Embedding Planning Support Systems (PSS) in the spatial planning process: The case of the Spatial Development Framework (SDF) methods in Rwanda.

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June, 2020

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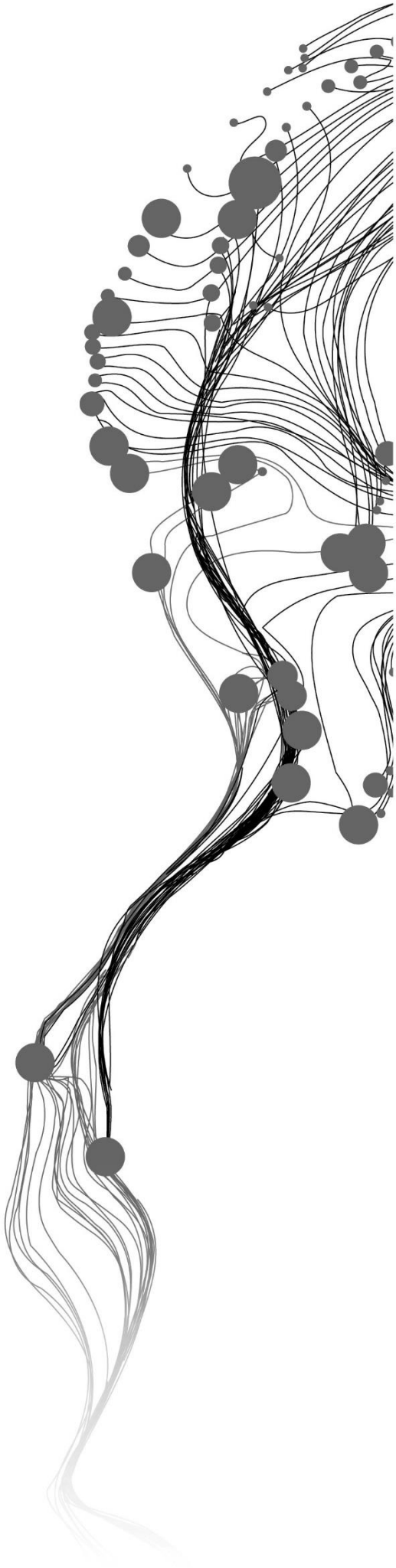

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ABSTRACT

The gaps in embedding planning support systems (PSS) in spatial planning practice has been on for decades. There are countless studies to highlight the gaps in embedding PSS in practice. Some studies claim that the limited use of PSS in practice is a result of the mismatch between developers instrument capabilities and users requirements. Others identify implementation gaps such as instrument capabilities, usefulness and user acceptance. Nevertheless, none of the studies has been able to explain the changes in PSS implementation process that contribute to the lack of embeddedness in practice.

Therefore, it is vital to challenge the recommendations from previous studies as specific solutions to bridge the gaps in embedding PSS in practice. Hence, this thesis explores a different perspective to understand the role of changes in PSS implementation process that impacts the embeddedness in practice. It builds on the concept of "drift" in technical system implementation as a means to predict the occurrence of the existing gaps and proffer solutions to enhances PSS embeddedness in practice.

This thesis aims to understand the role of drift in embedding PSS in practice using the spatial development framework (SDF) methods in Rwanda. It considers the most comprehensive theoretical view to study drift – *the interaction-context*. The drift interaction-context research considers both human and non-human elements that trigger drift in the technical system implementation process to achieve actual use. Though due to the timeline of this thesis, achieving the drift interaction-context research was impossible. As such, this thesis adopts the actor research context that considers just the human role in drift during technical systems implementation to describe users' acceptance of the SDF methods that triggers drift in embedding it as a PSS in planning practice. This thesis illustrates *how* users acceptance can predict the drift in PSS implementation process and achieve embeddedness in practice. In this research, drift is the *implementation tactics*, *adjustments* or *compromises* users identify as essential to adopt PSS in practice. Thus, this thesis is an early warning system to highlight the role of drift in embedding PSS in practice.

Concerning the case study area, the thesis gives an overview of the land use planning (LUP) process at the national and local levels *to understand the need for the SDF methods adoption in practice*. It adopts the drift actor research to describe the users understanding and perceived ease of use and usefulness of the SDF methods that trigger *drift in embedding the SDF methods in practice*. Lastly, a description of the results of the SDF methods adoption identifies *where the methods are embedding as PSS* in Rwanda.

The result analysis reflects a need for PSS adoption in practice and *signs of drift* required to embed the SDF methods in the planning practice at the national and local levels. Hence, this thesis establishes the need to consider the role of drift in embedding PSS in practice as a possible solution to bridging the gaps in PSS adoption in practice.

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LIST OF ACRONYMS

ANT	Actor-Network Theory
DBMS	Database Management Systems
DDPs	District Development Plans
DDSs	District Development Strategies
DSS	Decision Support Systems
EDPRS I	Economic Development and Poverty Reduction Strategy (2008-2012)
EDPRS II	Economic Development and Poverty Reduction Strategy (2013-2018)
GIS	Geo-Information Systems
ISPs	Institutional Strategic Plans
IUC1	Intermediate Urban Centre 1
IUC2	Intermediate Urban Centre 2
IUIDP	Integrated Urban Infrastructure Development Planning
LODA	Local Administrative Entities Development Agency
LUC	Local Urban Centre
LUP	Land Use Planning
MDAs	Ministries, Departments, Agencies
M&E	Monitoring And Evaluation
MoF	Matrix of Function
MINALOC	Ministry of Local Governments
MINECOFIN	Ministry of Finance and Economic Planning
MININFRA	Ministry of Infrastructure
MTDP	Medium-Term Development Plans
MTEF	Medium-Term Expenditure Framework
MUC	Main Urban Centre
NIPs	National Investment Programs
NLUPG	National Land Use Planning Guidelines
NSAP	National Strategic Action Plan
NST1	National Strategy for Transformation (2017-2024)
NUP	National Urbanisation Policies
PEDP	Physical and Environmental Development Plan
PEOU	Perceived Ease of Use
PRSP	Poverty Reduction Strategy (2002-2006)
PSS	Planning Support Systems
PU	Perceived Usefulness
SDF	Spatial Development Framework
SF	Spatial Frameworks
SMCE	Spatial Multi-Criteria Evaluation
SSPs	Sector Strategic Plans
SUDP	Strategic Urban Development Plan
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action

1. INTRODUCTION

1.1. Overview

In many developing countries, the planning, evaluation, implementation and monitoring responsibilities for spatial development are limited to the national level because of the top-down (national to local levels) governance systems. A notable consequence of such governance system is weak spatial planning systems that are characterised by broad policy objectives, lack of spatial policies, inefficient and weak institutional capacities to implement existing national policies at the local levels (Spaliviero, Boerboom, Gibert, Spaliviero, & Bajaj, 2019). Spaliviero et al. (2019) further describe weak planning systems as central planning systems that inhibit the efficient implementation of policies and spatial plans at the local levels. On the one hand, the lack of spatial policies and inefficient implementation of spatial policies at the local levels have contributed to territorial disparities. On the other hand, weak planning systems have limited spatial policy implementation at the local levels. Furthermore, the spatial complexities across the local levels coupled with conflicting interests from stakeholders, proponents of physical development, as well as decision-makers, have increased unplanned spatial expansions in countries with weak planning systems.

In most developing countries, the challenges of unplanned spatial expansion are beyond the local level capabilities due to lack of financial resources and weak planning systems. However, the national level response to unplanned spatial expansions challenges includes outright neglect, slow reactions, concentrating on specific urban challenges and lack of policies to manage the expansion (Turok & Parnell, 2009). In recent times, national governments in developing countries have identified the relationship between urban growth and economic development as a policy problem that needs attention. Hence, the need for strategic spatial planning methods for the development and implementation of spatial policies to ease the consequences of unplanned and uncontrolled growth of regions (Turok & Parnell, 2009; Turok & McGranahan, 2013). Developed countries have studies to establish the achievements and impacts of the adoption of specific strategic spatial planning methods for decision-making processes at the national and local levels (Albrechts, 2006b; Healey, Khakee, Motte, & Needham, 1999). However, for developing countries that have adopted strategic spatial planning methods for specific spatial planning processes, research on identified achievements does not exist.

1.2. Background and Justification for Research

Many national policies in African countries are spatially blind with broad objectives resulting in disparities between spatial policies and the realities at the local levels (Spaliviero et al., 2019). Some developing countries are embracing the application of strategic spatial planning methods to address the disparities between policy formulation and implementation. However, in many African developing countries, the challenges of strategic spatial planning are not limited to spatial policy implementation. Instead, it is complicated by the need to manage the high rate of rural-urban migrant population and spatial qualities of settlements at the local levels (Turok & McGranahan, 2013). Turok and McGranahan (2013) emphasise the need for national governments in such countries to manage the impacts of the high rural-urban migration with strategic spatial policies that will enhance regional growth, socio-economic and environmental sustainability. Hence, the need to understand the implications of the adoption of strategic spatial planning methods for policy implementation in Africa's developing countries.

In Africa, the focus of spatial policies in developing countries is to guide spatial development in urban areas and economic centres. However, the interaction among economic centres, urban and rural areas

requires the development of spatial policies that will achieve comprehensive physical, socio-economic and environmental development across all regions. It implies that the role of strategic spatial planning in bridging the gaps between the development and implementation of national policies at the local levels are recognised. Hence, many governments are adopting the national urban policy (NUP) in Africa as a strategy to integrate spatial development across regions for socio-economic transformation and urban development (Turok & Parnell, 2009). A review of fifty African countries by Turok (2015) revealed a wide variation in the development, adoption and implementation of NUPs. The percentage of countries that do not have any form of NUP outnumber those that either have or have implemented it for urban development.

Rwanda adopted the NUP as a central policy for urban development and economic growth in December 2015, to become one of the countries that have NUP but without defined implementation methods. However, unlike many of the African developing countries without an implementation strategy for NUP, Rwanda sought for a strategic spatial planning method to implement the NUP (Ministry of Infrastructure, 2015; Spaliviero et al., 2019). The adoption of strategic spatial planning in Rwanda led to the development of the spatial development framework (SDF) methods as an implementation framework for the NUP. Among the policy actions of the NUP implementation plan is the development of a planning support systems (PSS) to support spatial data capture, analysis and management for the SDF methods for land use planning processes and the spatial implementation of policies at the national and local levels (Ministry of Infrastructure, 2015, p.47). PSS is a geoinformation technology-based systems to aid stakeholders (professional and non-professionals) participation in spatial planning decision-making processes (Geertman, 2006).

The SDF methods as a type of PSS for spatial policies implementation, monitoring and evaluation of the NUP aims to bridge the gaps in spatial policies implementation between the national and local levels of government (Mutuku, Boerboom, & Madureira, 2019; Spaliviero et al., 2019). Mutuku et al. (2019) assessed the success of the SDF methods as a PSS for policy transfer and translation within the context of two secondary cities (Rubavu and Musanze) in Rwanda. The study reveals that the SDF methods adoption as PSS at the local levels for the spatial planning processes, spatial policy development and implementation is achievable. However, the authors concluded that embedding the SDF methods in a well-structured process in line with stakeholders' expectation will enhance policy transfer and translation at the local levels.

Although PSS is a strategic spatial planning method that supports decision-makers at all levels of government in spatial planning processes, studies identify limited PSS adoption and embeddedness in planning practice (Pelzer, 2017).

1.3. Research Problem

Geertman (2017) emphasise that asides studying PSS application in specific case studies, embedding it in spatial planning processes is essential to bridge the gaps in PSS implementation and adoption. Geertman and Stillwell (2009) categorise implementation gaps in PSS into three:

a) **Instrument approach**: explains PSS capabilities to solve the planning problem according to the users' acceptance;
b) **Transfer approach**: highlights the mismatch between PSS developers and users' in the planning processes; and
c) **User approach**: considers the characteristics of users that influence perception and acceptance of PSS.

Research on the bottlenecks in PSS capabilities, user potentials and acceptance, as well as improved support for PSS performance, are essential to address the identified gaps in PSS implementation (Geertman, 2017). Although there are studies that include the assessment of PSS usefulness and the added value to planning practice, such studies need to investigate the embedding process of PSS in planning practice (Pelzer, 2017; te Brömmelstroet, 2013). Geertman (2017) claims that a decade of evaluating innovative PSS case study applications is yet to establish the importance of PSS in spatial planning practice, especially within the "*user approach*" context. Therefore, the recommendations that PSS studies should go beyond the identifying challenges, investigation on theoretical, conceptual and technical components to include their application to specific spatial planning issues from the user acceptance perspective to understand the embedding process in planning practice (Geertman, 2017; Karashima & Ohgai, 2019; Pelzer, 2017). Such research should not be limited to the assessment of the PSS capabilities; applications and benefits to specific spatial planning processes; it must encompass users' acceptance to ascertain the usefulness and embeddedness in practice (Pelzer, 2017).

Several studies on PSS adoption gaps in planning practice identifies the role of users' perception of PSS capabilities, usability; and acceptance for actual use (Vonk & Geertman, 2008). Such research focuses on the PSS technical capabilities and users' acceptance of PSS usability in planning practice. Precisely, the user acceptance perspective in PSS adoption focus on the individual user abilities such as the lack of understanding of PSS capabilities and lack of experience as factors that influence perceptions on the ease of use and usefulness to determine the actual use of PSS in practice (Geertman & Stillwell, 2009). None of such studies considers users' acceptance as triggers of unanticipated changes required to embed PSS in practice.

However, studies on embedding information systems in practice identify the unanticipated changes during implementation as crucial to achieve actual use (Ciborra et al., 2000; C. U. Ciborra & Lanzara, 1994; Elbanna, 2008; Nandhakumar, Rossi, & Talvinen, 2003). Such studies describe the unanticipated changes by users and technology with the concept of "drift". The unanticipated changes are groups of activity that triggers drift and influence the success or failure of embedding technical systems in organisational practice.

Some research shows the role of the SDF methods as a spatial data-oriented method and policy framework that enhances the spatial implementation of government policies to achieve planned economic growth and transformation of territories at the organisational level (Boerboom et al., 2017; Musvoto, Lincoln, & Hansmann, 2016; Ruhiiga, 2014; Spaliviero et al., 2019). Spaliviero et al. (2019) explained the strength of SDF methods in Rwanda to be the combination of different methodologies that complements each another and are adaptable to different spatial scales (national, regional or local) and contexts (analytical or descriptive). Thus, the SDF methods strengths make it useful as a PSS in the spatial planning process for the national and local government levels.

Hence, this thesis adopts the Rwanda SDF methods to understand and document the role of drift in embedding the methods as a PSS in planning practice. It applies the van Baalen and van Fenema (2005) actor research model to study the influence of the individual user acceptance of the SDF methods to identify "early signs" of drift in embedding the methods as a PSS in planning practice.

1.4. Research Objectives and Questions

1.4.1. Main Objective

The main research objective is to understand the role of drift in embedding PSS in practice.

1.4.2. Research Sub-objectives

In order to achieve the objective, the research examined the SDF methods in Rwanda. The sub-objectives are in three parts:

1. To **understand the need** for the SDF methods adoption in the land use planning process;
2. To **identify the drift** in the SDF methods adoption; and
3. To **identify where** the SDF methods are embedded.

1.4.3. Research Questions

In Rwanda, the SDF methods have been developed and implemented at the Ministry of Infrastructure (MININFRA) to enhance spatial implementation of policies across the country. Adopting the SDF methods as PSS for decision-making in the planning process requires engaging all government (national and local levels) authorities responsible for the spatial, socio-economic and environmental development to recognise the need for it.

1. To understand the need for the SDF methods adoption in land use planning processes.
    a. What is the land use planning **process** at the national and local levels?
    b. What are the **benefits** of the land use planning process?
    c. What are the **limitations** in the land use planning process?

PSS adoption for spatial planning process requires adequate user understanding to enhance its acceptance and actual use in practice. Depending on the users' understanding and acceptance to use, the SDF methods, like other technical systems, will experience planned or unplanned changes during adoption to embed in practice. Therefore, it is essential to identify the early signs of drift in embedding the SDF methods in planning processes across the levels of government. The drift actor research model was adopted to understand and document the individual level acceptance that triggers drift in PSS adoption and actual use in practice at the national and local levels.

2. To identify the drift in the SDF methods adoption.
    a. What is the **users' understanding** of the SDF methods?
    b. What is the **users' perception of the ease of use** of the SDF methods?
    c. What is the **users' perception of the usefulness** of the SDF methods?
    d. What are the **signs of drift** in the SDF methods adoption?

Embedding the SDF methods in the land use planning process in Rwanda is an ongoing process. Therefore, it is essential to identify the achievements, document the outcomes at the national level and understand how to enhance the actual use in practice across the levels of government (Geertman, 2017).

3. To identify where the SDF methods are embedded.
    a. What are the **outcomes** of the SDF methods adoption?
    b. What are the **signs of embeddedness** of the SDF methods as a PSS?
    c. What are the **roles** of the national government and UN-Habitat in the SDF methods adoption?

1.5. Conceptual Framework

Pelzer (2017) propose *utility* and *usability* as two fundamental concepts in the users' acceptance research that can influence PSS usefulness and adoption in spatial planning processes. PSS utility is the capability of PSS technology to support the activities in spatial planning processes, and usability relates to users capability of *"how to use"* PSS and to *"what extent"* the use will support spatial planning processes. However, the author recommends a contextual evaluation of PSS adoption in real-world planning processes to understand PSS usefulness as well as identify the adoption and actual use in practice.

Just like other information technology systems, PSS implementation creates new routines, adapt to existing ones as well as trigger changes in user behaviour or technology to achieve actual use. The hidden changes in user behaviour or technology during implementation when ignored can lead to the success or failure of embedding such technical system as a stabilised routine (Ciborra & Lanzara, 1994). Consequently, the need to study the role of drift in embedding PSS in planning practice.

Reay et al. (2013) emphasise that drift in technical systems implementation as crucial for laying a foundation to embed such technology as part of existing procedures as well as create new ones. The authors highlight the relationship between the individual levels understanding of new methods and the actual use in practice. The individual users' capabilities and willingness to learn, unlearn and relearn new technology enhances acceptance and the embeddedness in practice. The users learning phases, in turn, triggers drift in the technology usage, implementation process or routines that influence the actual collective use of such systems at the organisational level (Ciborra, 2002a; Reay et al., 2013).

Four theoretical views have been adopted to study drift in technical systems implementation (van Baalen & van Fenema, 2005). This thesis adopts one of the four theoretical views to study drift in embedding PSS in practice – the actor research. The drift actor research studies embedding technical systems from the perspective of users' influence on the implementation process that triggers drift using the technology acceptance model (TAM) by Davis, Bagozzi, and Warshaw (1989). The TAM model describes the role of end-user perceptions of the ease of use and usefulness of systems that influence users' attitude in embedding technical systems.

Unlike existing PSS research, this thesis applies the drift actor research model to understand the individual level perceptions of the ease of use and usefulness of PSS that triggers drift in the embedding process in planning practice. Hence, it is an "*early warning system*" to highlight the role of drift in embedding PSS in practice.

Figure 1. 1 describe the structure this thesis applies to understand the triggers of drift in embedding PSS in practice focusing on the connections between the individual level acceptance of PSS (ease of use and usefulness perceptions) and actual use. Also, it highlights the PSS acceptance at the individual level that influence organisational level use and embeddedness in practice.

