER 2018

DECISIONS TAKEN BY UHDC OF 1ST OCTOBER 2018

Application for approval of Thesis research proposal in Environmental Science:
F. Moffat (11616958)

Topic: "Spatial transformation in city of Polokwane of South Africa (1996-2016)."

Promoter	UNIVEN	Dr. J. Chakwizira
Co-Promoters	UNIVEN	Dr. E. Ingweni
	UNIVEN	Prof. P. Bikam

UHDC approved Thesis proposal



SENIOR PROF L.B KHOZA

ACTING DEPUTY VICE-CHANCELLOR: ACADEMIC

Appendix I: Request for permission to conduct research



University of Venda

School of Environmental Sciences

Department of Urban and
Regional Planning

University Road, Thohoyandou, Limpopo
Private Bag X5050, Thohoyandou, 0950
Limpopo, South Africa

+27 15 962 8585

+27 15 962 8597

james.chakwizira@univen.ac.za

azwidowi.mashangu@univen.ac.za

The Municipal Manager
City of Polokwane Local Municipality
Civic Centre
Corner Landros Mare and Bodenstein Street
Polokwane
0700

23/05/2018

Dear Sir / Madam

Ref: Request for permission to conduct interviews with municipal officials and the survey the community in City of Polokwane

My name is Moffat Frank of student number 11616958. I am a PhD student in Urban and Regional Planning at the University of Venda. My research is titled: Spatial transformation in City of Polokwane, South Africa.

To successfully complete my research project, I humbly request for permission to (i) conduct interviews with municipal officials, any relevant stakeholders and (iii) survey the community in City of Polokwane and (iii) have access to any available documents that may assist in my research.

If you need any further information please do not hesitate to contact the researcher on 0796386548 or moreblessing.moffat@gmail.com or 11616958@mvula.univen.ac.za.

Thank you for your consideration.

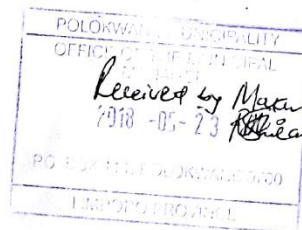
Yours faithfully

Dr James Chakwizira



Promoter

Head of Department: Urban and Regional Planning





University of Venda

School of Environmental Sciences

Department of Urban and
Regional Planning

University Road, Thohoyandou, Limpopo
Private Bag X5050, Thohoyandou, 0950
Limpopo, South Africa

+27 15 962 8585

+27 15 962 8597

james.chakwizira@univen.ac.za

azwidowi.mashangu@univen.ac.za

The Municipal Manager
City of Polokwane Local Municipality
Civic Centre
Corner Landros Mare and Bodenstein Street
Polokwane
0700

03/07/2018

Dear Sir / Madam

**Ref: Request for permission to conduct research in City of Polokwane Municipality by
Mr Moffat Frank student number 11616958**

Mr Moffat Frank of student number 11616958, is a PhD student in Urban and Regional Planning at the University of Venda. His research is titled: Spatial transformation in City of Polokwane, South Africa (1996-2016). This research is part of a bigger project on Resilience and Spatial Justice in South Africa's Built Environment: Generating Interdisciplinary Transformative Knowledge. This project is under the National Research Foundation (NRF) Collaborative Post-graduate training programme between University of Venda, Durban University of Technology and University of Witwatersrand.

He selected City of Polokwane as a case study area to unravel the dynamics and deepen the understanding on spatial transformation in small and intermediate cities in South Africa. In my capacity as his supervisor, I humbly request your highly esteemed office to give him the necessary assistance he may require.

Thank you for your consideration.

Yours faithfully

Dr James Chakwizira



Promoter

Head of Department: Urban and Regional Planning

REPORT CONTROL SHEET

SUBJECT: Request to conduct research (Mr F Mofeet)
DOCS NUMBER# _____

SECTION A: SUBMISSION BY SBU MANAGER
SBU: HR Training NAME (AUTHOR): Ms R. E Ramele
SIGNATURE / SBU MANAGER: _____ DATE: _____

SECTION B: AUTHORIZATION / SUBMISSION BY
DIRECTORATE: College of Shared Services
SIGNATURE / DIRECTOR: _____ DATE: 07/11/2018

SECTION C: COMMENTS REQUIRED FROM: (TICK IN APPLICABLE BLOCK)

DIRECTOR: ENGINEERING SERVICES	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
DIRECTOR: DEVELOPMENT & ECON. PLAN	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
DIRECTOR: COMMUNITY SERVICES	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
DIRECTOR: CORP. AND SHARED SERV.	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
CHIEF FINANCIAL OFFICER	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
DIRECTOR: COMMUNITY DEVELOPMENT	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
DIRECTOR: STRAT PLAN, MONITOR. & EVAL	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____
MAN: COMMUNICATION AND PUBLIC PART.	<input type="checkbox"/>	SIGNATURE: _____	DATE: _____