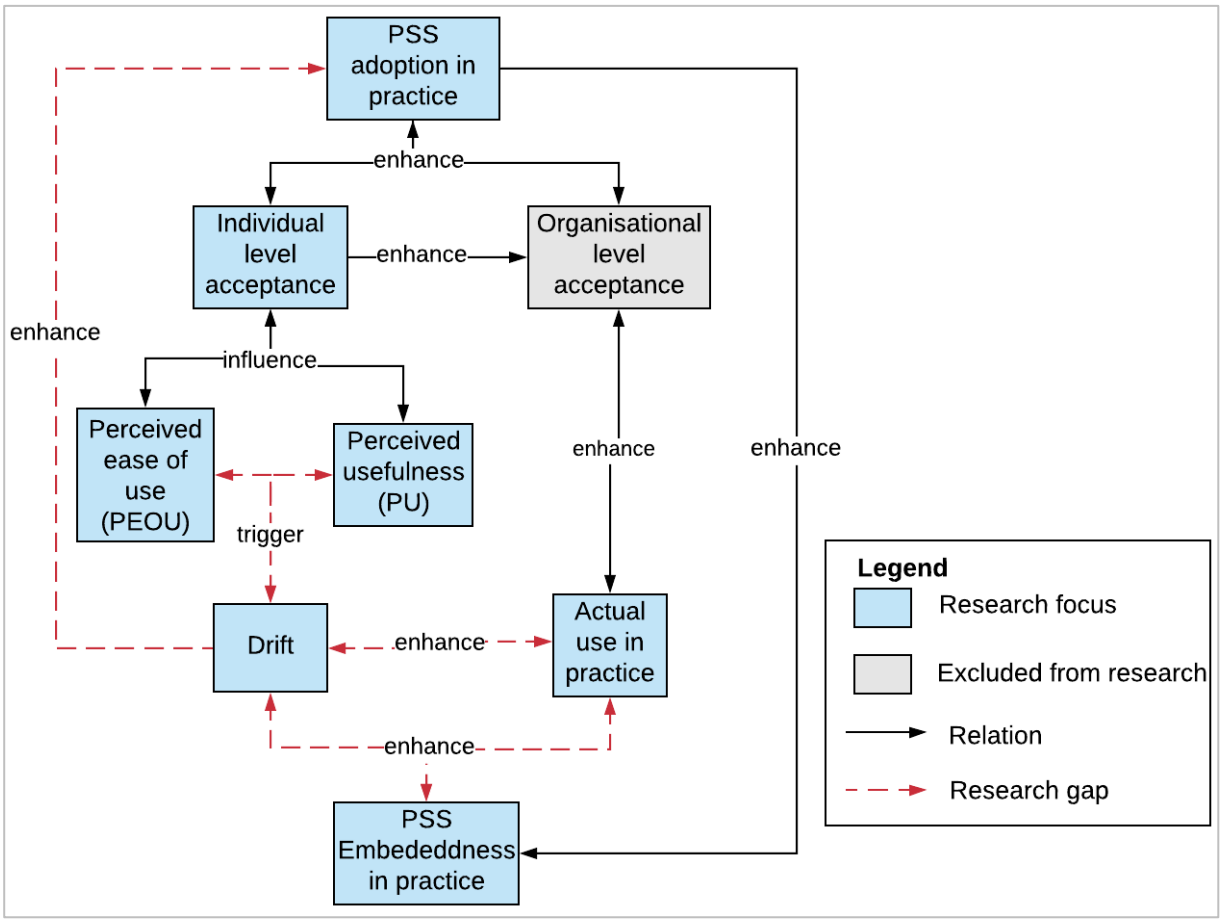


Figure 1. 1: Conceptual framework.
Adapted from Ciborra (2002a) Davis, Bagozzi, and Warshaw (1989).

1.6. Research Design

Research on PSS implementation focuses on implementation gaps, added value, capabilities, usability and usefulness in planning practice (Karashima & Ohgai, 2019; McEvoy, van de Ven, Santander, & Slinger, 2019; Pelzer, 2017; te Brömmelstroet, 2017). Research on how PSS becomes embedded (invisible) in the spatial planning process is yet to be published. Embeddedness is "*the dependence of a phenomenon on its environment*" (Schmidt, 2019). Pike, Lagendijk, and Vale, (2000) recommend the contextual application of "*embedding*" process as a rooted system that considers the unpredictable human behaviours within an organisational setting in the implementation process to become a routine. In essence, embedding is the process in which the actions of users (unpredictable human behaviours) becomes a part of an independent technology to establish or enhance a routine (Pike et al., 2000). Also, Star (1999) emphasise that infrastructure embeddedness occurs as the system becomes an invisible part of other independent social and technical structures. It is the implementation phase when users acknowledge the system as a routine.
Technical systems research adopts the interpretivism method to study interactions between users' and technology to understand drift in the embedding process (Ciborra, 2002b; Ciborra et al., 2000; Ciborra & Lanzara, 1994; Elbanna, 2008; Holmström & Stalder, 2001; Nandhakumar et al., 2003; Star, 1999; van Baalen & van Fenema, 2005). The interpretivism method entails using concepts and theories to interpret users' subjective experience of the real-world events under investigation through participants observation by the researcher within a timeline. However, due to the timeline of this thesis undertaking interpretive research to establish the role of drift in embedding PSS in practice is not achievable (Section 3.1.1).

Hence, this study adopts semi-structured interviews (fieldwork) and participant observation (internship) for the data collection on PSS users' perceptions to understand and document the 'early signs' of drift in embedding the SDF methods in practice (Section 3.3). The research design adopts Pike et al. (2000) recommendation for understanding "embedding" as a process towards actual use:

- "what is to be embedded" – *the SDF methods*;
- "in what" will it be embedded – *the land use planning process*;
- "for whom" – *the users*; and
- "at what spatial and temporal scale" – *at the national and local levels, as well as adoption time*.

Primary data collection method for the study are semi-structured interviews with identified potential users in the land use process across the national and local levels. Secondary data collection method includes a broad review of existing literature, working papers, policy documents, policies and laws. The qualitative research technique adopted in this study considered methods from existing studies on technology-based systems adoption (Elbanna, 2008; Nandhakumar et al., 2003; Silva, 2007). Data analysis explores the inductive and deductive data coding process using Atlas.ti 8; a Computer Assisted Qualitative Data Analysis (CAQDAS) software.

In the result chapter, the thesis discusses the existing land use planning process at the national and local levels in Rwanda to ascertain the need for adopting the SDF methods as a PSS in planning practice. It highlights the SDF methods components, the implementation process and output as of date. Moreover, it reviews the user understanding of the SDF methods for the land use process to identify likely change in the embedding process of the SDF methods across the spatial and temporal scale. The results and discussion from data analysis adopt a descriptive method for the presentation.

1.7. Report Outline

Chapter 1 gave an overview of strategic spatial planning in some developed countries compared to the traditional land use planning in many developing countries of Africa. It highlights challenges of spatial implementation of national policies at the local levels and the use of strategic spatial planning for the spatial implementation of policies. Also, it discusses PSS implementation gaps as a research problem, the research focus, objectives, questions and structure to understand the use of PSS in practice.

Chapter 2 describe existing knowledge of strategic spatial planning and PSS adoption in practice. It explains the land use planning in Rwanda and the SDF methods adoption as a type of PSS in land use planning practice at the national and local levels. The research context considers the theoretical framework for individual level acceptance and influence on PSS adoption in practice to understand the drift in embedding processes.

Chapter 3 describes the research methods and ethical considerations for the thesis. It highlights the limitations of the research method for studying drift and the structure for research findings.

Chapter 4 explains the findings of the study on the need for PSS adoption in the planning process, the user understanding and perceptions of the SDF methods. It discusses the drift required for the actual use of PSS as well as outline existing outcomes of PSS adoption and roles of agencies responsible for embedding the PSS in the planning process.

Chapter 5 discusses the results as applicable to the case study for embedding PSS to achieve actual use in planning practice. It also highlights the limitations of this research.

Chapter 6 concludes the thesis and highlights research contributions.

2. LITERATURE REVIEW

2.1. Introduction

Land use planning is a land governance process that guides the physical development of territories through plans, laws and policies (Albrechts, 2004). A fundamental limitation to land use planning practice is the emphasis on the physical aspect of territorial developments through zoning plans and regulations without due consideration to providing the solution to social and economic issues arising from territorial development and stakeholder participation (Albrechts, 2004; 2006a; Todes, Karam, Klug, & Malaza, 2010). Some European countries have transitioned from traditional land use planning to a spatial planning process that integrates cultural, social, economic and environmental characteristics of territorial development since the end of the nineteenth century (Albrechts, 2006a; Allmendinger & Haughton, 2010). However, global south countries still experience the limitations of land use planning practices that focus only on the physical aspect of territorial developments and are exploring ways to address them.

At present, strategic spatial planning is being adopted as a method to achieve collaboration and coordination for policy integration and implementation. Planning Support System (PSS) play an essential role in strategic spatial planning but will limited success in the embeddedness in practice. Though, unlike other technical systems implementation, PSS embedding process ignores the role of drift in the actual use in planning practice. The main objective of this thesis is to understand the role of drift in embedding PSS in practice. Therefore, this chapter considers the strategic spatial planning methods in Africa, the role of drift in embedding PSS in planning practice, and ways to manage drift in technical systems implementation.

2.2. Strategic Spatial Planning

Strategic spatial planning is a combination of place-based methods, tools and policy-specific approaches adopted by decision-makers to implement spatial policies (Albrechts, 2004; 2006a; 2010). It is a process for the involvement of stakeholders and decision-makers in the evaluation as well as the interpretation of spatial realities to achieve spatial policy objectives and shared values (Albrechts, 2006b). Albrechts (2006b) identified five characteristics of strategic spatial planning with nine case studies from seven European countries between 1989 to 2004 - Bilbao, Spain; Pesaro and Turin, Italy; Euralille, France; Prague, Czech Republic; Ghent and Flanders, Belgium; Groningen, Netherlands; and Perth, Australia. The characteristics are:

a) **Selective**: adaptable to address specific spatial planning issues;
b) **Relational-annex-inclusive**: integrate the spatial realities, time, different methods and stakeholders in the decision-making process;
c) **Integrative**: focus on the decision-making process between different (vertical and horizontal) levels of government to achieve collaboration in spatial planning;
d) **Visioning**: involve a continuous creation of the desired future of places embedded in place-based processes according to the spatial realities; and
e) **Action oriented**: relates to the adoption of specific actions (short-term, medium-term, and long-term), resources and decision-making process needed for spatial policy implementation.

Healey, Khakee, Motte, and Needham (1999) explain the adoption of strategic spatial planning in the implementation of spatial policies with spatial qualities of settlements at the local levels in ten cases from

the Western European countries between 1986 to 1995. The case studies illustrate the creation of new institutional capacities, collaboration among different stakeholders and decision-makers for spatial policy implementation at the local levels especially in Lyon, France; Bergen, Norway; Lancashire, England; Zurich, Switzerland; Lisbon, Portugal; Madrid, Spain; and Copenhagen, Denmark. The use of strategic spatial planning as a method to mobilise consensus, as well as commitments among citizens, private sectors and between levels of government with conflicting interest, were achievements in Marks Kommun, Sweden; Friesland, Netherlands; and Grosseto, Italy case studies. In the United Kingdom, the use of strategic spatial planning methods led to the development of strategic plans and policies for the integration of various spatial dimensions and sectoral activities for sustainable development (Allmendinger & Haughton, 2010).

Friedmann (2004) emphasise the inclusion of stakeholders participation in the spatial planning decision-making process for long-term strategies for territorial development as "strategic spatial planning". The author highlighted the role of stakeholders participation in the integration of sectoral policies for implementation. Albrechts (2006a) further describe strategic spatial planning as a transformative and integrative framework for the coordination of spatial change and development. Moreover, Albrechts (2010) defines the role of strategic spatial planning as a method that can be adopted to develop and coordinate a preferred future of territories from existing structural realities through collaborative decision-making processes. At present, the challenges of unplanned spatial expansion and spatial complexities in Africa's developing countries have led to the adoption of new approaches to land use planning and management to achieve an equitable and sustainable territorial development (Todes et al., 2010).

Todes et al. (2010) highlight the role of UN-Habitat in developing countries in the adoption of strategic spatial planning for achieving sustainable development. The use of the Integrated Urban Infrastructure Development Planning (IUIDP) in Asia; the Physical and Environmental Development Plan (PEDP) as well as Strategic Urban Development Plan (SUDP) in Tanzania, India, Nepal and Indonesia; and the Spatial Frameworks (SF) in South Africa (Todes et al., 2010). Spaliviero et al. (2019) further explained the continuous role of UN-Habitat's support for strategic spatial planning in developing countries with weak planning institutions such as in Darfur, Sudan for the post-war spatial redevelopment; in Myanmar for development of the hierarchy of settlements for adaptation to climate change vulnerability; and in Nampula Province, Mozambique for the planning of economic inclusion of a refugee camp into its region. The strategic spatial planning method adopted in Sudan, Myanmar and Mozambique are known as the Spatial Development Framework (SDF) developed by the UN-Habitat in 2010-2011 (Boerboom et al., 2017). According to Friedmann (2004), the SDF is a strategic spatial planning method developed for countries with weak planning systems to adopt stakeholders participation in the identification of spatial potentials and the integration of policies for spatial implementation. As such, the adoption of the SDF methods as a PSS in the implementation of National Urban Policies is worth debating.

2.2.1. National Urban Policy in Africa

In contrast to traditional master planning, many African countries are now adopting strategic spatial planning to shape urban growth. The need to develop a national policy that can plan as well as manage the urbanisation process has led to the adoption of the National Urban Policy (NUP) in some countries. Turok and Parnell (2009) describe NUP as a strategy to facilitate urban growth for socio-economic development, shared prosperity and improved environmental quality. NUP is a strategic policy to support the coordination of spatial developments towards achieving a balanced social, economic and environmental development across territories (Turok, 2015). Turok and Parnell (2009) examine the use of NUP as a national policy to improve urban management and the decision-making process in South Africa.

The study emphasises the role of NUP as a strategy to complement land use planning processes at the local levels enhanced by cooperation and coordination between the levels of government.

Based on the notion that NUP is not in Africa, Turok (2015) did a review of fifty (50) African countries to ascertain the claim and establish the facts on the adoption of NUP in Africa. The study reveals that the adoption and implementation of a NUP to coordinate urbanisation challenges exist in four (4) countries, while thirteen (13) countries have NUPs but without defined implementation capacities. Although five (5) countries have recognised the need to develop NUP to promote urbanisation, there are still twenty-eight (28) that do not have any national strategy or policy for coordinating spatial developments (Turok, 2015, p. 351). Among the thirteen (13) countries that have made NUP a national strategy to promote and coordinate urban development but without an implementation framework was Rwanda that adopted the NUP as a central policy for urban development and economic growth in December 2015. The Rwanda NUP is called the '*National Urbanisation Policy*' with the vision to make the country urbanised and economically prosperous.

2.2.2. National Urbananisation Policy in Rwanda

In 2000, the Republic of Rwanda developed the Vision 2020 that presents the goal of transforming the country to an urbanised middle-income nation that is united, healthier, prosperous and socio-economically competitive regionally as well as globally (Republic of Rwanda, 2000). One of the challenges acknowledged by Vision 2020 is the weak institutional capacities of the government to achieve efficient urban governance and planning (Republic of Rwanda, 2000). The NUP is a central urbanisation policy that supports the quest of the revised Vision 2020 to achieve a 35% urbanised country by 2024 (Republic of Rwanda, 2012).

The Rwanda NUP's vision is to make *"urbanization an engine of economic development and sustainable human settlement"* (Ministry of Infrastructure, 2015, p. 19). The policy aims to achieve urban growth of territories to improves economic growth and quality of life of citizens at the national and local levels. The NUP goal is to integrate urban development through the implementation of spatial planning strategies for resource management and compact growth between the levels of government. The NUP has four (4) pillars - coordination, densification, conviviality and economic development – to achieve the vision. The *coordination* pillar targets the establishment of institutional capacities for efficient planning systems and governance. The *densification* pillar focuses on spatial development and resource management of territories. *Conviviality* pillar addresses social issues to improve quality of life. The success of the three pillars contributes to the fourth pillar of *economic development* to improve productivity and socio-economic opportunities and prosperity in Rwanda.

The NUP policy actions identify the development of an implementation framework to achieve the objectives of developing appropriate tools for land use planning in Rwanda (Ministry of Infrastructure, 2015). The adoption of strategic spatial planning for decision-making led to the recommendation of the spatial development framework (SDF) as an implementation framework for NUP by a former minister of infrastructure in Rwanda (Boerboom et al., 2017). Spaliviero et al. (2019) describe SDF as a method to facilitate the implementation and monitoring of the spatial policies between levels of government, especially in countries with weak planning systems.

The SDF is a methodology developed by UN-Habitat and first applied in Darfur, Sudan in 2011 and 2013 to identify spatial potentials of Darfur to implement predefined development policies through donor-pledged funding after years of civil war (Spaliviero et al., 2019). The SDF methods functions include spatial analysis of settlements, stakeholders participation, and formulation of strategic development actions and strategies for spatial policies implementation. In 2016, the SDF was further redeveloped for Rwanda as a combination of methods to evaluate spatial complexities, provide a better understanding of the spatial

structure and identify territorial potentials for complementing the implementation of the NUP and other spatial policies at the national and local government levels (Spaliviero et al., 2019). Thus, the SDF methods in Rwanda became a planning support systems for strategic spatial planning to bridge the gaps in spatial policies implementation across the levels of government.

2.3. Planning Support Systems (PSS) for Strategic Spatial Planning

Yeh (1990) discuss the use of geo-information systems (GIS) in different stages of urban planning processes in developed countries in the early 1980s and developing countries in the 1990s. The functions of GIS in urban planning include the integration of spatial data from diverse database management systems (DBMS) for decision support systems (DSS) at the various stages of urban planning activities. Consequently, GIS became an essential technical system component in the development of planning support systems (Yeh, 1990). An increase in the use of planning support systems (PSS) has enhanced stakeholders knowledge of urban planning issues for collaborative and participatory decision-making processes for spatial planning across different levels of government (Geertman, 2002; Mccall & Dunn, 2012). Geertman (2002) recognised that spatial data affordability in addition to availability contributes to the use of PSS for public participation, collaboration and decision-making in spatial planning processes.

PSS is defined as GIS-based technical systems developed for the integration of spatial data, methods and tools to enhances stakeholders' participation in collaborative decision-making processes for spatial planning purposes (Geertman, 2002; 2006; Geertman & Stillwell, 2004; 2009; Pelzer, Geertman, Heijden, & Rouwette, 2014; te Brömmelstroet, 2010). It facilitates various spatial planning processes such as data collection, problem identification, analysis, evaluation and public participation. Therefore, there is an increase in the use of PSS for decision-making for various spatial planning activities (Pelzer, 2017), land use and transport management (Pelzer, Geertman, Heijden, & Rouwette, 2014; te Brömmelstroet, 2010); climate change adaptation (McEvoy et al., 2019); and urban disaster management (Karashima & Ohgai, 2019).

Still, recent PSS studies reveal that there exist gaps of embedding PSS in planning practice with regards to the perspectives of development against user-friendliness and usefulness (Pelzer, 2017; Pelzer, Geertman, & van der Heijden, 2016; te Brömmelstroet, 2017). Geertman (2017) recommends a continuous study of PSS implementation to understand the users' acceptance in spatial planning activities to address the gaps. However, the identified PSS implementation gaps completely ignore the role of drift in embedding technical system infrastructure. This thesis explores embedding the SDF methods in the national and local levels planning practice to understand the users' acceptance of PSS that triggers drift to embed the methods as a PSS in planning practice.

2.3.1. Spatial Development Framework (SDF) Methods as a type pf Planning Support Systems (PSS)

Geertman and Stillwell (2004) and Geertman (2006), describe PSS as a combination of various geoinformation tools as a technical system that can integrate the three critical spatial planning activities for stakeholders' participation and collaboration. The three activities are:

- Identification of planning tasks, problems and data collection;
- Analysis, prediction and recommendation; and
- Transformation of the collected and analysed spatial data to information required for planning, implementation, monitoring and evaluation.

The SDF methods are a type of PSS designed for countries with weak planning systems to provide a national strategic spatial planning method to complement urban growth and economic development

(Spaliviero et al., 2019). Strategic spatial planning methods are innovative practices in spatial planning to develop a spatial understanding of settlements, mobilise agreements and decision-making between levels of governments and stakeholders for policy implementation and monitoring (Albrechts, 2010). Sartorio (2005) highlight three main approaches of strategic spatial planning methods – institutional; communicative and descriptive; as well as interactive approaches. The institutional approach validates and embeds the method as part of the spatial planning process. The communicative and descriptive approach enrol levels of government (national and local) and stakeholders (citizens, public and private sectors professionals) in collaborative decision-making for the planning process. The interactive approach engages stakeholders' in a bottom-up planning process for decision-making, policy implementation and monitoring. Hence, the SDF methods is a type of PSS for strategic spatial planning, accomplishes the three approaches of a strategic spatial planning method.

2.3.2. Spatial Development Framework (SDF) Methods in Rwanda

Spaliviero et al. (2019) describe SDF as a method to facilitate the implementation and monitoring of the spatial policies between levels of government, especially in countries with weak planning systems. The SDF was first developed in 2011 by UN-Habitat, and the application was to identify spatial potentials in Darfur, Sudan between 2012 and 2013 for the implementation of predefined development policies with donor-pledged funding after years of civil war. Between 2014 and 2016, the redeveloped SDF method for application in Rwanda is a combination of methods to identify spatial structures; evaluate spatial complexities; and identify territorial potentials to complement the implementation of NUP and other spatial policies at the national and local government levels (Spaliviero et al., 2019). Other functions of the SDF methods in Rwanda covers the spatial analysis of settlements, stakeholders participation, and formulation of strategic development actions for spatial policies implementation at the local levels. As a PSS, the SDF methods was implemented in two phases: the Matrix of Function (MoF); Consultative training/workshops; Spatial Multi-Criteria Evaluation (SMCE); and the development of a National Strategic Action Plan (NSAP) for local levels implementation (Figure 2. 1).

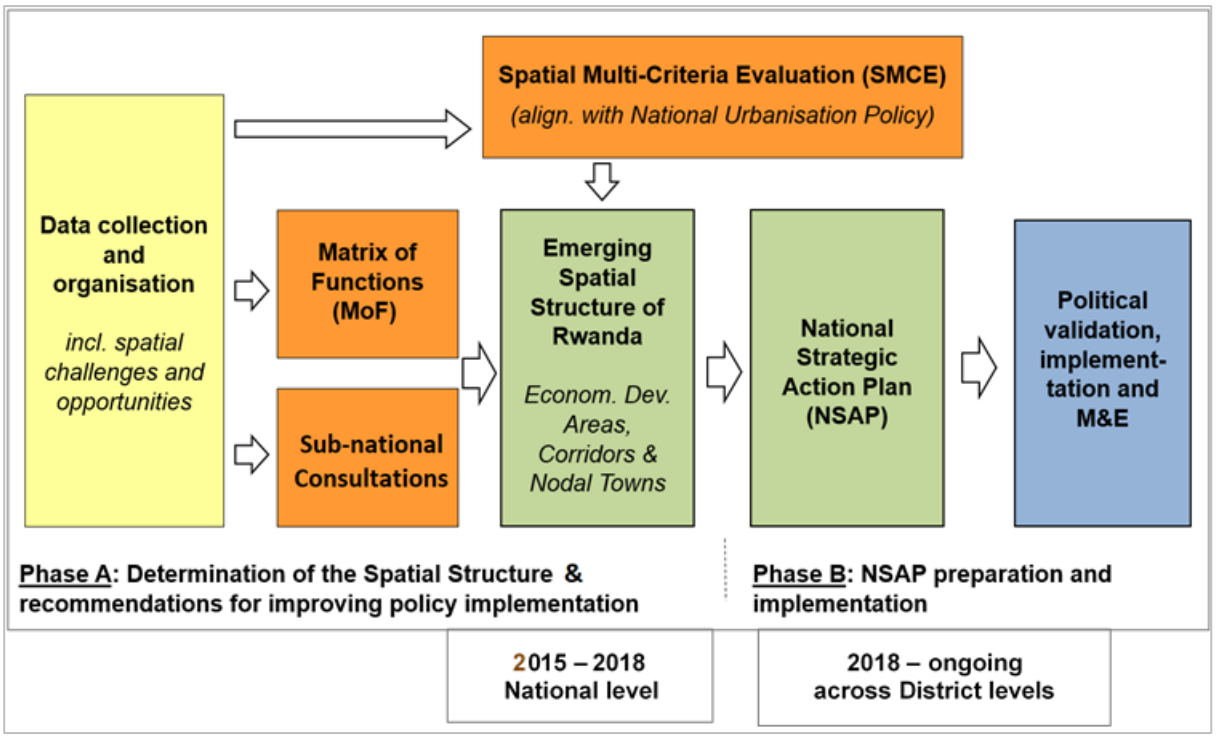


Figure 2. 1: The SDF Methodology for Rwanda.
Adapted from UN-Habitat and ITC University of Twente (2019).

The first phase commenced in 2015 with spatial data collection and analysis of territories with the MoF method, which identifies, analyses and categorises settlements based on their functional hierarchies. Presentations of derived territorial structures were done with various stakeholders' during the consultative training/workshops to prioritise settlements using the identified potentials to plan for the future development of settlements across the country. The SMCE was used to analyse the emerging spatial structure of settlements in line with identified potentials and existing development policies, such as the NUP and Economic Development and Poverty Reduction Strategy (EDPRS II) 2013-2018 that is now the National Strategy for Transformation (NST1) policy. As a result, the SMCE develop strategic short, medium and long-term action plans for investments prioritisation across the regions (Boerboom et al., 2017; Spaliviero et al., 2019). The second phase (B) involves the development of a National Strategic Action Plan (NSAP) from a redefined MoF of local levels clusters from the emerging spatial structure of settlements for the implementation of existing (short, medium and long-term) strategic policies and interventions (Spaliviero et al., 2019). Specifically, NSAP focuses on the implementation of all recommendations of the SDF methods as action plans across the local levels of government to achieve improved spatial development for efficient and equitable socio-economic transformation of Rwanda.

2.3.3. PSS adoption for the Spatial Implementation of Non-Spatial Policies

The Vision 2020 goal is to make Rwanda a middle-income country by the year 2020. The vision implementation is in three phases – short, medium and long-term. The short-term vision promotes macroeconomic stability and wealth creation for private sector development for economic development and international aid dependence reduction with the Poverty Reduction Strategy (PRSP) 2002-2006. The medium-term implementation is for transforming the country from an agrarian economy to a high value and productive economy for growth using the Economic Development and Poverty Reduction Strategy (EDPRS I) 2008-2012. The long-term implementation was to create productive private sector entrepreneurship for wealth creation and employment opportunities for the citizen as well as economic productivity and export opportunities for the country. The EDPRS II (2013-2018) that focus on innovation, emerging priorities, sustainability (economic, social and environment) local level led developments, citizen inclusion and engagement implement the long-term plan (Ministry of Finance and Economic Planning (MINECOFIN), 2013; Republic of Rwanda, 2000). The NST1 is a seven (7) year government programme (7YGP) (2017-2024) with three priority areas: economic transformation; social transformation; and transformational governance. It is a medium-term development strategy that replaced the EDPRS II, for sustainable growth and socio-economic transformation to improve the standard of living and good quality of life for Rwanda citizens in line with the Vision 2050 (The Republic of Rwanda, 2017). Therefore, the NST1 is a foundation policy for the implementation of Vision 2050.

The NST1 implementation framework (Figure 2. 2) adopts the Sector Strategic Plans (SSPs) and District Development Strategies (DDSs) to set priorities, interventions and annual implementation plans at the local levels. The SSPs are sectoral plans, and DDSs are local level plans developed for budget planning and implementation of the NST1 pillars. The SSPs and DSSs are collated in the national budget plans using the medium-term expenditure framework (MTEF) (**Appendix 1**) instituted by Vision 2020 (Republic of Rwanda, 2012) and the "Imihigo" which are annual goals of the local levels used for monitoring and evaluation (M&E) at the national level.

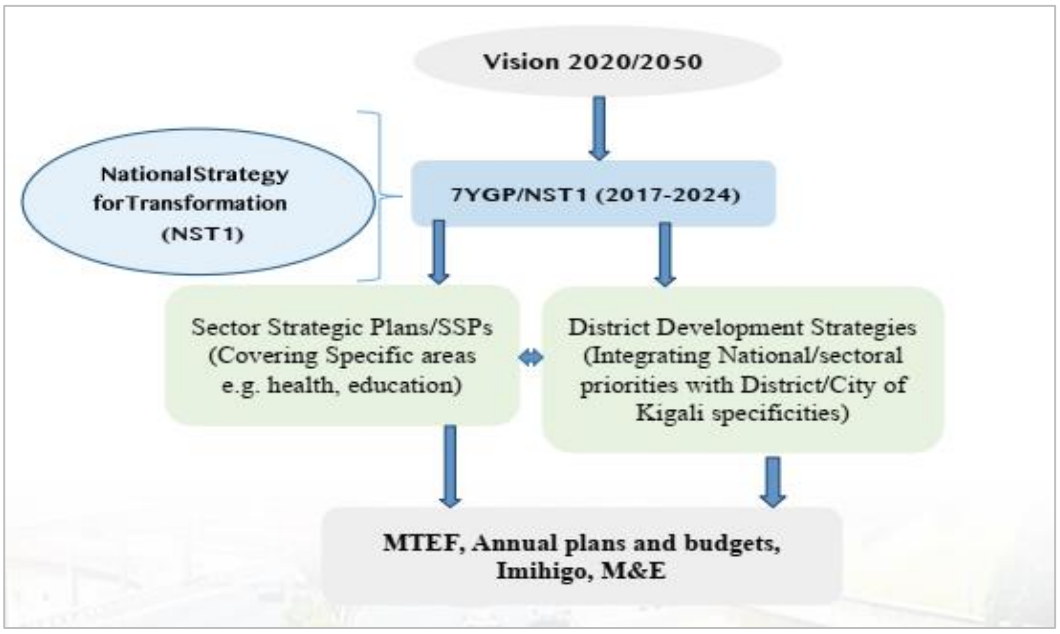


Figure 2. 2: NST1 implementation framework
Adapted from The Republic of Rwanda (2017)

The SDF methods have been adopted for the spatial translation of the NST1 for implementation across the local levels (UN-Habitat & ITC University of Twente, 2019). It led to the development of the NSAP a spatial tool for the implementation of strategic interventions (non-spatial) of the NST1 at the local levels (UN-Habitat & ITC University of Twente, 2019). The NSAP goal is to advance the spatial transformation of Rwanda through investment distribution and development of various industries identification across the local levels with the NST1. The job creation and spatial development will contribute to urbanisation and economic transformation of the country. Consequently, embedding SDF methods with the NST1 implementation framework (Figure 2. 3) will enhance coordination, monitoring and evaluation at the national levels as well as achieve collaboration in spatial policies implementation at the local levels towards achieving Vision 2050.

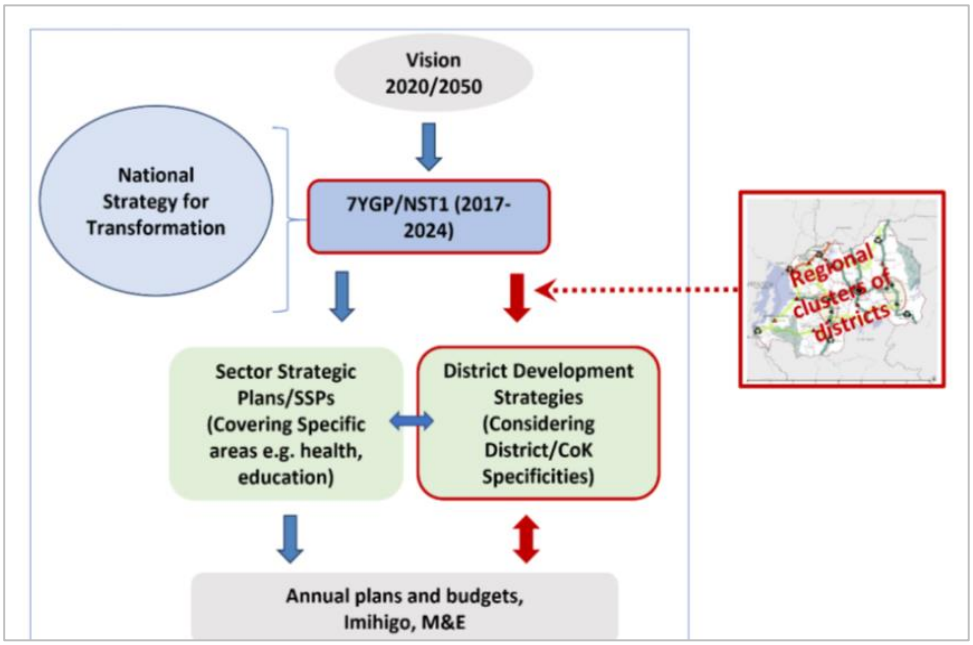


Figure 2. 3: Embedding the SDF methods with the NST1 framework.
Adapted from UN-Habitat & ITC University of Twente (2019)

According to Albrechts (2006b), the SDF methods as a PSS fulfils the five characteristics of strategic spatial planning methods- selective, relational-annex-inclusive, integrative, visioning, and action oriented (Section 2.2).

2.4. Drift Actor Research in Planning Support Systems (PSS)

Research on embedding geoinformation technology emphasises the role of humans (users, designers, stakeholders and decision-makers) and the technical systems that trigger drift during the implementation to achieve embedding it practice (Mohd Hussain, 2011; Mungai, 2018). Research on embedding PSS in spatial planning processes and implementation gaps are in three categories: PSS quality; compatibility between PSS and spatial planning tasks; and PSS user acceptance (Vonk, 2006). The user acceptance influence on the added value of PSS embeddedness in practice focuses on quality, capability, usability and usefulness (McEvoy et al., 2019; Pelzer, 2017; Pelzer et al., 2014; Russo, Lanzilotti, Costabile, & Pettit, 2018). None of such research considers the role of drift in the embedding process.

There are studies on the quality and compatibility of the SDF methods as a PSS for spatial planning processes in practice (Boerboom et al., 2017; Mutuku, 2017; Mutuku et al., 2019; Spaliviero et al., 2019). Like other PSS research, the role of drift in embedding it in practice is not in consideration. This thesis focus on establishing the need to investigate the role of drift in embedding PSS in practice. Studies on embedding technical systems in practice emphasise the nature of user-technology-based activities (planned or unplanned) that triggers drift to achieve the desired goal (Ciborra, 2002a; Elbanna, 2008; Nandhakumar et al., 2003). Orlikowski (1992) identified the ability of users to change the expected outcomes in technical systems implementation and embedding processes.

In most cases, capturing the drift as part of the implementation processes are rarely done (Ciborra & Lanzara, 1994; Elbanna, 2008). The different theoretical models that have been adopted to describe the identified changes in systems implementation and users impact include structuration theory (W. J. Orlikowski, 1992); institutional theory (Gosain, 2004); and actor-network theory (Ballantyne, 2015). The use of these theoretical models focuses on the role of human actors in technology implementation as a component (external/internal) towards embedding technical systems as routines that lead to organisational change (Volkoff, Strong, & Elmes, 2007).

However, van Baalen and van Fenema (2005) identifies four theoretical views that can study drift from the diffusion factor characteristics, implementation phases, human actors influence and human-technology actors perspectives. The human actor research focuses on the user ability that influences the implementation of technical systems, as well as triggers, drift to embed systems in practice it the perspective the thesis considers. It helps to understand the drift contributing to acceptance and embedding PSS in practice. The actor research model builds on the technology acceptance model (TAM) by Davis et al. (1989).

Moreover, Davis and Venkatesh (2000) identify theoretical models that have been adopted for predicting and explaining user acceptance of technical system - Theory of Reasoned Action (TRA); Theory of Planned Behaviour (TPB) and Technology Acceptance Model (TAM). On the one hand, TRA claims that user beliefs influence attitude towards intention and acceptance behaviour. On the other hand, TPB extends TRA to include the user-perceived behavioural control, which impacts both intention and acceptance behaviour (Madden, Ellen, & Ajzen, 1992). Finally, TAM modifies both TRA and TPB to include external factors that can influence users' intention towards acceptance (Sentosa & Mat, 2012).

TAM identifies users perceived usefulness and ease of use of technical systems as key determinants to users acceptance (Davis & Venkatesh, 2000; Sentosa & Mat, 2012). Therefore, adopting the actor research to study drift is a technique to probe and predict the user acceptance influence during technical systems implementation to identify drift for embedding it in practice (van Baalen & van Fenema, 2005). Also,

Chuttur (2009) reiterates that studies on the user acceptance of technology adopt TAM as a baseline for understanding the connection between technical systems implementation, users acceptance and actual use.

2.4.1. Technology Acceptance Model (TAM)

TAM explain users' acceptance to be outcomes of technical system functionalities and capabilities as well as a significant factor for actual use in organisations (Davis et al., 1989). Davis (1989) highlighted the need for two variables (usefulness and ease of use) to measure, predict and explain user acceptance of information technology. Though earlier studies on user acceptance adopt TRA and TPB, Davis, Bagozzi, and Warshaw (1989) highlight the strengths of TAM over the two theories. TAM strength of TRA and TPB is the ability to predict and explain user acceptance of technology as well identify an appropriate solution to address why a technical system becomes unacceptable. The authors further proposed that users' motivation for actual use of technical systems is determined by "*perceived usefulness*" and "*perceived ease of use*". Consequently, the perceptions influence users' "*attitude toward using*", *"intention to use"* and finally *"actual use"* of the technical system.

Perceived ease of use (PEOU) is the extent to which a user considers the adoption of a new technical system will be easy and effortless. Perceived usefulness (PU) is the extent to which a user considers the adoption of a technical system will enhance job performance (Chen, Li, & Li, 2011; Davis et al., 1989; Davis & Venkatesh, 2000). Figure 2. 4 describe how the end-user PEOU and PU of the technical systems influence attitude towards intention to use as well as acceptance for actual use or otherwise.

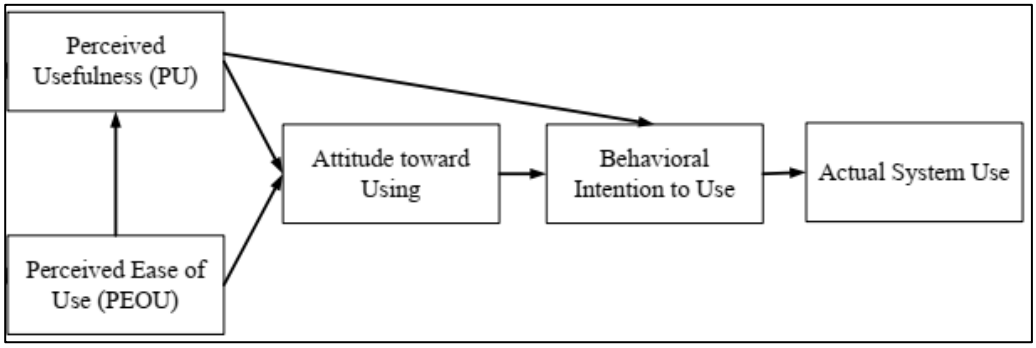


Figure 2. 4: Technology Acceptance Model (TAM).
Adapted from Davis et al. (1989)

Vonk, Geertman, and Schot (2005) describe five stages of PSS organisational implementation and individual adoption to involve the users' understanding; interest in the use; intention to use; the decision to use; and actual use. Specifically, the authors highlight the individual acceptance process of technology implementation with TAM to be a result of "the attitude" and "continuous usage" of the technical systems. Like other studies on PSS adoption in practice, the authors ignore the effects of drift in the implementation stages for embedding PSS in planning practice.

Although TAM has been adjudged a suitable theoretical model to describe and understand user's acceptance of technical systems implementation, it ignores the technology role in the predictions for actual system use. As such, drift actor research presumes that only the users' acceptance influences organisational adjustment of routines to accommodate the use and embeddedness of new technologies.

The SDF methods adoption in Rwanda is redefining planning processes at the national level and will further influence the local levels planning process. Thus, embedding the SDF methods as a PSS in the land use planning practice at the levels of government is an ongoing process. Consequently, the need to understand how the users' PEOU and PU of the SDF methods influence acceptance and triggers drift required for actual use and embed it as a PSS in planning practice.

2.5. Drift in Technical System Implementation

Technical systems implementation framework has advanced from "strategic alignment" and " functional integration" between external (organisation strategies, technology strategies) and internal (organisation structures and processes, technology systems and processes) domains in the last three decades (Henderson & Venkatraman, 1999). The transition is due to the unnoticed changes in the implementation process by the external and internal actors leading to new routines or adaptation to old ones to embed in organisational practice. Ciborra and Lanzara (1994) attribute failures or successes of technical systems to the unnoticed changes by human actors (users, managers, developers) or non-human actors (technical infrastructure, processes, strategies) during the implementation process.

The changes are described as surprises, deviations and shifts from predefined processes that require a "muddling" through and improvisation to accommodate the changes and adapt over time to become a routine (Ciborra, 1996; W. Orlikowski & Hofman, 1997). Ciborra (1997) express the need for a change in methodology to investigate "technology drifting" to capture the changes in the implementation process that requires adaptations or improvisations from predefined processes.