SECTION D: SECRETARIAT & ADMINISTRATION
REG. NO: _____ REG. DATE: _____ COMMITTEE CLERK: _____

SECTION E: MUNICIPAL MANAGER
APPROVED FOR SUBMISSION: [Signature] DATE: 14/11/2018
REMARKS: _____
ALLOCATION TO COMMITTEES

FINANCE & LED	ENERGY	HOUSING	CULTURE, SPORTS, REC & SPEC. FOCUS	ADMIN & GOV.
WATER & SANITATION	COMMUNITY SAFETY	ROADS, SWATER & TRANSPORT	WASTE & ENVIRON.	SPATIAL PLAN & DEV
LAND USE MAN.	LOCAL LABOUR FORUM	COUNCIL	MAYORAL COMMITTEE	

APPROVED ITO DELEGATED POWERS _____ DATE _____
MM/ NUMBER ALLOCATED BY CAO - SECRETARIAT _____ MM/ _____

APPROVAL OF EXECUTIVE MAYOR IN TERMS OF DELEGATED POWERS

APPROVED ITO DELEGATED POWERS _____ DATE: _____
EM/ NUMBER ALLOCATED BY CAO - SECRETARIAT _____ EM/ _____

515557
MS. R.E RAMELA (05/11/2018)

DIRECTORATE: CORPORATE AND SHARED SERVICES

ITEM:

FILE REF:

**REQUEST TO GRANT MR F MOFFAT TO CONDUCT RESEARCH WITHIN
POLOKWANE MUNICIPALITY**

Report of the Director: Corporate and Shared Services

Purpose of the Report

To request the Municipal Manager to grant Mr. F Moffat to conduct his research at Polokwane Municipality.

Background and Discussion

Mr. F Moffat sent a letter requesting permission to conduct research at Polokwane Municipality. His research topic is titled: Spatial transformation in City of Polokwane.

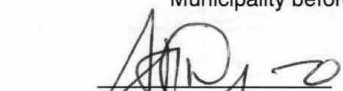
"A copy of the letter from University of Venda is attached for reference"


Financial Implication

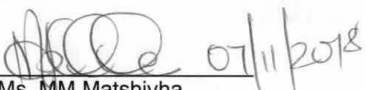
There is no financial implication.

Recommend

1. That approval be granted to Mr. F Moffat to conduct his research within Polokwane Municipality.
2. That the findings emanating from the research study be shared with the Municipality before they are published.


Mr. J. Manyama
HR Manager


Mr. DH Makobe
Municipal Manager


Ms. MM Matshivha
Director: Shared & Corporate Services

Appendix J: Univen Ethical Clearance letter

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:

Mr F Moffat

Student No:

11616958

PROJECT TITLE: **Spatial transformation in City of Polokwane of South Africa (1996-2016).**

PROJECT NO: **SES/18/URP/03/2111**

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr J Chakwizira	University of Venda	Promoter
Dr E Ingwani	University of Venda	Co - Promoter
Prof P Bikam	University of Venda	Co - Promoter
Mr F Moffat	University of Venda	Investigator – Student

ISSUED BY:

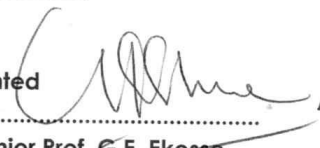
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE

Date Considered: November 2018

Decision by Ethical Clearance Committee Granted

Signature of Chairperson of the Committee:

Name of the Chairperson of the Committee: Senior Prof. **G.E. Ekosse**




University of Venda

PRIVATE BAG X5050, THOHYANDOU, 0950. LIMPOPO PROVINCE, SOUTH AFRICA
TELEPHONE (015) 962 8504/8313 FAX (015) 962 9060

"A quality driven financially sustainable, rural-based Comprehensive University"



Appendix K: Consent form



University of Venda

**SCHOOL OF ENVIRONMENTAL SCIENCES
DEPARTMENT OF URBAN AND REGIONAL PLANNING**

CONSENT FORM

PhD Thesis Title

Spatial transformation in City of Polokwane, South Africa (1996-2016)

Researcher : Moffat Frank Student number : 11616958

Synopsis

Broadly, this study seeks to track spatial transformation in City of Polokwane, South Africa from 1996 to 2016. This study seeks to attain this broad aim through mapping the post-apartheid spatial transformation of Polokwane city, determine the drivers and implications of spatial transformation and lastly to develop a framework for tracking spatial transformation in small and intermediate cities in South Africa.