According to Ciborra (2002a, p. 85) drift is "*a slight, or sometimes significant, shift of role and function in the actual situation of usage, compared to the planned, pre-defined, and assigned objectives and requirements that the technology is called upon to perform*". The author describes that drift in technical systems implementation is a consequence of various planned or unplanned changes during the adoption process either by users or the technology to achieve the desired outcome. Furthermore, the author explains drift as hidden but noticeable changes from pre-defined goals in the implementation procedures and use of new technologies with the study of technology systems implementation in seven multinational companies. Ciborra's research indicates that the outcomes of drift can vary from success stories to crisis development, depending on the improvisations during the implementation process.

The success factors of drift identified by Ciborra (2002a, Table 5.1) include the development of new standards for collaboration and coordination; change in existing routines; development of new system functions; and the emergence of new users. The crisis in the implementation of some technical systems led to a lack of collaboration among users; under-utilisation of technology; and rivalry among users. However, drift is not a negative occurrence, rather an essential part of technical systems implementation resulting from a sequence of repeated actions that are influenced by the user acceptance of the technical system (Nandhakumar et al., 2003). Hence, there is the need to study and understand the role of drift in embedding PSS to bridge the implementation gaps in practice

Figure 2. 5 describe the technical system implementation framework by Ciborra (2002a) adopted in this thesis to illustrate how user acceptance can trigger drift in the actual use of PSS. The framework shows that the complexities of actors (users, technical systems, processes and standards) and the effects on users' acceptance towards technical systems implementation requiring compromises that trigger drift to embed systems in actual use. Also, it highlights the vital role of *installed base* influence on the implementation and actual use of the technical system.

Rolland (2000) describe installed base as "*the interconnected practices and technologies*" that are established although unseen during the development process of new systems but "*becomes increasingly visible as the system is embedded in the organisational context*". An installed base consists of existing users, technologies, processes, standards or skills that can influence (positively or negatively) the actual use of the implemented system (Hanseth, 2000; Rolland, 2000; Rönnbäck et al., 2006). Therefore, the changes in technical system implementation caused by users (surprises) and technical systems (side-effects) tends to influence the installed base and can also trigger drift to enhance users acceptance and achieve actual use.

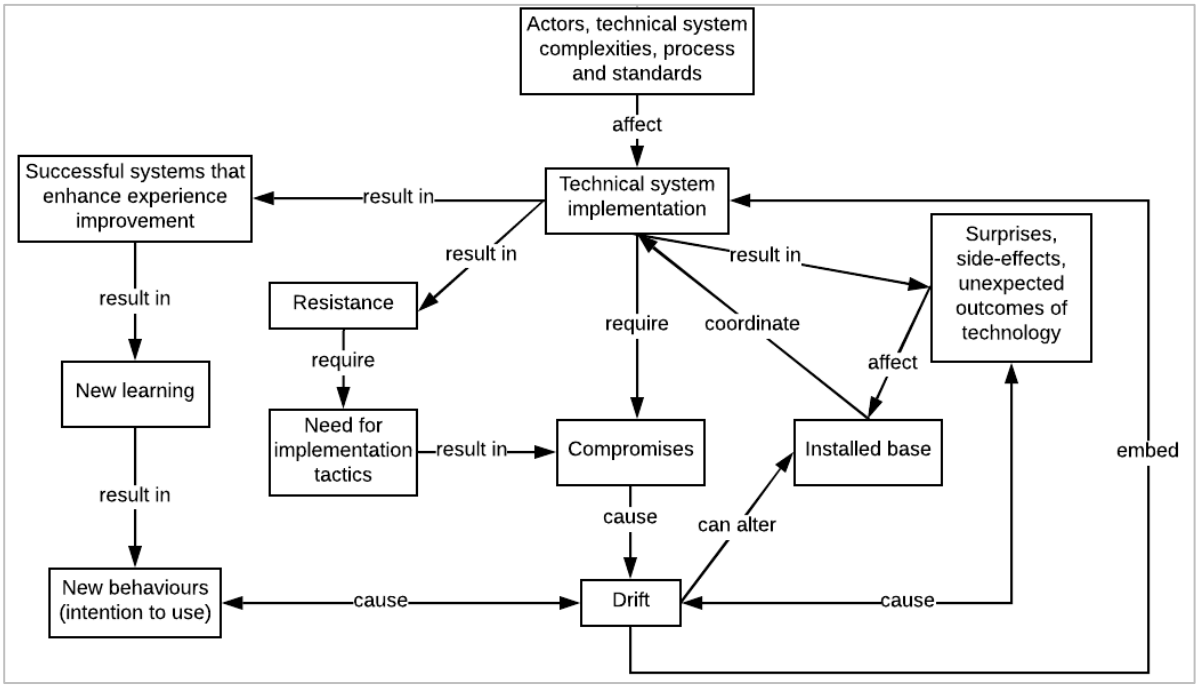


Figure 2. 5: Technical system implementation framework.
Adapted from Ciborra (2002a, Figure 5.1).

Studies on PSS adoption focus on technical capabilities and usefulness as factors contributing to use without documenting the drift that can influence actual use in planning practice. Thus, this thesis explores the drift actor research to document the early surprises encountered in the implementation process of the SDF methods. Also, it studies the users' acceptance to understand and document the drift to enhance embedding the SDF methods as PSS in the planning practice in Rwanda.

2.6. Technology Acceptance Model (TAM) and Drift to Embed PSS in Practice

Drift resulting from users acceptance and decision to use technical systems when ignored has been identified as a trigger to systems failure or success to embed in the existing process or become a part of a new routine (Ciborra, 1997; Holmström & Stalder, 2001). Also, TAM is a regarded a baseline model to understand, identify and predict the level of users acceptance based on the choice on the intention to use and actual use of the technical system that triggers drift (Davis et al., 1989; van Baalen & van Fenema, 2005). It studies how the perceived ease of use (PEOU) and perceived usefulness (PU) of PSS will influence users decision to refuse or willingly use PSS in planning practice (Figure 2. 6). The individual level of knowledge of the SDF methods and acceptance that trigger drift facilitates the organisational level decisions to enhance adoption and embed the methods in planning practice (Figure 1. 1).
Moreover, such drift also offers solutions to increase the individual and organisational level acceptance to embed the PSS as a routine. Thus, this thesis implements the drift actor research as a theoretical model to identify the role of drift in embedding PSS in planning practice. It highlights existing strategies to manage drift in technical systems implementation.

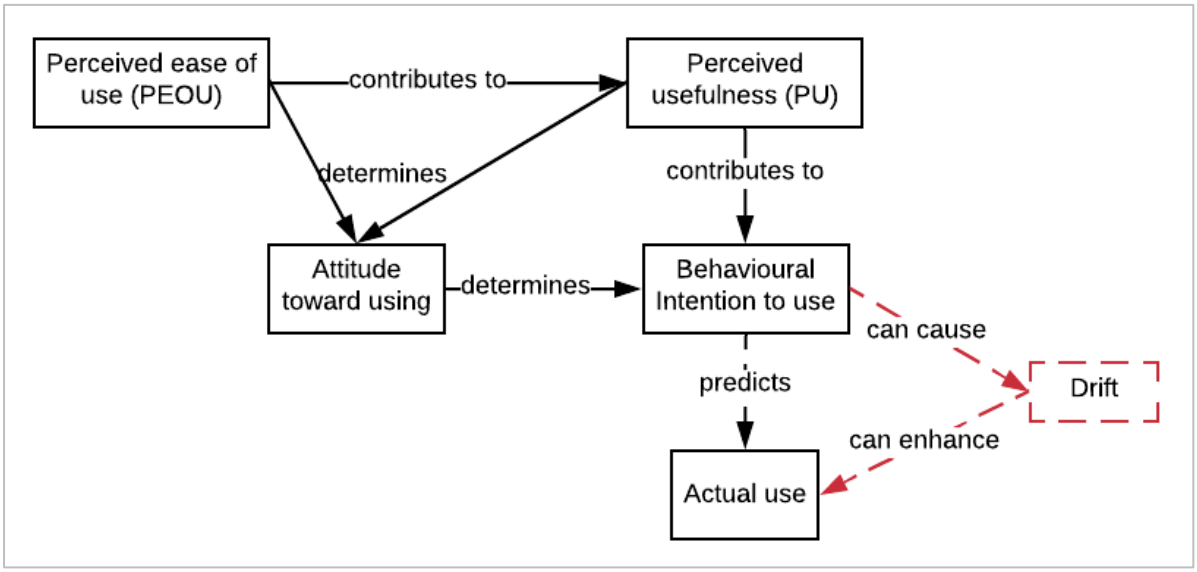


Figure 2. 6: Drift actor research using TAM and Drift context.
Adapted from Chen et al. (2011).

2.6.1. Managing Drift in Technical Systems Implementation

According to van Baalen and van Fenema (2005), research on the implementation of technical systems should not only predict the disparity between predefined outcomes and unexpected changes that triggers drift. The aim of such research should include identifying the likely drift and suggest different ways to deal with them to achieve the successful implementation and embeddedness of technical systems. The authors highlighted three strategies from the information systems implementation research (control, incremental and containment) that have been proposed to manage drift in technical system implementation. The three strategies are:

- **Drift control strategy**: the core method is *communication*. It allows users to exchange information base on experiences from the implementation process to achieve a shared understanding of the actual use of systems for potential users and enhance adoption;
- **Drift incremental strategy**: emphasise the individual and organisational *learning* (predefined or improvisation) process during the implementation of new technical systems. Individual learnings are gained experiences, and organisational learnings are combined individual experiences and abilities that becomes routines, practices and values to embed the technical system; and
- **Drift containment strategy**: focus on how the *management of knowledge* gained from the organisational learning processes. It highlights the deliberate collection, storing and sharing of knowledge gained at a particular time (temporal) and space (spatial) in the organisation.

Therefore, in addition to identifying the role of drift in embedding PSS in practice, the thesis will identify appropriate drift management strategy that will enhance the adoption of the SDF methods as a PSS in Rwanda.

3. RESEARCH METHODOLOGY

3.1. Introduction

Understanding the role of drift in embedding PSS in practice is the focus of this thesis. Studies on the drift in infrastructure and technical systems implementation adopt the interpretive research methods. Interpretive research views that social reality is formed based on human involvement in social or technical experiments. It entails the study of participants' experiences in real-world situations overtime to reconcile the subjective interpretations of various participants to present analytical understanding and theoretical generalisation rather than a hypothesis testing process based on statistical analysis. Such research will require a longitudinal study that investigates specific changes and processes over a long time.

Precisely, there are four categories of theoretical generalisations research to study drift in technical system implementation (van Baalen & van Fenema, 2005). First, the *diffusion factor research* that applies the "diffusion of innovations theory" by Everett Rogers to identify the complexities of characteristics (innovation, adopter, organisational and environment) and relationships as factors that trigger drift in technology implementation. However, the limitation of the diffusion factor research is that it is generic and abstract (not technical systems specific). Second, the *phase model research* describes technical system implementation as a linear process executed in different stages consisting of drift and adjustment that must be resolved in each stage to embed the technology in the organisation. Still, it ignores the organisational complexities in technical systems implementation, which is the limitation of the research model. Third, is the *actor research* that emphasises the vital role of human actors in technical systems implementation process using the Technology Acceptance Model (TAM). The limitations of the actor research are that it cannot explain the drift from the organisational level choices and acceptance for actual use; as well as it ignores the role of technical systems in drift.

The fourth theoretical view to study drift is the *interaction-context research* that adopts either the structuration model or the Actor-Network Theory (ANT). The structuration model highlight the complexities in the interactions of human actors (users) and non-humans (technology and institutional properties of an organisation) that cause drift in the implementation process. Though, the structuration model research provides detail insights into the origins of drift in embedding technical systems; it does not explain the contribution of drift in specific elements and functions of technical systems on the organisational choices. ANT, on the other hand, considers and explains the contributions of both technical and non-technical elements as actors in networks of the implementation process that triggers drift to embed technical systems (van Baalen & van Fenema, 2005).

Considering the theoretical views and capabilities for the analytical understanding of both human and non-human actors in drift, the most reliable theory to execute an interpretive study as well as understand the role of drift in embedding PSS in practice is the ANT interaction-context method.

3.1.1. Research Method Limitations

This thesis takes a different method from existing research PSS on implementation gaps. It considers the role of drift in embedding PSS in practice. Though, the study of drift in technical systems implementation is an inclusive process that must consider the interactions between users and technology that triggers drift (Ciborra, 2002b; Ciborra et al., 2000; Elbanna, 2008; Holmström & Stalder, 2001; van Baalen & van Fenema, 2005). The research method did not consider the interactions between users and technology that triggers drift. Therefore, the thesis did not adopt the ANT interaction-context because of the study timeframe.

Instead, the research applied the actor research theoretical model from van Baalen and van Fenema (2005) theoretical views to establish the role of users acceptance that triggers drift to embed PSS in planning practice. It implies that though the influence of the drift on the organisational structure during implementation is an essential part of studying drift; this thesis did not consider the organisational role in drift (Figure 1. 1).

The thesis timeline hinders the adoption of interaction-context research from studying the role of drift in embedding PSS in practice. Therefore, this study excludes the broader context of users and technical systems complexities that trigger drift in embedding PSS in practice. It only considers the users' role in identifying drift in embedding PSS in practice. As such, it is an 'early warning system' to reveal the role of drift in embedding PSS in practice as well as establish the need for comprehensive study in this regard.

Hence, it is vital to note that a comprehensive understanding of the role of drift in embedding PSS in practice will need to adopt a broader context of technology use, practices and users within specific real-world implementation timeline using the interpretive research method. Thus, implementing such research method will require the Actor-Network Theory (ANT) *"interaction-context research"*. ANTtheoretical view includes both human (users – individual and organisational) and non-human (technical systems) in the study of drift (van Baalen & van Fenema, 2005).

3.2. Thesis Research Strategy

This research on the role of drift in embedding PSS in practice focuses on understanding the planning process from the users perspective to establishes the need to adopt the Spatial Development Framework (SDF) methods. It adopts the drift actor research to describe data on users perceived ease of use and usefulness of the SDF methods to verify drifting as a process to embed PSS in practice.

Noor (2008) identifies that the focus of social science research exceeds hypothesis testing of assumptions or dimensions of processes to include the understanding of perceptions of users of such processes in real-world. Thus, the reason for adopting a case study research method. Crowe et al. (2011) describe the case study method as a research design applicable for an in-depth study of experiences or trends of the event in the real-world environment. The main advantage of case study research is the extent to which the analysed data can be the representation of the complexities in the real-world if the research builds on scientific theory.

A case study research can be exploratory, descriptive or explanatory. Zainal (2016) defines a descriptive case study as a method supported by a scientific theory for data analysis and reporting with a focus on narrating the real facts deduced from the data collection process. Due to the limitations of this thesis to adopt the interpretive research method (Section 3.1.1), it adopts the descriptive case study method to implement data collection, interpretation and discussion within the geographical extent of Rwanda.

3.2.1. Case Study Selection

Research on the limited use of PSS in practice has been on for decades. Recently, recommendations to bridging implementation gaps between PSS development and actual use in practice is the use of real-world cases during research. The SDF methods is a type of PSS developed to facilitate spatial planning process between the nation and local levels of government in countries with weak planning systems. Therefore, the rationale for selecting the Rwanda SDF methods as a case study to investigate the role of drift in embedding PSS in planning practice.

The SDF methods originate from the need to develop PSS for the implementation of the National Urbanisation Policy (NUP) and spatial implementation of other existing policies such as the National Strategy for Transformation (NST1) and Vision 2050. The SDF methods as a type of PSS for policy transfer and translation have been assessed with two secondary cities (Rubavu and Musanze) at the local levels in Rwanda (Mutuku, 2017; Mutuku et al., 2019). The authors concluded that adopting the SDF

methods for policy transfer and translation at the local levels is possible if the implementation process considers the influence of the user expectations and perceptions to enhance acceptance and use in practice.

The SDF methods adoption at the national level is ongoing in the Ministry of Infrastructure (MININFRA) the coordinating ministry for the NUP implementation towards achieving urbanisation, infrastructure development and economic transformation in Rwanda. Also, the training of users at the national and local levels of government is on-going and aims to make the SDF methods a PSS for the planning process at all levels of government. Therefore, the study adopts data collection from trained users at the national and local levels to explore the research objective of identifying triggers of drift in embedding PSS in planning practice.

3.2.2. Case Study Area

Rwanda is a developing country with an area of 26,338 square kilometres (sq. km) in Central Africa. Rwanda shares boundaries with Uganda, Tanzania, Burundi and the Democratic Republic of the Congo. It is a landlocked country of over twelve million people (National Institute of Statistics of Rwanda (NISR), 2020) with about seventeen percent (17%) of the population living in the urban centres (National Institute of Statistics of Rwanda (NISR) & Ministry of Finance and Economic Planning (MINECOFIN), 2012, p. 10). Rwanda is a democratic republic with the central administrative system at the national level and thirty local (districts) government levels divided into five provinces.

The five provinces in Rwanda are made up of a minimum of three districts at the central (Kigali city) and a maximum of eight districts in the southern province (Figure 3. 1). The highest population concentration of 24.7% is found in the eastern province (seven districts), 24.6% in the southern province (eight districts), 23.5% is in the western province (seven districts). Also, the northern province (five districts) has 16.4%, and the central province is 10.8% of the total population (National Institute of Statistics of Rwanda (NISR) & Ministry of Finance and Economic Planning (MINECOFIN), 2012). Although the central province has the lowest population, the three districts have the highest population density as well as the most urbanised in Rwanda.

The governance system in Rwanda allows the sole responsibility of land use planning and housing development at the local levels (Commonwealth Local Government Forum, 2018; Republic of Rwanda, 2018). Also, the implementation of national plans and policies are done at the local levels, and this is challenging because of the weak planning system common in the African developing countries (Spaliviero et al., 2019). Specifically, in Rwanda, challenges of implementing national policies at the local levels have led to various contraventions by unplanned and informal development contrary to existing master plans at the national level (Ministry of Natural Resources, 2017).

Therefore, the prospect of the Rwanda SDF methods as PSS in the planning process, decision-making, coordination and collaboration across the levels of government is documented, though, the reality of such prospects are still unverified with studies. Consequently, the selection of Rwanda as a case study to understand the role of drift in embedding SDF methods as a PSS in the planning process is never better than now.

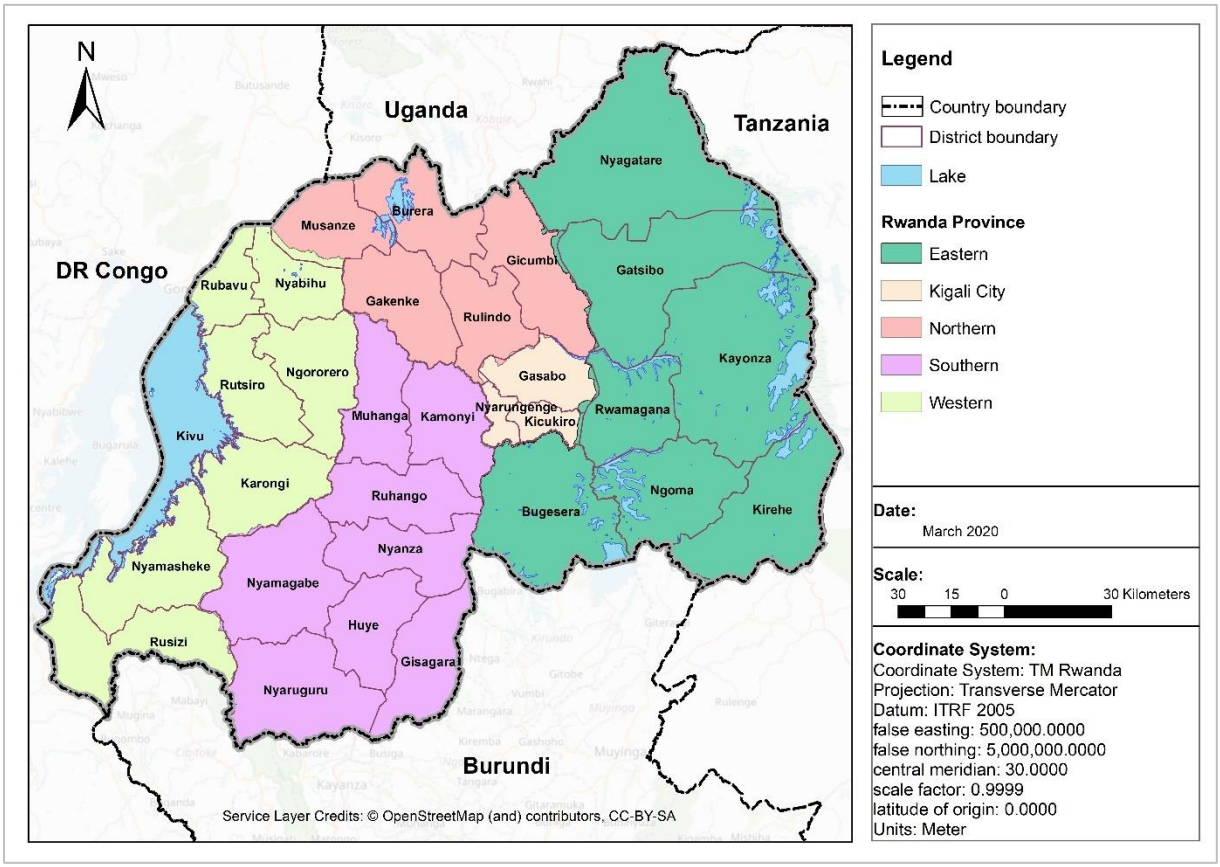


Figure 3. 1: Study area.
Sources: Author (2019); MININFRA (2019); OSM (2020).

3.3. Data Collection

Data collection methods adopted in studying the drift in technical systems implementation are either qualitative methods or the combination of qualitative and quantitative methods. The data collection methods include interviews with project participants, follow-up discussions, reviews of document, minutes of meetings, project status reports, workshop presentations, training manuals and detailed project documents (Elbanna, 2008; Nandhakumar et al., 2003; van Baalen & van Fenema, 2005). Furthermore, PSS research on implementation gaps has adopted different case studies to analyse developers and users through workshop participation, questionnaire administration, observation and semi-structured interviews (Pelzer, 2017; Pelzer & Geertman, 2014; Pelzer et al., 2014; Pelzer et al., 2016). This thesis adopts the semi-structured interview as the primary data collection method.

The secondary data sources include the review of data from websites, reports, documents, plans and policies for land use planning in Rwanda. The secondary data gave an overview of the national planning policies and land use planning process at the national and local levels—also, the results from the SDF methods adoption to date.

3.3.1. Primary Data Collection

The development of the SDF methods in 2016 as part of the policy actions to implement the National Urbanisation Policy (NUP) led to its adoption for spatial translation and implementation of national policies as well as training and workshops for potential users at the national and local levels. Therefore, this thesis considers existing users at MININFRA as primary as data sources to understand the role of drift in embedding the SDF methods in planning practice. Additional data sources include a selection of

trained potential users at different stages of the land use planning processes from each province at the local levels that have participated in the previous training or workshops.

This study combines fieldwork observations and semi-structured interviews for primary data collection. Data collection focuses on identifying adjustments according to users' experience with the SDF methods that can trigger drift to embed it as PSS in practice. Moreover, observation of SDF methods use in the decision room (MININFRA) during the internship period, observation of workshops participants (January 16 – 17, 2020), visits to the local levels and fieldnotes from fieldwork were additional sources of primary data. The additional sources show the importance of some recommendations and implementation tactics for the SDF methods adoption in the land use planning process at the local levels by respondents.

The combination of an internship period (January 13 to March 31, 2020) with fieldwork activities presented an ample opportunity for observations of the use of the SDF methods for spatial location of functions and infrastructure identified in the existing non-spatial policies such as the National Strategy for Transformation (NST1), Sector Strategic Plans (SSP) and District Development Strategies (DDS).

3.3.2. Sampling Method

The spatial distribution of key-informants selection from the local levels across the Rwanda provinces considered key factors for the '*realistic representation*' of respondents. The spatial complexities across Rwanda require that selection of respondents must first consider the representation of the five provinces (northern, southern, western, eastern and central). As such, the selection of one local level from each of the five provinces (Figure 3. 2) adopt criteria identified by the SDF methods analysis of the spatial structure (Appendix 2).

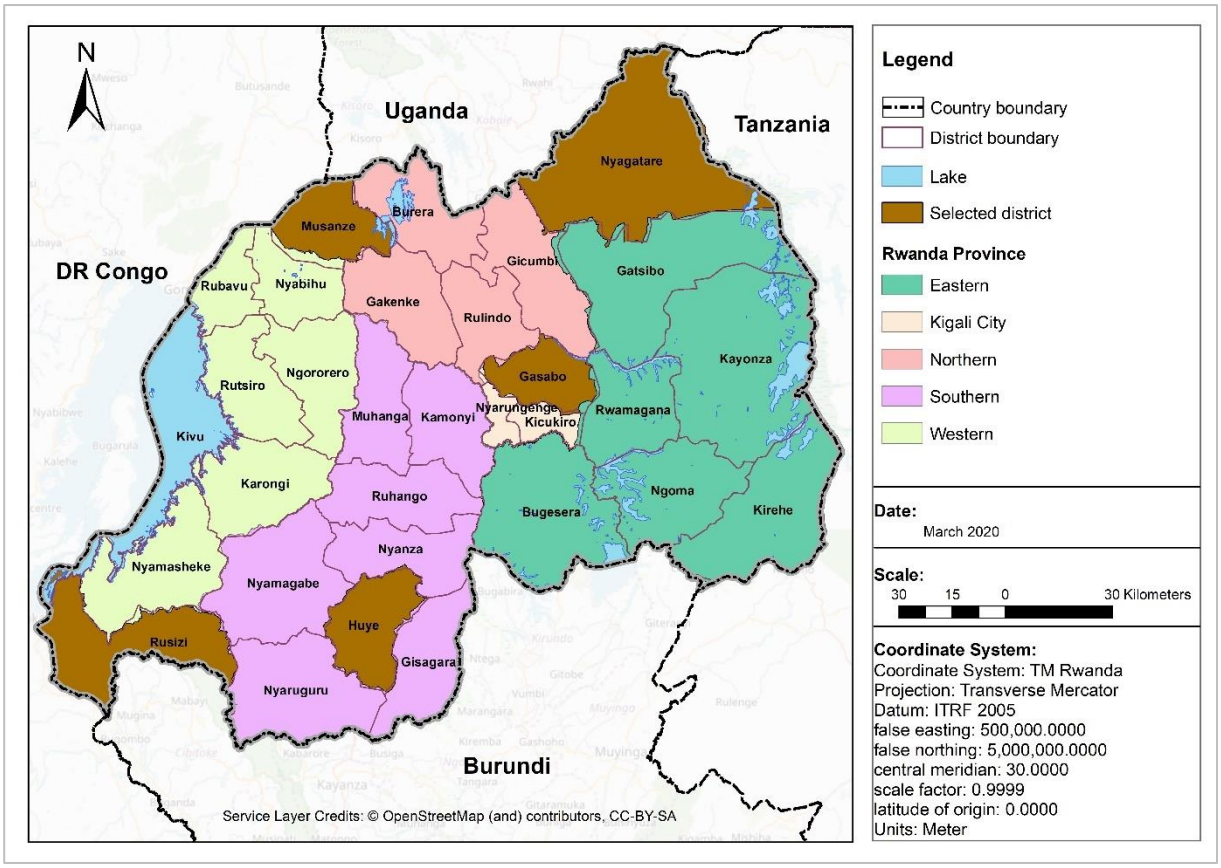


Figure 3. 2: The spatial distribution of selected respondents at the local levels.
Sources: Author (2019); MININFRA (2019); OSM (2020).

The selection of respondents for the study adopted the *purposeful sampling method*. The study selected a small group of respondents identified from the list of participants from previous training and workshops of the SDF methods. The selection of a respondent from the local levels across the five provinces gives an overview and understanding of the larger group of participants of the SDF methods training and workshops from the case study area. Patton (2002, p. 273) highlights the strength of purposeful sampling method in qualitative research to be a tool for in-depth study of small samples that provides '*information-rich*' data on the objective of study.

The selection of one key-informant for interview from Nyagatare (eastern province), Gasabo (central province), Huye (southern province), Rusizi (western province), and Musanze (northern province) used the *snowball sampling* method (Marvasti, 2018). The method was very effective in instances where the selected respondents decline an interview, and referrals were given based on the same selection criteria.

The local levels selection criteria consider functionalities as a secondary city or the settlement hierarchy as identified by the SDF methods. The identified economic potentialities of local levels, primary and secondary corridors, as well as gateways, were considered for local levels selection (Figure 3. 3). Economic potentialities identify settlements that are development corridors to decentralise the concentration of people and economic activities from the capital city. Whereas, the primary corridors are the transportation axis that connects urban centres to facilitate economic investment and trade. Also, secondary corridors are transportation axis that facilitates regional and international connectivity for economic investment, trade and transportation efficiency (UN-Habitat & ITC University of Twente, 2019).

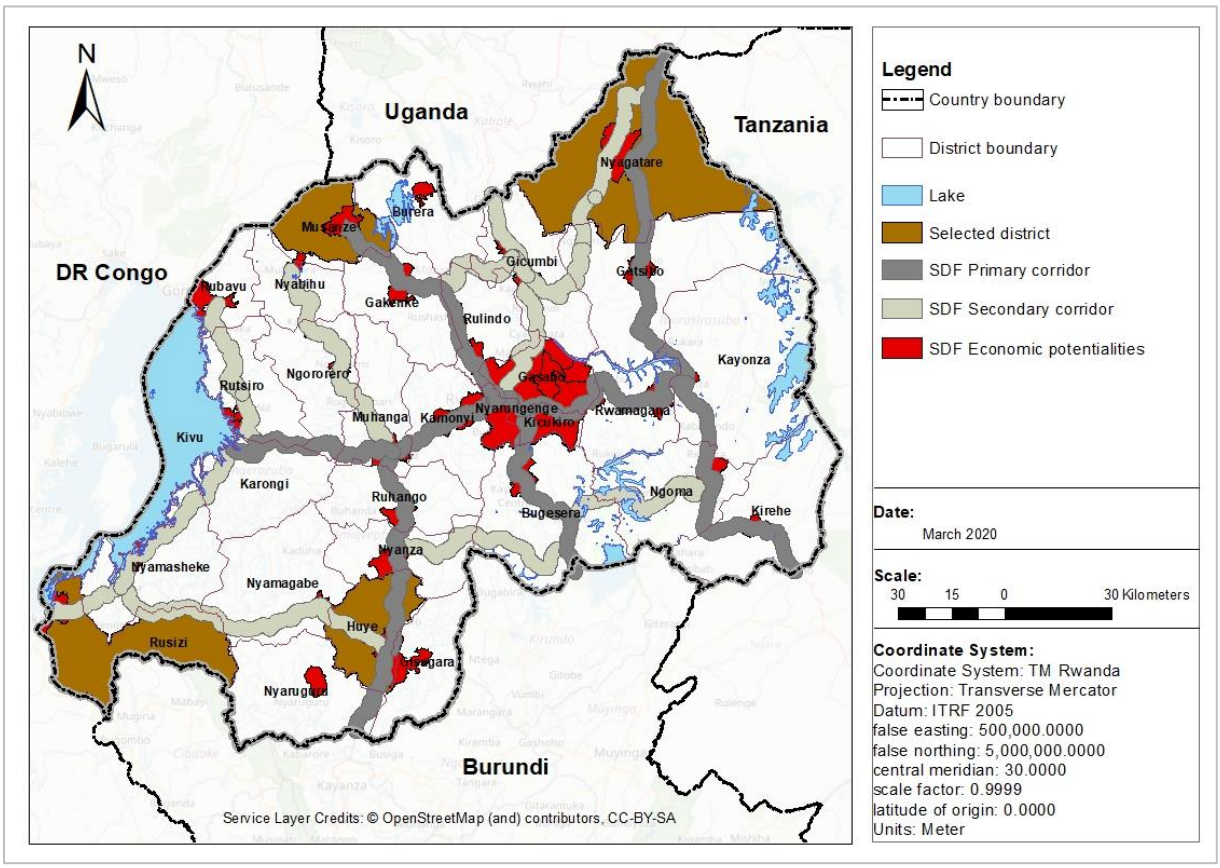


Figure 3. 3: Selection criteria of respondents.
Sources: Author (2019); MININFRA (2019); OSM (2020).

Also, settlements hierarchy classification was according to the availability and the spatial distribution of physical, social as well as economic infrastructure. The settlements hierarchy include main urban centre (MUC), local urban centre (LUC), intermediate urban centre 1 (IUC1), and intermediate urban centre 2

(IUC2) (Appendix 3). MUC are urban centres that serve as the international hub due to its centrality and connectivity. The IUC1 are 'international/national cross-border towns', and UC2 settlement types are third-level urban settlements. The LUC settlements are rural areas with essential services and infrastructure.

The interview with the local level respondents (five) focused on understanding the land use planning process, use of geo-information, benefits and limitation as well as individual interpretations of the SDF methods. It also considers the user knowledge of what needs to change for adoption in the land use planning process. The interviews at the national level were with respondents (four) from MININFRA to understand the role of the ministry in the SDF methods adoption for spatial implementation of policies and plans across the levels of government, limitations as well as the outcomes. Also, an interview with a respondent from UN-Habitat was to understand achievements, limitations and roles in embedding the SDF methods in planning practice (Table 3 1).

Table 3 1: Primary Data Collection Overview

Respondent Selection	Attribute	Respondent	Research Questions Data
UN-Habitat	SDF methods developer	1 (Managerial level)	SDF methods achievements. What is the role of UN-Habitat in the SDF methods adoption process? What are the challenges in the SDF methods adoption in practice?
National Level			
MININFRA	SDF Installed base Urbanisation sector Housing sector Infrastructure sector Spatial data provision (for national and local levels planning)	1 (Managerial level)	SDF methods achievements (national and local levels) MININFRA's role in embedding SDF methods in planning practice. What are the challenges in the SDF methods adoption in practice?
		3 (Planning, monitoring, GIS specialist)	Respondent responsibilities The planning process, benefits and limitations Ministry role in the planning process (national and local levels) SDF methods achievements (national and local levels) Ministry role in embedding SDF methods in planning practice (national and local levels)
Local Level and Province			
Musanze (Northern)	Intermediate urban centre 1 (IUC 1) Primary corridor Economic potential	1 (Planning, monitoring, GIS specialist)	Respondent responsibilities The planning process, benefits and limitations Use of geoinformation in the planning process (benefits and limitations) User understanding of the SDF method(s) Perception of the SDF methods ease of use
Huye (Southern)	Intermediate urban centre 1 (IUC 2) Primary corridor Secondary corridor	1 (Infrastructure planning, management	

	Economic potential	and monitoring)	Perception of the SDF methods usefulness to enhance job performance Perception of the SDF methods usefulness to enhance the planning process Challenges of embedding the SDF methods. Embedding SDF methods in planning practice (benefits, recommendations
Nyagatare (Eastern)	Intermediate Urban Centre 2 (IUC 2) Primary corridor Secondary corridor	1 (Infrastructure monitoring)	
Rusizi (Western)	Intermediate Urban Centre 1 (IUC 2) Secondary corridor	1 (Planning, monitoring, GIS specialist)	
Gasabo (Central)	Main urban centre Primary corridor Secondary corridor Economic potential	1 (Building engineer)	

Source: Fieldwork, 2020.

However, data collection at the local levels identified additional respondents at the national level. It highlights the role of other national level authorities responsible for the coordination, monitoring, evaluation and funding of the land use planning process at the local levels. It identifies the need to select respondents from three national level authorities directly involved in local levels planning process. First, the Ministry of Finance and Economic Planning (MINECOFIN) is in charge of budgeting and planning for the entire country. The Ministry of Local Governments (MINALOC) is in charge of coordination, monitoring and evaluation of the local levels planning process. Third, is the Local Administrative Entities Development Agency (LODA) an entity under the supervision of MINALOC in charge of funding local levels planning process.

The identification led to making arrangements to contact two respondents each from the management level (head of department or director of planning) to discuss the roles in the adoption of SDF methods for the planning process (short-term/annual plans). However, the sudden restriction in movement and work from home due to the COVID-19 pandemic led to the abrupt halt in data collection. It led to an abrupt departure from Rwanda and the cancellation of some scheduled consultations for contact meetings and interviews at the national level.

As a result, follow-up appointments and interview of respondents from MININFRA and UN-Habitat were via e-mail correspondences, Skype as well as WhatsApp chats and calls. Moreover, poor internet connections in Rwanda was a challenge and limiting factor to data collection after return to the Netherlands. Hence, data collection with respondents from MINECOFIN, MINALOC and LODA could not be achieved.

3.3.3. Semi-structured Interview

The use of semi-structured interview for data collection allows for the flexibility to engage respondents at different time and location. During the interviews, data collection were via audio recording, note taking and observations. First-hand contacts made with many of the respondents were by calls to introduce the research and purpose of data collection. Follow-ups with respondents were by visits and emails to send an interview guide (Appendix 12), consent document (Appendix 5) or request for an appointment for the interviews.

Some respondents prefer follow-up calls for the interview or rescheduling of an earlier appointment. Also, modifications on the location for the interviews were according to the respondents preferred place (office, hang-outs, phone call) and time (during working hours, lunch break, after working hours). The method

was to enhance enthusiasm and convenience of respondents to participate willingly and without restrictions. Table 3 2 highlights the operationalisation of research objectives and questions. The number of contacts (chats, calls, emails, visits) with respondents for discussions and follow-up interviews were between four to seven times for data collection.

Table 3 2: Research Objectives, Questions and Respondents.

Research Objective	Research Question	Respondent
To understand the need for the SDF methods adoption in the land use planning process.	What is the land use planning process at the national and local levels?	National level Local level
	What are the benefits of the land use planning process?	
	What are the limitations in the land use planning process?	
To identify the drift in the SDF methods adoption.	What is the users' understanding of the SDF methods?	
	What is the users' perception of the ease of use of the SDF methods?	
	What is the users' perception of the usefulness of the SDF methods?	
	What are the signs of drift in the SDF methods adoption?	
To identify where the SDF methods are embedded.	What are the outcomes of the SDF methods adoption?	National level UN-Habitat
	What are the signs of embeddedness of the SDF methods as a PSS?	
	What are the roles of the national government and UN-Habitat in the SDF methods adoption?	

Source: Fieldwork, 2020.

3.4. Data Analysis

Qualitative data analysis focus on understanding the sequence and logic in the available data to deduce an interpretation that identifies the need for research or provide answers to research questions (Maxwell & Kaplan, 2005). The data analysis followed a series of process to establish the need to research on the users' acceptance that triggers drift to embed PSS in practice. During fieldwork for primary data collection, prompt content analyses of field notes and interview transcript in addition to text document from secondary sources gave insight to efficient follow-up questions for respondents when necessary.

Maxwell and Kaplan (2005) highlight four basic techniques for qualitative data analysis: data coding, development of analytical memos, graphic displays, and narrative analysis. Transcription of interviews from primary data collection precedes the data analysis. Data reduction method through coding; drawing of inferences through detailed content analysis, result display with analytical methods as well as graphical presentations in addition to narrative discussions were done (Marvasti, 2018, p. 29).

Data transcription of interviews was with the *Transcribe* software ("Transcribe - transcription software for converting audio to text," n.d.). Data coding and analysis explored a descriptive content analysis method using the computer-assisted qualitative data analysis (CAQDAS) software (Atlas.ti8) ("ATLAS.ti 8 Windows," n.d.).

Moreover, data coding explored both inductive analysis (that adopts open coding from interview transcripts) and deductive analysis (that adopts codes from research concepts and theoretical framework). Inductive coding was done with the selection of phrases, sentences or segments of transcribed interviews and categorised with "*themes*" that describes the respondent's response to interpret the perception in the interview guide for research objectives. Deductive coding uses phrases such as user understanding, perceived ease of use, perceived usefulness, LUP benefits, LUP limitations, which are independent of field notes and data transcripts. Others were deduced from the interpretation of selected segments or sentences

to become themes that represent respondent views. Figure 3. 4 highlights the coding strategy adopted for data analyses. The presentation of analysed data is with written narratives, concept maps and casual networks between codes or phrases for comparison or connections (Chapter Four).