Motivation

This study is motivated by the urgent need for managing spatial transformation in cities attributed by growing rate of urbanisation. Which manifests itself into spatial segregation, structural inequality, non-sustainable growth paths, non-resilient, spatially unjust developments. Hence, tracking spatial transformation of the city will aid in understanding the drivers and evaluating the implications of spatial transformation.

You are being invited to take part in this research because we feel that your experience in and within Polokwane city will contribute much to our understanding and knowledge of spatial transformation, drivers and its implications

I confirm that I have read and understood the information above. I agree to take part in this study.

Tick

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.

I agree to the interview being recorded (video/audio)

I agree to the use of anonymised quotes in publications

Name of Participant

Date

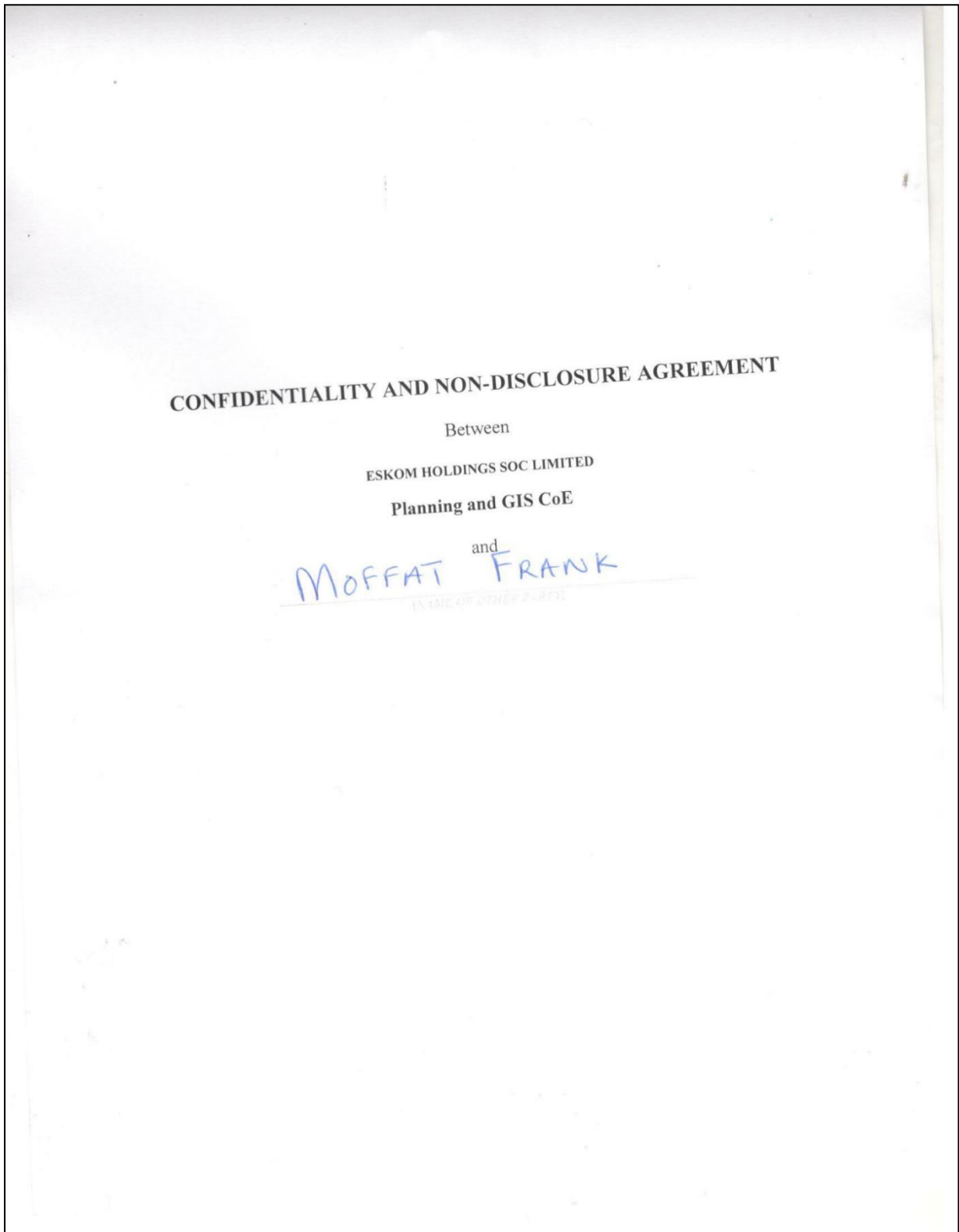
Signature

Name of Researcher

Date

Signature

Appendix L: Eskom Dwelling Layer Confidentiality and non-disclosure agreement



1. PARTIES

The parties to this Agreement are:

- 1.1. **ESKOM HOLDINGS SOC LIMITED** ("Eskom") a company incorporated under the laws of the Republic of South Africa, having its registered office at Megawatt Park, Maxwell Drive, Sunninghill Ext. 3, Sandton, Republic of South Africa, with registration number 2002/015527/06.;

- 1.2. MOFFAT FRANK a PHD student at University of Venda (NAME OF OTHER PARTY)
("Counterparty") a company incorporated under the laws of in South Africa [insert name of country],
 having its registered office at _____ [registered address],
 _____ [insert name of country], with
 registration number N/A [insert registration number];

Hereinafter referred to as "Party" or "Parties" as the context requires.