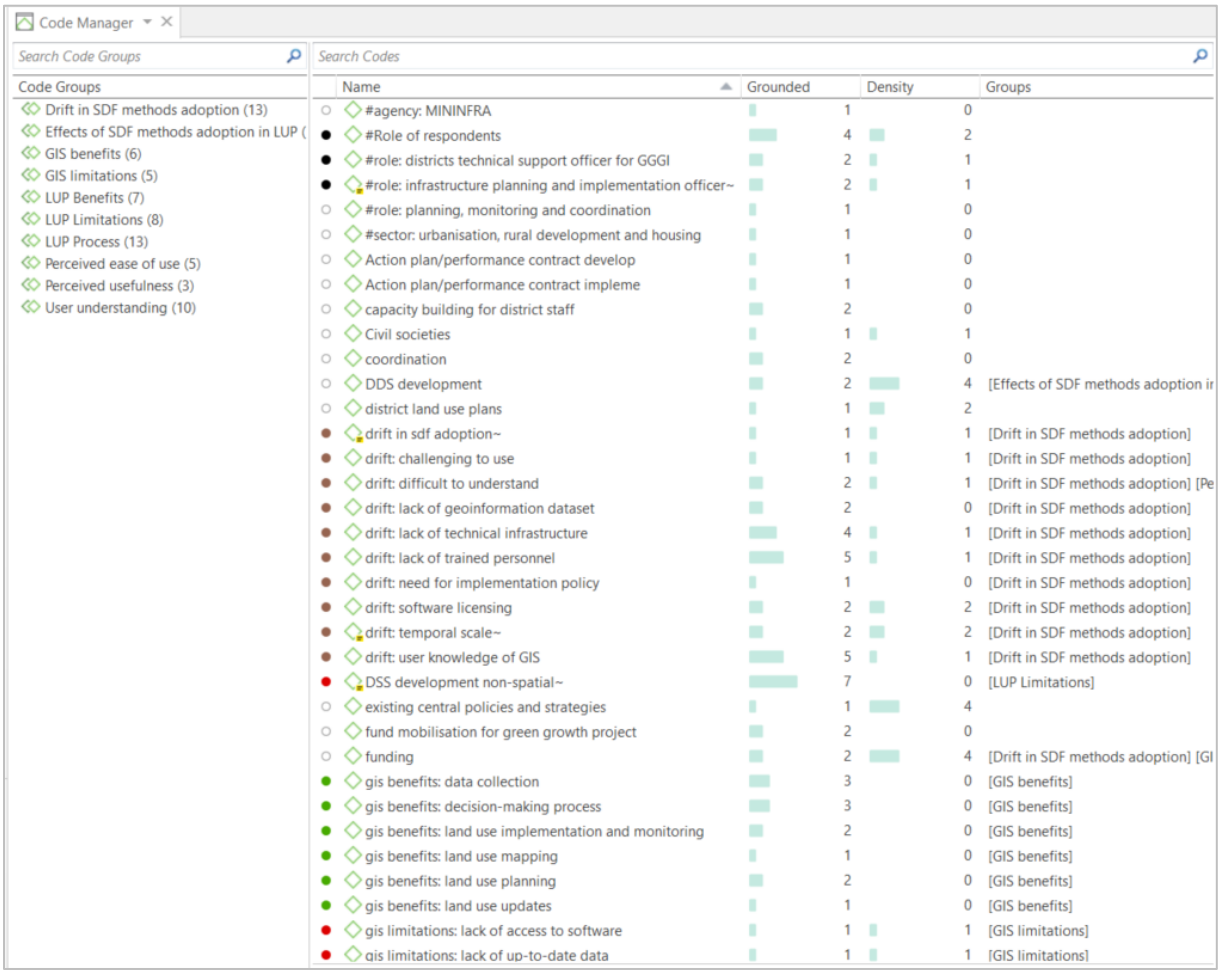


Figure 3. 4: Coding strategy
Sources: ATLAS.ti 8 software; Fieldwork (2020).

3.4.1. Interpretation of Case Study Findings

Chapter four presents result from the case study on the role of drift in embedding PSS in practice based on the drift actor research perspective. The respondents for the thesis is a combination of management level users of the SDF methods and geoinformation experts from MININFRA (the national level) and trained potential users at the local levels. The local levels respondents include experts and non-experts in geoinformation technology with different roles in the planning process. A representative from UN-Habitat - SDF methods developer – was also interviewed (Table 3 1).

The results presentation follow the outline of research objectives and questions as headings for presenting results (Table 3 2). The first research objective identifies the need for SDF methods adoption from interviews and secondary data sources. Next, the second objective adopts the drift actor research model to describe interviews and understand the triggers of drift in the SDF methods adoption at the national and local levels. Lastly, the third objective utilises both interviews and secondary data sources to identify where the PSS is embedding in planning practice and the roles of MININFRA and UN-Habitat.

Chapter five discuss the results strictly within the context of the case study area to establish the need for comprehensive research. Still, it is of note to mention that the thesis did not generalise the results as a full representation of the role of drift in embedding PSS in planning practice for all developing countries. Neither did it give a full insight into the drift in embedding PSS in planning practice.

3.5. Ethical Issues

There are ethical considerations in qualitative primary data sources (interviews) with human participants compared to the secondary data review sources. Two critical issues that require ethical considerations in semi-structured interviews for data collection are *confidentiality* and *anonymity* (Longhurst, 2010). Longhurst (2010, p. 111) highlighted three concerns for interview participants:

- Collected data remain protected by the researcher;
- Participants remain anonymous and all interviews confidential (unless permitted otherwise); and
- Respondents right to withdraw at any time from the research without explanation is guaranteed.

This research addresses the respondents concerns with regards to confidentiality and anonymity as follows:

- Information on the overview and purpose of the research, stating the benefits and risk of participation were made available to all interview participants (**Appendix** 4);
- Information on the role of interview participants as a primary data source for the study was made available (Appendix 5);
- Request for consents for confidentiality and anonymity of participants was with a signed consent form (Appendix 5); and
- Data privacy consents such as the willingness to be audio recorded, quoting responses in research outputs and future of data were also requested (Appendix 5).

Identification of direct quotations from respondents was by assigning numbers to all participants to ascertain anonymity. The researcher adheres to the responsibility to provide participants with research details and the purpose of as well as details of consents for data use, storage, confidentiality and anonymity (Appendix 6). All participants received a copy of the duly signed consent form.

The research on the adoption of SDF methods in the land use planning process is part of an ongoing spatial planning process to achieve urbanisation in Rwanda. Finally, there is a commitment to make available the outputs of the study (reports, infographics or online presentation) on completion.

4. RESULTS

4.1. Introduction

The process of embedding is "*how*" the unpredictable users' behaviours become a part of an independent technical system to establish or enhance a process (Pike et al., 2000). It will require knowing "*what is to be embedded*"; "*in what*" will it be embedded; "*for whom*"; and "*at what spatial and temporal scale*". This research entails understanding *the users'* perception of the *land use planning process*, to establish the need for *SDF methods adoption* at *the national and local levels* according to which *timeline*. Chapter two discusses the timeline as well as how the SDF methods are becoming a PSS for spatial implementation of plans and policies in Rwanda.

This thesis focuses on the user approach of the PSS implementation gap to explain the influence of users' understanding and acceptance triggers drift towards achieving the actual use of the SDF methods in land use planning (LUP) process. This result chapter uses data from interviews and secondary sources *to understand the need for SDF methods* adoption in the land use planning process; *to identify the role of drift in embedding it as PSS in practice*; and *where the embedding process is* taking place.

4.2. To understand the need for the SDF Methods Adoption in Land Use Planning Processes.

The LUP process plays a central role in urban governance through the development of master plans for zoning, land allocation and settlement development with a focus on the capital city (Kigali) and emerging settlements as urban centres. In 1996, Rwanda adopted the human settlement (Umujyi) policy in to coordinate urban governance and planning. The human settlement policy promoted economic development and efficient use of land through the coordination of networks of urban and rural settlements (Cottyn, 2018). Berlanda (2012) explained that "*umujyi*" in Swahili is to describe distance or difference between city and countryside. However, the Umujyi policy was a plan to coordinate the existing economic activities and settlements which led to the establishment of "*Imidugudu*" (villages) as the last form of local levels administration in Rwanda (Berlanda, 2012, p.137).

In 2000, Vision 2020 was adopted as the main urban development plan for the categorisation of settlements in terms of their economic activities and development potentials through infrastructure development and services. In 2012, Vision 2020 was revised to accommodate the national Economic Development and Poverty Reduction Strategies (EDPRS II) (2013-2020), which was implemented through sector strategies and district development plans across the local levels. In 2015, the National Urbanisation Policy (NUP) was adopted as a central policy for urbanisation to achieve social, economic and environmental development in Rwanda. Later in 2018, the National Strategy for Transformation (NST1) replaced the EDPRS II to complete the implementation plan of Vision 2020 as well as start the implementation of Vision 2050.

It is of note to mention that policies guiding the land use planning process and development in Rwanda were non-spatial before the adoption of the SDF methods in 2016. As such, the land use planning process in Rwanda is evolving to strategic spatial planning with the support of the UN-Habitat. One of UN-Habitat's strategic spatial planning support is the establishment of secondary cities, which are economic development areas connected by networks of settlement to support the capital city of Kigali as development centres. Another strategy to bridge the gaps that exist in the spatial implementation of the non-spatial policies was the development of the Spatial Development Framework (SDF) methods. Thus, the need to understand the LUP process and identify the need for the SDF methods adoption in practice

4.2.1. What is the Land Use Planning Process at the National and Local Levels

The development of the national master plan and policies coordinates the LUP in Rwanda and the implementation at the local levels through the development of district development plans (Ministry of Natural Resources, 2017). The institutional framework for the national planning system, implementation, monitoring and evaluation of the land use development plans is through the top-down governance system (Ministry of Finance and Economic Planning (MINECOFIN) & Ministry of Public Service and Labour (MIFOTRA), 2015, p.10). The top-down governance system for the LUP entails the development of the National Land Use Planning Guidelines (NLUPG) that guides plans and policies of various ministries, sectors and institutions at the national level (Ministry of Natural Resources, 2017). The Ministry of Natural Resources (2017) identified ten steps for the land use planning process at the national and local levels that align with public participation and use of geo-information technology. The steps include:

1. Baseline data capture and identification of stakeholders;
2. The revision of existing baseline data to set the vision for the land use plan;
3. Situation analyses of baseline information to identify issues, potentials and future development as well as the spatial requirements (Figure 4. 1);
4. Formulation of goals and objectives for land use plan;
5. Draft plan preparation for spatial strategies and developments;
6. Public consultation on the draft land use plan through public display and information dissemination; conduct of hearings; and consultations (Figure 4. 2);
7. Preparation of the detailed draft land use plan;
8. The review, adoption and approval of the land use plan;
9. Implementation of the land use plan; and
10. Land use plan monitoring, review and evaluation.

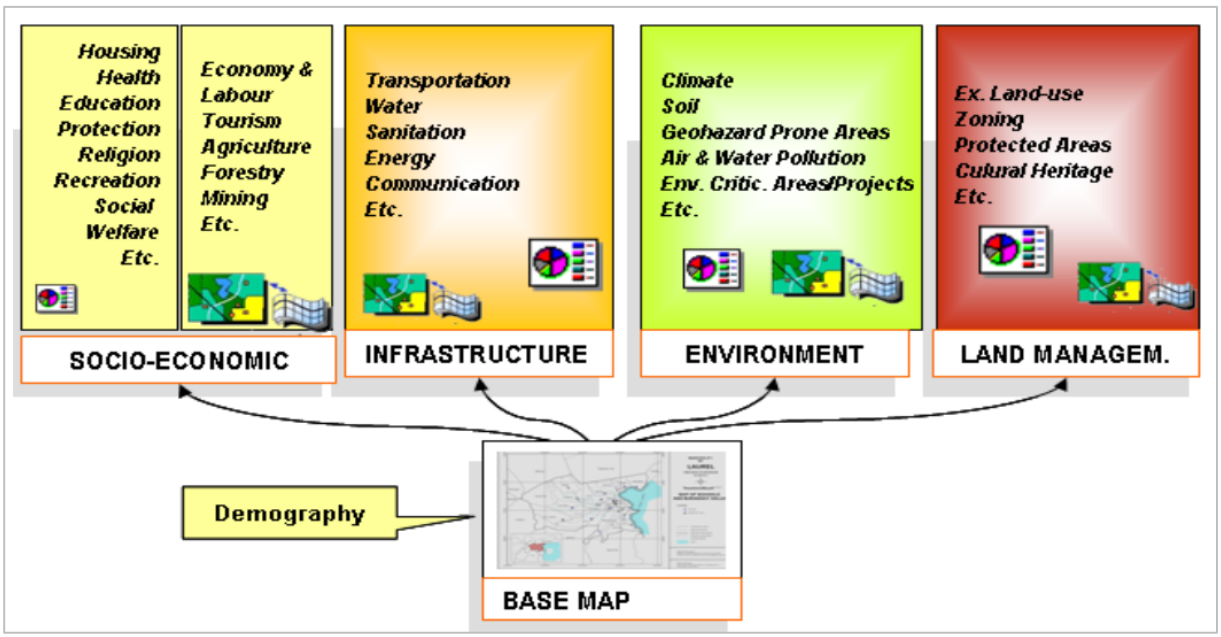


Figure 4. 1: Situation analysis and base map development for land use plan.
Source: Ministry of Natural Resources (2017).

The statutory responsibility of the Ministry of Local Governments (MINALOC) is the coordination governance at the local levels. MINALOC is also in charge of local levels planning processes through a coordinating and funding agency - the Local Administrative Entities Development Agency (LODA) (Commonwealth Local Government Forum, 2018). Although Rwanda follows a top-down governance system, it also uses the bottom-up system of governance decentralisation for administration and planning

process at the local levels. Moreover, Article 6 of Rwanda's constitution support decentralisation of administrative powers at the local levels (Republic of Rwanda, 2015). This bottom-up governance system (decentralisation) aims to achieve efficient service delivery for citizens through public participation for the development of plans and policies and implementation at the local levels as well as good governance (Republic of Rwanda, 2018). The NLUPG emphasises the role of public consultation and participation in LUP processes at the national and local levels (Figure 4. 2).

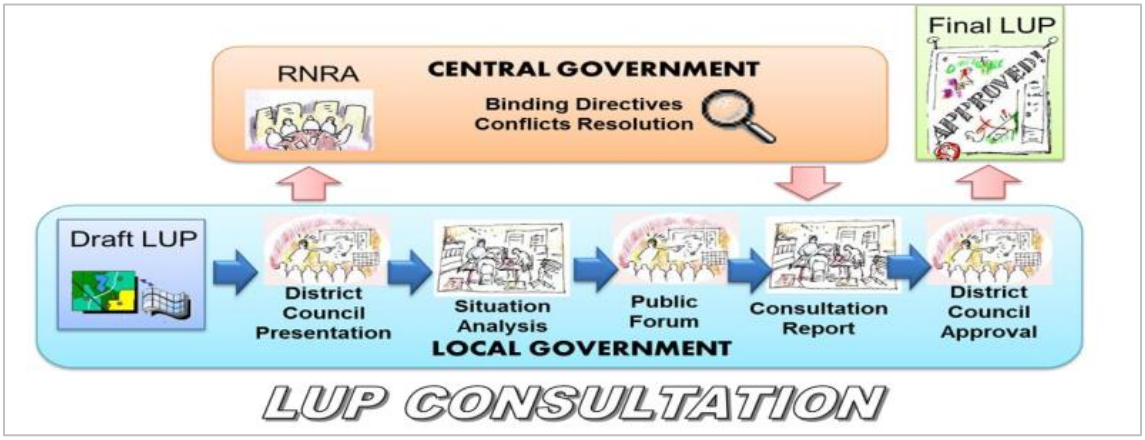


Figure 4. 2: The structure for LUP processes at all levels of government.
Source: Ministry of Natural Resources (2017).

The lower-level targets and action plans for sectors, institutions and local levels implementation translates the long-term development guidelines at the national level (Figure 4. 3). The planning framework sets out the national planning policies and development objectives to coordinate planning across the national and local levels. The three stages of the LUP process are long-term; medium-term; and short-term strategies, targets and action plans (Figure 4. 3).

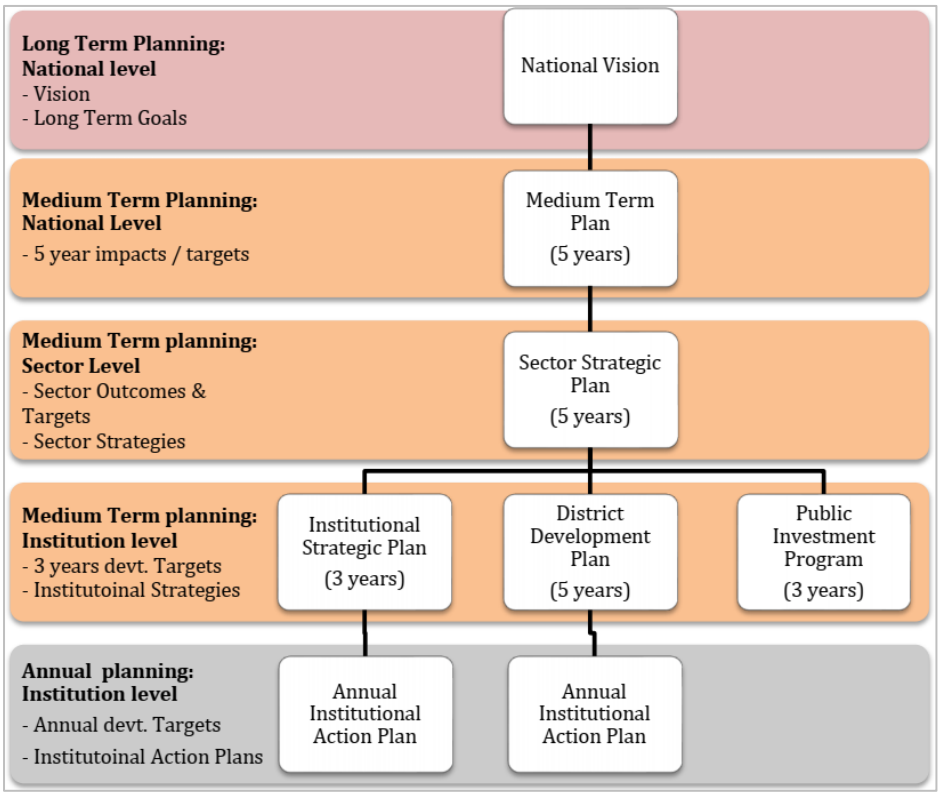


Figure 4. 3: Rwanda Planning framework.
Source: MINECOFIN and MIFOTRA (2015).

The long-term plans are prepared at the national levels for continuous planning vision for strategic developments goals and objectives to guide the medium-term and short-term plans such as Vision 2020, Vision 2050, NST1, NUP. The medium-term plans are plans that interpret the long-term plans to actionable plans within specific timelines (3 - 5 years). The short-term plans translate the medium plans to annual planning document for implementation.

At the national level, the medium-term plans prepared include three to five-year plans or strategies. The Medium-Term Development Plans (MTDP) are five years plan prepared by MINECOFIN the ministry in charge of national planning and budgeting. Other ministries and agencies at the national level in charge of various development sectors prepare five-year Sector Strategic Plans (SSPs) as well as the three-year Institutional Strategic Plans (ISPs) and National Investment Programs (NIPs) that align to the SSPs and MTDP. The sectors include education, health, agriculture, infrastructure, justice, urbanisation, housing, environment and green growth. At the local levels, the medium-term plan is the five-years District Development Plans (DDPs). The DDPs are specific strategic development priorities and targets for each local levels and aligns with the MTDP and SSPs at the national level.

The Short-term plans are annual (one year) planning documents that translate the medium-term plans for annual implementation at the national and local levels. The annual district plans development at the local levels adopts the decentralisation policy for governance and administration and the public participation process during preparation (Republic of Rwanda, 2018, pp. 47-49). Thus, the LUP process supports the top-down and bottom-up systems for planning and implementation of plans and policies and enhances the process across the national and local levels.

4.2.2. What are the Benefits of the Land Use Planning Process

The knowledge of the land use planning process is one component for understanding the need for the SDF methods adoption. The user understanding of the benefits of the planning process and the use of geo-information technology is another component that can emphasise the need for PSS adoption in practice. The perception of the need for geoinformation technology to enhance the LUP process is a vital component to identify the need for PSS adoption in the planning practice. Respondents at the national and local levels provided insights into the benefits of the LUP process across the levels of government.

The respondents acknowledged that the coordination, funding, evaluation and monitoring of the LUP process from the national levels (MINECOFIN, MINALOC and LODA) is a benefit. Also, is the use of geo-information technology and public participation in the LUP process. As a result, available resources for land use development are well utilised, and there is adequate control for the duplication of function across the local levels during plans and policies implementation.

Data analyses from coded interviews identify the reduction in informal and unplanned developments in urban centres in recent times, especially in the capital city of Kigali as another benefit of the strict adherence to the LUP process. Furthermore, the planning framework functions in enhancing the implementation of policies and plans through funding from coordinating and monitoring authorities at the national level (MINECOFIN, MINALOC and LODA) for local levels implementation a benefit of the LUP process the respondents identify. One of the respondent at the local level explain the roles of the coordinating authorities (MINECOFIN, MINALOC and LODA) in the planning process.

> *"MINALOC coordinates the districts land use process; this includes planning, budgeting and implementation. Local Administrative Entities Development Agency (LODA) is the land use planning funding agency under MINALOC. The district follows a bottom-up planning process to develop district land use plans in line with existing central strategies and policies such as master plans, NUP, NST1 etc. At present, development and implementation of district land use plans must*

comply with central policies and strategies while One-stop-centre facilitates land use plan implementation. Adoption of SDF methods have to start at the central levels, especially from ministries, departments and agencies (MDAs) in charge of district levels coordination, e.g. MINALOC, MINECOFIN, LODA"……Respondent 3.

In Particular, respondents at the local levels with responsibilities such as technical support for secondary cities development, district engineer at the One-Stop centre and infrastructure development officer describe the bottom-up planning system as a benefit of the LUP process. The bottom-up planning process is with public participation from the village, cell and sector levels during the preparation of annual district plans. As a result, there is citizens ownership of development plans as well as it improves the implementation of plans when approved. The implementation of development plans, budgeting and funding, is according to the national level institutional framework for planning across the levels of government. The preparation for the planning process is established through the yearly *budgeting call circulars* to all levels of government for integration in the national budget by MINECOFIN. The submitted budgets for the annual development plans are known as "*performance contracts*" and called "*Imihigo*" (individual or joint) submitted for evaluation, approval and funding. Figure 4. 4 highlight the procedure for LUP process for annual development plans at the local levels.

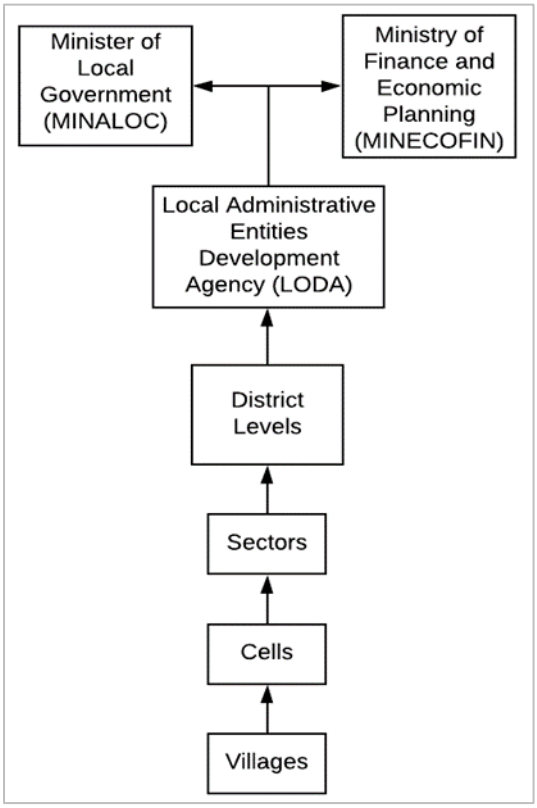


Figure 4. 4: Land use planning process for annual local levels plans.
Source: Fieldwork, 2020.

4.2.3. What are the Limitations in the Land Use Planning Process

Another vital component required to identify the need for PSS adoption in planning practice is understanding the limitation in the LUP process. Good knowledge of such limitations determines the solution that will be adopted to improve the planning process. For instance, the use of geoinformation technology methods in the LUP process for mapping, data collection, decision-making, implementation and monitoring is a type of planning support systems (PSS) existing in the planning process. However,

there are limitations with regards to the use of geoinformation technology in the planning process, especially in some territories at the local levels. Although the use of geo-information technology in the LUP process is a benefit, some respondents at the local level still consider it as a limitation of the process.

> *"The geo-information systems have been able to help us to update the existing situation, to map out where is the residential trends, where are people going….. to track developments...to put like criteria to have which areas are most suitable for development…….getting some shapefiles is an issue …. which they would call up-to-date. So for us doing planning, this is a limitation for. Out-dated information and also some sectors lack shapefiles. So when you are doing the planning, you have to go on-site to do data collection, so it is huge those are the limitations."……Respondent 2.*

> *"limited expert capacity in the use of geo-information tools is another challenge of the land use planning process"…….Respondent 3.*

> *"inadequate tools for spatial data causes a lack of collaboration and duplication of functions"……Respondent 4.*

The contradictions among respondents are because of the challenges experienced at the local levels, and it varies across the local levels. Such challenges include the lack of geoinformation technology resources (hardware, software, experts, spatial data and methodology) that has limited the use in the local levels planning process. At the national level, the limited number of geo-information technology experts, as well as unavailability of up-to-date spatial data for baseline information, were identified as challenges in the use of geo-information technology in the planning process. Hence, the respondents recognise the need for PSS adoption at the national and local levels (Figure 4. 5).

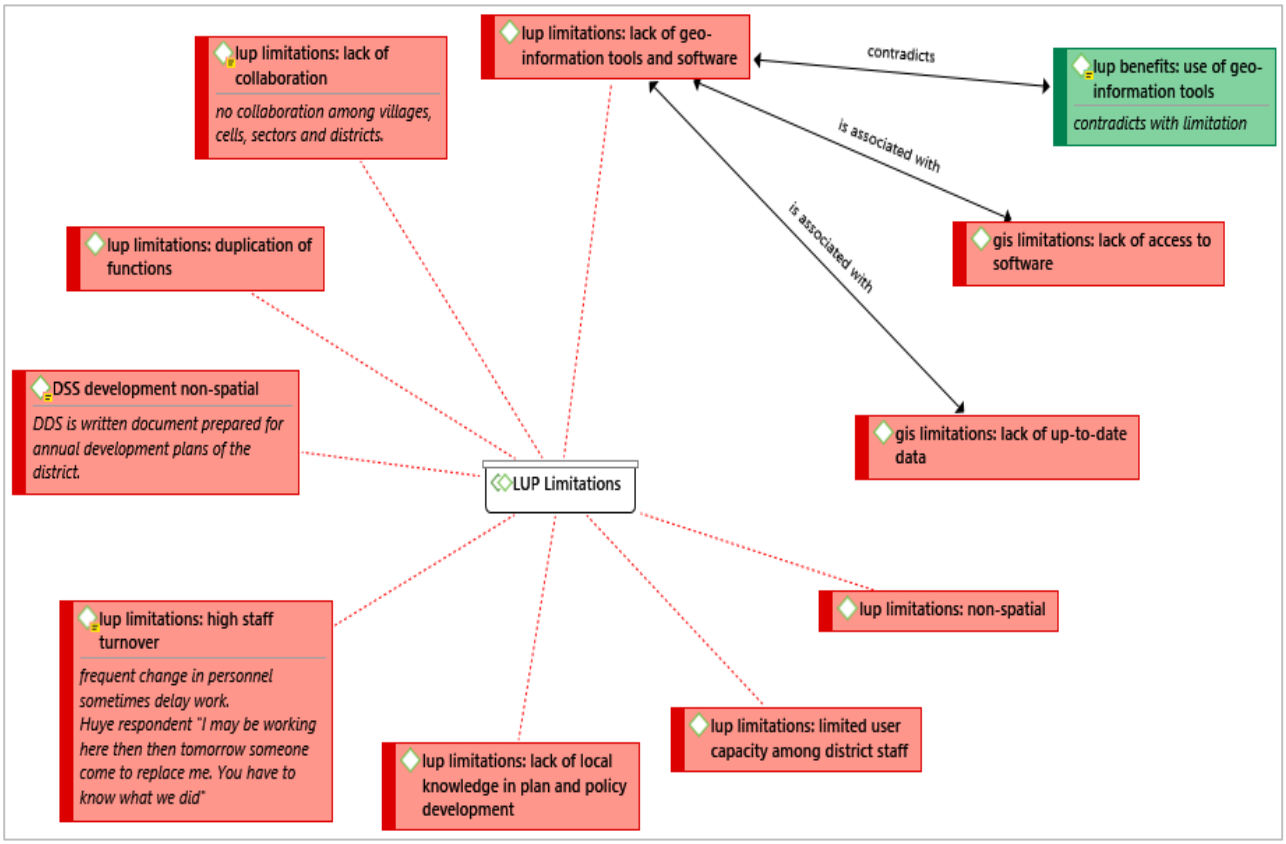


Figure 4. 5: Some limitations of the land use planning process.
Source: Fieldwork, 2020.

Currently, the annual district development plans are written documents (non-spatial) developed according to national policies such as NST1, NUP and medium-term plans (SSPs and DDSs) with the bottom-up public participation processes at the local levels (Figure 4. 4). However, a shared perception of the limitation in the LUP process by respondents at the local level is the non-spatial process of the annual district development plans and other medium or short-term strategies. Respondents mentioned that the non-spatial methods of the annual district plans especially at the local levels have contributed to the lack of collaboration among villages, cells and sectors of the same local levels, resulting in the duplication of functions and inadequate prioritisation of spatial projects implementation.

> *"…..it comes from local people the people sit together in a community. Then they asked they discuss what they want. They want Road from here to here if they want to water supply everything...and then the local community local authorities the said office to record what the people need and then they put from the cell to move to the sector and then the sector combining what people said they choose likely some of them and then come to the district..... step like that. up to the central government."……Respondent 1.*

> *"…..no collaboration even .....starting from the bottom from the village. They don't ….. collaborate..... in a village you need cow and everything in another village nearby you they need road and water but this only need water because they don't know." ……Respondent 1.*

> *"……collaboration at some point limited because each district wants to have its own milestones or its own achievements. So you will realize maybe Musanze says it wants an airport, Rubavu says it wants an airport .....they say we want an industry,..... or in processing flour .... the same thing is proposed." ……Respondent 2.*

4.3. To identify the Drift in the SDF Methods Adoption

Research identifies users' acceptance of PSS in spatial planning processes as an implementation gap (Geertman & Stillwell, 2009; Pelzer, 2017). This thesis adopts the user acceptance perspective to illustrate the role of drift in embedding PSS in practice and establish another research gap in PSS research.

Ciborra (2002a) describe users' acceptance during technical systems implementation leads to surprises, unexpected outcomes, compromises, new learning and behaviours that trigger drift to embed the systems (Figure 2. 5). According to van Baalen and van Fenema (2005), theoretical views for studying drift in technical systems implementation (Section 3.1), drift in systems implementation are essential. Such drift establishes structures that will embed new systems as part of existing processes or create new ones (Reay et al., 2013).

As such, this thesis applies the drift actor research to understand the impact of potential users acceptance of the SDF methods that trigger drift in the adoption process to embed it in the planning practice at the national and local levels (Section 3.2). The users understanding of the SDF methods at the local levels on the perceived ease of use (PEOU) and perceived usefulness (PU) express the choice on the intention to use and actual use of the SDF methods in practice. This section highlights the users PEOU and PU that triggers drift in the adoption process to influence embedding the SDF method as PSS for the LUP process.

This section of the result explores only the users' of SDF methods to study the role of drift to embed PSS in practice. However, it acknowledges that triggers of drift in the SDF methods adoption for LUP processes are either by users' of the PSS or the technology to achieve the desired outcome for planning process (Ciborra, 2002a, p. 85). Therefore, this thesis recommends comprehensive research on the role of drift in embedding PSS in practice.

4.3.1. What is the users' understanding of the SDF methods

Vonk and Geertman (2008) identify the role of users' understanding in the improvement of PSS implementation, acceptance and adoption for actual use. The SDF methods capabilities as PSS in the LUP process at all levels of government have been identified and established (Spaliviero et al., 2019). Still, the SDF methods capabilities according to the users' acceptance as well as the possible mismatch between developers objectives and users' need that influences understanding and acceptance for actual use needs study (Geertman & Stillwell, 2009).

During the interviews, respondents acknowledge the role of SDF methods as an essential tool for the LUP process at the national and local levels. The respondents recognise the SDF methods capabilities for the identification of planning gaps, enhance collaboration and spatial implementation of non-spatial plans to improve the LUP process.

"SDF methods can integrate DDS implementation then it makes your work easier and fast"……..... Respondents 1.

"..we were doing some urban work in Rubavu to see the projects which I was implementing. So without the..... the use or consultation of the SDF, it would have been easier for us to select projects because..... we had a tour but the tour was on making the selection prioritizing which projects for the UN-habitat to take up for the urbanisation for the development. But then we said we have a tool which is ..... which is helping in decision-making. This tool could have reflected the criteria right early enough we could have used it to say, okay. We have evolved."……Respondent 2.

"Yes, SDF methods are useful….it makes decision-making for policy development and implementation easier"…… Respondents 3.

"SDF methods gives spatial representation and categorisation of plans and developments. Can be used for the development of annual plans (performance contract) Monitoring and evaluation of annual plans. It will be efficient for facility planning and space allocation"……Respondents 4.

"Enhance coordination and monitoring of land use planning and implementation"..……Respondents 5.

"the SDF methods have introduced spatial components to land use planning and have identified the unbalanced distribution of Functions across districts"……..Respondent 6.

However, asides users' understanding, perceptions of the ease of use and usefulness of the SDF methods influence behavioural change (intention to use) that triggers drift that can result in actual use.

4.3.2. What is the Users' Perception of the Ease of Use of the SDF Methods

Users' perceived ease of use (PEOU) of the SDF methods can challenge the user understanding and capabilities for the need for adoption in the planning process. PEOU is the extent to which a user considers the SDF methods as simple to learn or use. Respondents at the national and local levels with knowledge in the use of geoinformation technology perceived the SDF methods as easy to learn and use. However, at the local levels, respondents with little or no knowledge of geoinformation technology use perceived the methods as challenging to learn and understand. The respondents that perceived the SDF methods as not easy to learn and use suggest that continuous training, as well as adoption in the planning process, will improve expertise over time.

"The SDF methods is difficult to understand….learning the use of new software takes time…….use might be a bit challenging"……..Respondent 4.

"If staff are adequately trained, use of the SDF methods will be effortless"……. Respondent 3.

4.3.3. What is the Users' Perception of the Usefulness of the SDF Methods

The five stages of PSS adoption include the users' understanding; interest in the use; intention to use; the decision to use; and actual use of PSS. The five stages influence perceived usefulness (PU) of the PSS for actual use in practice. PU is the way a user considers the adoption of SDF methods to be relevant for tasks and enhance the outputs of the planning process. Since the choice to use the SDF methods and potential outcomes cannot be predetermined before the adoption in LUP processes, the users' PU can influence the SDF methods adoption and embeddedness in the LUP process. The PU of respondents at the national and local levels shows the willingness to adopt the SDF methods as a PSS in the LUP process.

"Yeah, it is the best tool to the best one and of course doing planning you have to know what you have. You do not plan for what you did not have so that tool of the SDF is very important for me. I think the implementation right now, will be helpful because as I said, we have to avoid the duplication of Function. I wish it can come even right now, indeed if we can use it this year for starting the planning for the year 2020 - 2021. Okay, if we use it right now it will be helpful it is a matter of time"……Respondent 1.

"The benefits of using it, if we have used it for the master plan revision.....at the moment...we have only revised the secondary cities, so we realize we still have satellite cities we have other neighbourhood which needs planning...so as much as they set the criteria for land use planning in the process of doing the land use plan.....now we do use the planning model. I think SDF methods can also be another tool to add because as much as I am using the planning model with different criteria like population,...few people will consider the function .....few people know the importance of the functions before the SDF methods application"……..Respondent 2.

"The SDF methods contributed to the efficiency of my roles at the district if implemented"……..Respondent 3.

"It will make planning, monitoring and implementation easier. In terms of infrastructure development, it enhances identification, prioritisation and selection for implementation. Collaboration with regions for planning and implementation will be improved"……..Respondents 4.

An overview of users' understanding of the SDF methods capabilities and perceived usefulness in the planning process at the national and local levels are determinants to the individual levels adoption of the methods. Figure 4. 6 highlights the respondents understanding and PU of the SDF methods that influence the acceptance and actual use in planning practice at the national and local levels.

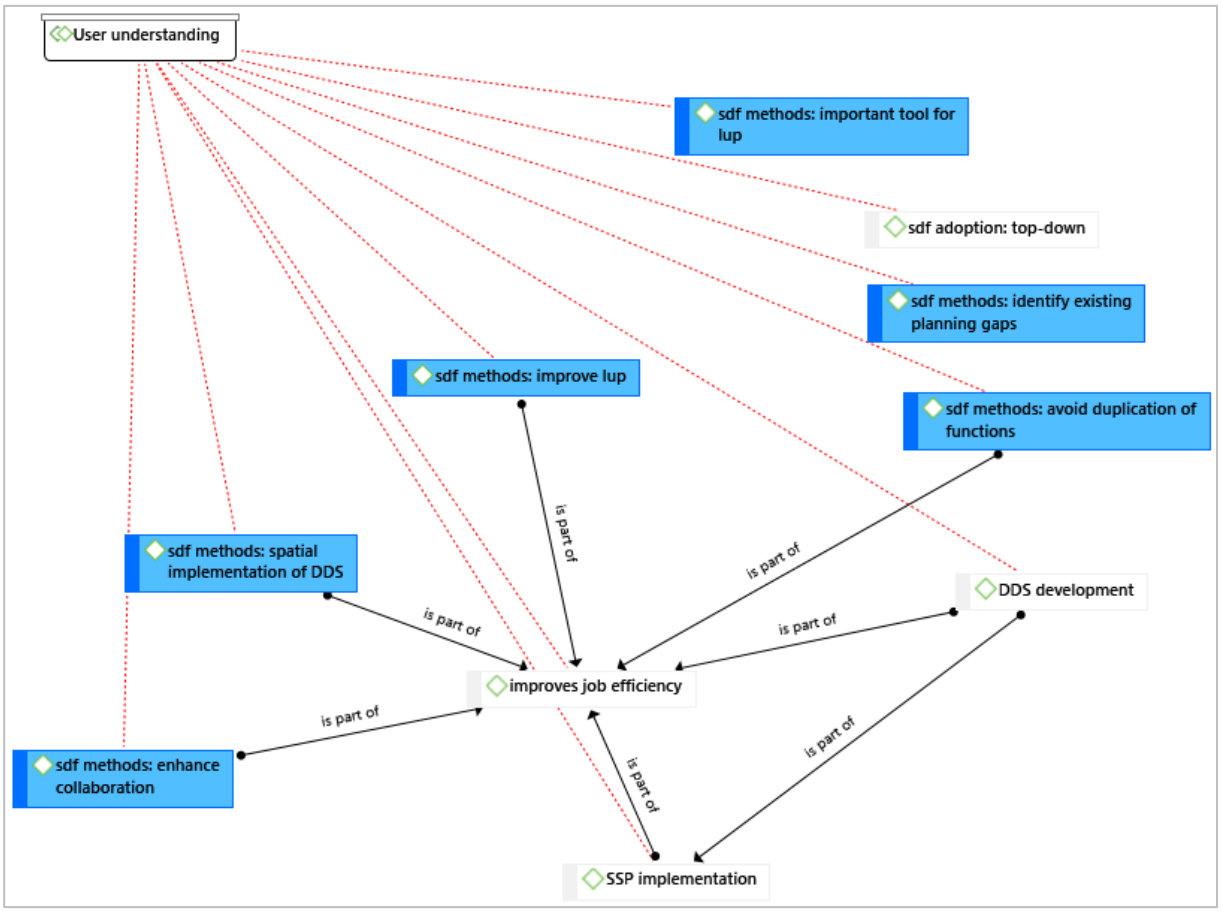


Figure 4. 6: Overview of users' understanding of the SDF methods.
Source: Fieldwork, 2020.