2. INTRODUCTION

- 2.1. The Parties intend providing each other with certain Confidential Information; SPOT BUILDING COUNT (SBC) Eskom DWELLING LATER, for use in a project as described in 4 below.
- 2.2. The Parties wish to record the terms and conditions on which they are prepared to disclose such Confidential Information to each other.

3. RELATIONSHIP BETWEEN THE PARTIES

- 3.1. Neither this Agreement nor the exchange of information contemplated hereby shall commit either Party to continue discussions or to negotiate, or to be legally bound to any potential business relationship. The Parties shall only be bound to a business relationship by way of further definitive written agreements signed by the Parties.

3.2. Nothing contained in this Agreement shall be construed as –

3.2.1. Prohibiting either Party from entering into a business or commercial relationship with any Third Party;

3.2.2. Creating a joint venture, partnership or employment relationship between the Parties and neither Party shall have the right, power or implied authority to create any obligation or duty (express, implied or otherwise) on behalf of the other Party. For the avoidance of doubt, nothing in this Agreement shall oblige either of the Parties to enter into any agreements or transactions whatsoever.

4. RESTRICTION ON DISCLOSURE AND USE OF CONFIDENTIAL INFORMATION

The Receiving Party undertakes not to use the Confidential Information for any purpose other than:

4.1. The Project: SPATIAL TRANSFORMATION IN CITY OF POLOKWANE
SOUTH AFRICA (1996-2016)
(Name of the project)

If project is being done for Eskom, municipality or any organ of state, please provide contact person or project manager details.

4.2. Contact person: N/A

Contact Details: N/A

4.3. in accordance with the provisions of this Agreement.

5. BREACH

In the event that the Receiving Party should breach any of the provisions of this Agreement and fail to remedy such breach within 7 (seven) business days from date of a written notice to do so, then the Disclosing Party shall be entitled to invoke all remedies available to it in law including, but not limited to, the institution of urgent proceedings as well as any other way of relief appropriate under the circumstances, in any court of competent jurisdiction, in the event of breach or threatened breach of the Agreement

6. PUBLICITY

Neither Party will make or issue any formal or informal announcement or statement to the press or any Third Party in connection with this Agreement without the prior written consent of the other Party.

SIGNED by the Parties and witnessed on the following dates and at the following places respectively:

On behalf of Eskom:

SIGNED at _____ on _____

AS WITNESS:

For: **Planning and GIS CoE (ESI-GIS)**
Duly authorized

[Name of witness in print] [Specify full name of signatory]

On behalf of the receiving party:

SIGNED at UNIVERSITY OF VENDA on 23/04/2019

AS WITNESS:

W Tsorigo _____
For: _____
Duly authorized

Wendy Tsorigo _____
[Name of witness in print] MOFFAT FRANK
[Specify full name of signatory]

Appendix M: TURNITIN REPORT

Spatial transformation in City of Polokwane, South Africa (1996-2016)

ORIGINALITY REPORT

7%	6%	3%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to uvt Student Paper	<1%
2	hdl.handle.net Internet Source	<1%
3	uir.unisa.ac.za Internet Source	<1%
4	www.polokwane.gov.za Internet Source	<1%
5	univendspace.univen.ac.za Internet Source	<1%
6	researchspace.ukzn.ac.za Internet Source	<1%
7	journal.frontiersin.org Internet Source	<1%
8	repository.nwu.ac.za Internet Source	<1%
9	Wegener, M.. "New spatial planning models",	

Appendix N: LANGUAGE EDITING LETTER

mawokomayi@gmail.com

Date: 16/02/2021

RE: TO WHOM IT MAY CONCERN

This letter serves to confirm that I have edited the thesis titled:

***Spatial transformation in City of Polokwane, South Africa
(1996-2016).***

By

Moffat Frank

Student No: 11616958

I carefully read through the thesis, focusing on grammatical errors and spelling mistakes.

Please do not hesitate to contact me for any queries.

Yours Sincerely,



Ms Mawokomayi (PhD Candidate, University of Fort Hare)

Ms Mawokomayi. M.Sc, Communication, (University of Fort Hare) B.A. Hons, Lit. & Media Studies (University of Venda), B.A. Media Studies (University of Venda). Language and Writing Consultant (LWC) (University of Fort Hare).