4.3.4. What are the signs of drift in the SDF methods adoption

Understanding the early signs of drift in the SDF methods adoption at the national and local levels helps to acknowledge the role of drift in embedding PSS in practice. Depending on the users' understanding and perceptions, there are planned or unplanned changes during the SDF methods adoption and implementation to achieve the acceptance of different users' and the actual use in LUP processes. A crucial modification for the SDF methods adoption in the LUP process at the national and local levels reiterated by potential users is the *installed base* expansion outside MININFRA. The expansion of the installed base refers to the need for other national level ministries such as MINECOFIN, MINALOC and LODA to adopt the SDF methods to enhance use in the land use planning at the local levels.

Rolland (2000) defined installed base as the unseen "*interconnected practices and technologies*" established during the development process of new technical systems but "*becomes increasingly visible as the system is embedded in the organisational context*". The installed base consists of users, technologies, processes, standards or skills that can influence (positively or negatively) the actual use of the system (Hanseth, 2000; Rolland, 2000; Rönnbäck et al., 2006). Rönnbäck et al. (2006) highlight the influence installed base influence on technical systems implementation and actual use to include technical system improvements; redevelopment; addition of new components to achieve actual use in different spatial and temporal contexts.

The respondents identify expansion in the installed base of the SDF methods to enhance adoption in planning processes should start with MINECOFIN being the ministry in charge of national planning and budgeting. This ministry is responsible for the evaluation, funding and coordination for the implementation of development plans and policies.

"Adoption of SDF methods have to start at the central levels, especially from ministries, departments and agencies (MDAs) in charge of district levels coordination, e.g. MINALOC, MINECOFIN, LODA. Also, a systematic integration requires adoption at all central agencies for Strategic Sector Plans (SSP) development for district level implementation. Although MININFRA is the facilitating agency for SDF methods adoption in land use planning, MINECOFIN should be the lead agency for adoption based on the performance contract/Imihigo evaluation, and approval for districts is their responsibility".…….Respondent 3.

"SDF methods development, adoption and implementation are dynamic and an ongoing process, need to involve all central agencies which will encourage the adoption at the district level. This is important based on the top-down nature of the land use process. Lack of implementation policy for SDF methods across the national and district levels is the major limitation to adoption"…..Respondent 5.

"MININFRA as the initiator of the SDF has it work officially with the ministry in charge of finance and planning….here I will mention MINECOFIN of course…. the following step is just to officially present to the ministry in charge of finance and implementation of policies (MINECOFIN). I can plan good things, but when you have the money, you are the boss. How SDF can be embedded in the land use process at the national starts from MINECOFIN. Then at the district, it goes through MINALOC"……Respondent 6

"there is a need to have the SDF tool approved by the Government so that institutions adopt it and their results integrated into the planning. There is also a need for awareness to a wide range of people for ownership to facilitate the integration"…..Respondent 7.

Also, respondents at the local levels identify the need for more training, experts, hardware, software, funding and spatial data requirements. However, respondents identify the lack of implementation policy for the SDF methods use in annual development plans as a hindrance to embedding it in planning processes at the national and local levels. The SDF methods adoption in the planning process needs to incorporate the three planning phases (short, medium and long-term) of the institutional framework for plans and policy developments (Figure 4. 3).

"…if we want to implement the SDF method we do not have the basic requirement of the staff we do not have enough trained staff to use it. But depending on the knowledge of GIS it will be easy to start to try and start implementing it may take, not a long time like the two or three months or one month, but people need to be trained and also for the internet is not the fast as you want, but how it is can use it"……Respondent 1.

"the limitations in adoption was existing data, and I do not know how many datasets it needs to derive a decision for SDF in terms of up-to-date spatial data. Awareness how to use it because I do not know how but maybe as we understand it first because I have to explain it like twice or thrice to some people when you show some people the matrix they feel it looks like predictable for some, it does not make sense for some at some point. We may find the challenges is the understanding the matrix itself or how to interpret what the gaps mean and how to solve it, just the understanding and at some point budgets. The SDF can determine good urbanisation ideas or decisions, but then we are limited with that part of the finances to do it."…….Respondent 2.

"Lack of required equipment and lack of knowledge of use. Lack of advanced tools and software for planning. Awareness. Capacity building and Inconsistencies in personnel training"….Respondent 3.

"Learning the use of new software takes time…..Issues of affordability by the district and availability for use"……Respondent 4.

Figure 4. 7 describes users opinions on the changes in the SDF methods adoption in planning processes at the national and local levels. It emphasises the need to involve the national level authorities in the adoption and actual use of the SDF methods to enhance adoption at local levels planning processes, especially for integrating the spatial components with the budgeting planning process. Furthermore, it illustrates the role of the top-down adoption of the SDF methods that allows national levels authorities such as MINECOFIN, MINALOC and LODA adopt the SDF methods for the evaluation and approval of annual development plans submitted for approval to achieve implementation across the levels of government.

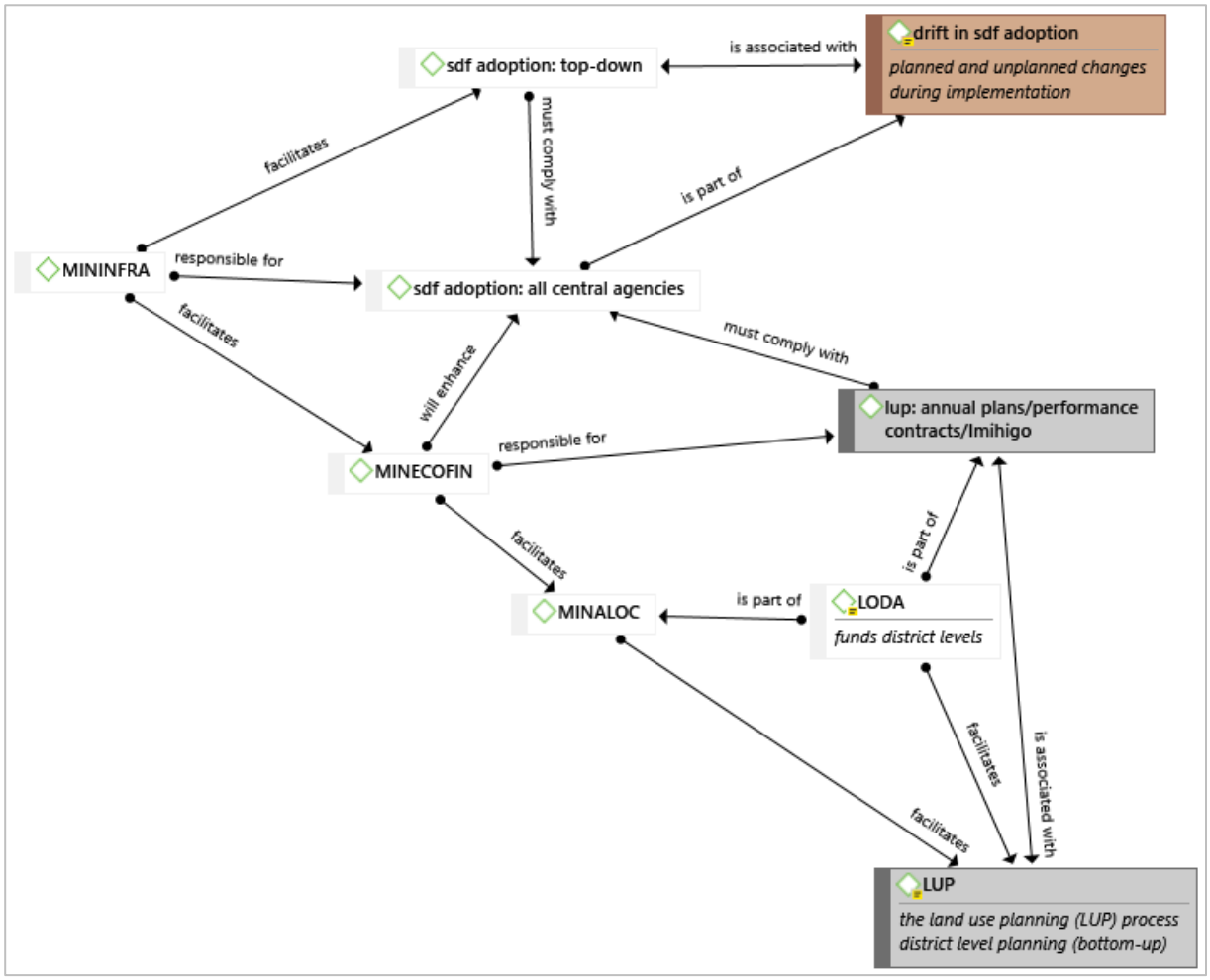


Figure 4. 7: Drift in SDF methods adoption at the national and local levels.
Source: Fieldwork, 2020.

4.4. To identify where the SDF Methods are Embedded

Embedding the SDF methods in the planning process at the national and local levels is an ongoing process. The earlier stages of the SDF methods adoption at the national level (MININFRA) and results are stated by respondents to ascertain the usefulness in the LUP process. Also, reflecting on the outcomes of the SDF methods implementation and adoption in the planning process can help identify the extent and likelihood of the embeddedness in the planning process. Moreover, understanding the roles of UN-Habitat and MININFRA in the adoption process will provide informed decisions that will establish the

needed recommendations for embedding the SDF methods in the planning process at the national and local levels.

The policy frameworks for urban planning in Rwanda are the Economic Development and Poverty Reduction Strategy (EDPRS II) (2013-2018) and the Urbanisation and Rural Settlement Sector Strategic Plan (SSP). The EDPRS II (Section 4.2) established the Urbanisation and Rural Settlement Sector in 2013. The SSP is a policy action plan and strategies developed for the Urbanisation and Rural Settlement sector by MININFRA in line with the NUP, NST1 and Vision 2050. The priority area of the frameworks is the economic transformation that will facilitate economic growth and urbanisation.

The economic growth and urbanisation vision was implemented with the development of six secondary cities to support the capital city, Kigali (Ministry of Finance and Economic Planning (MINECOFIN), 2013; Ministry of Infrastructure (MININFRA), 2012; Ministry of Infrastructure, 2015). The secondary cities became regional growth poles for promoting a balanced territorial development for economic investment and growth outside the capital city of Kigali (Boerboom et al., 2017). Likewise, analyses and identification of specific economic investment opportunities and growth poles for the country adopt the SDF methods.

4.4.1. What are the Outcomes of the SDF Methods Adoption

The first application of the SDF methods was the spatial analysis of Rwanda with the Matrix of Functions (MoF) according to existing functions across territories in 2015 (Appendix 7). Results of analyses from the MoF and the Consultative workshops classify the settlements into four hierarchies. The Main Urban Centre (MUC), Intermediate Urban Centres (IUC) 1 and 2, and Local Urban Centres (LUC) (Figure 4. 8) that identified the spatial structure of Rwanda in 2015 (Appendix 2).

Since 2015, the only MUC is the capital city of Kigali that serves as the international hub of Rwanda due to its centrality and connectivity. The IUC1 are 'international/national cross-border towns' and have four of the secondary cities (Rubavu, Rusizi Musanze and Huye) identified by EDPRS II and SSP. The secondary cities are gateways and service opportunities centres which identify them as the second level of urban settlements. The remaining two secondary cities (Nyagatare and Muhanga) are medium-sized settlements in the IUC2 settlement type that are third level urban settlements. Other settlements in the IUC2 apart from the two secondary cities are nodal town according to the SDF methods classification (Boerboom et al., 2017). The LUC settlements are rural areas with essential services and infrastructure. Appendix 8 show details of the hierarchies of settlements. An updated hierarchy of settlements according to a refined list of functions has been done in 2019 (Appendix 3) to ascertain the emerging spatial structure of Rwanda.

> *"The spatial structure of Rwanda emerged from the combination of the results of the MoF and Consultative workshops at Provincial level with Districts representatives. The organized consultative workshops are to reach consensus among local stakeholders on where are located the main economic activities and potentialities of the different Districts"…..Respondent 8.*

> *"The classification of cities into the hierarchy of settlements…to create systems of cities and town for appropriate spatial intervention"……Respondent 9.*

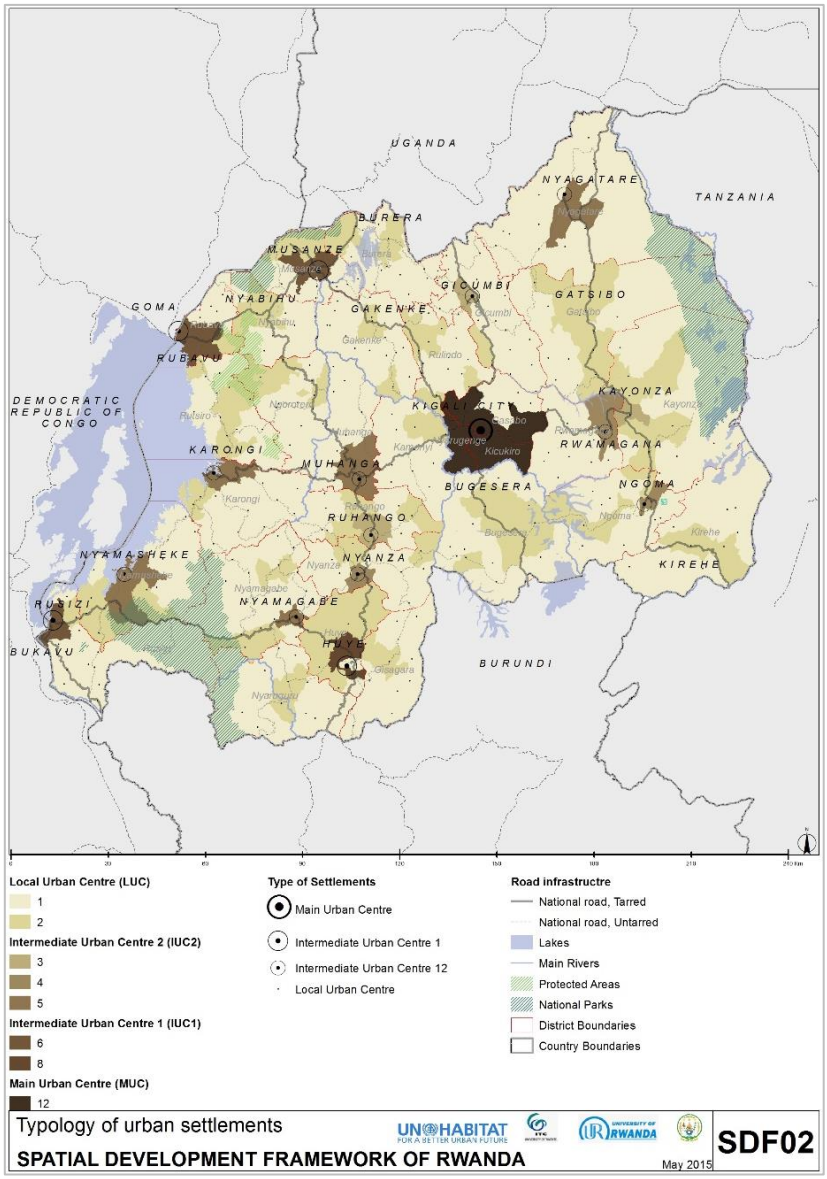


Figure 4. 8: Classification of Settlements

Source: Rwanda SDF methods – MoF output, 2016

The Spatial Multi-Criteria Evaluation (SMCE) of the SDF methods was adopted to evaluate the performance of the four pillars of NUP according to the urbanisation process in the main urban centres (Figure 4. 9). There are two objectives for the evaluation of the performance of the coordination pillar: '*adequate institutional capacities in cross-sectoral coordination and governance at all levels of government'* and *'ensure the use of appropriate urban planning and management tools*. Also, the performance for the densification pillar has two objectives: '*adequate efficiency on land use'* and *'planned and compact urban growth'*. Third, the conviviality pillar evaluation has two objectives: *'adequate and equitable socio-economic services'* and *'more inclusive and resilient human settlements'*. Lastly, the economic growth pillar evaluation has objectives: '*support green and sustainable economic development'*, '*adequate development of urban settlement as centres of innovation and entrepreneurship'* and '*enhance local revenue development and financial management'*.

> *"The SMCE was also used to evaluate the performance of the NUP from a spatial point of view based on its four pillars naming Coordination, Densification, Conviviality and Economic growth. The representation of the results of the evaluation was in the form of maps. The SDF reports also*

provided tables of performance per sector for each pillar, with comments on what is the situation and how to improve it"……. Respondent 8.

"The SMCE triggered the performance of territories and monitoring using NUP and National Strategy for Transformation (NST1)…..It opened up categories of cities and how they can be supported strategically for sustainable development"…….. Respondent 9.

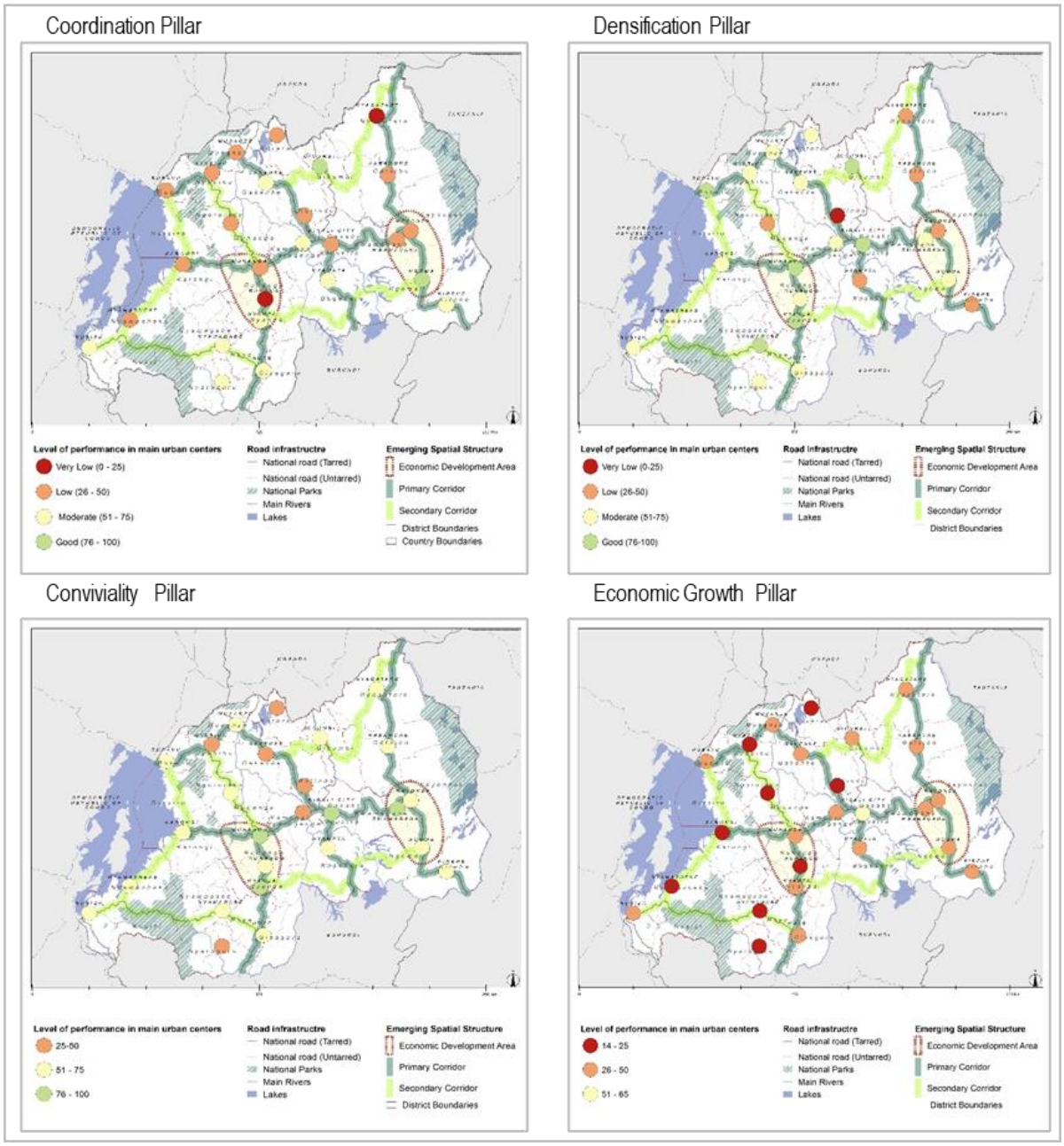
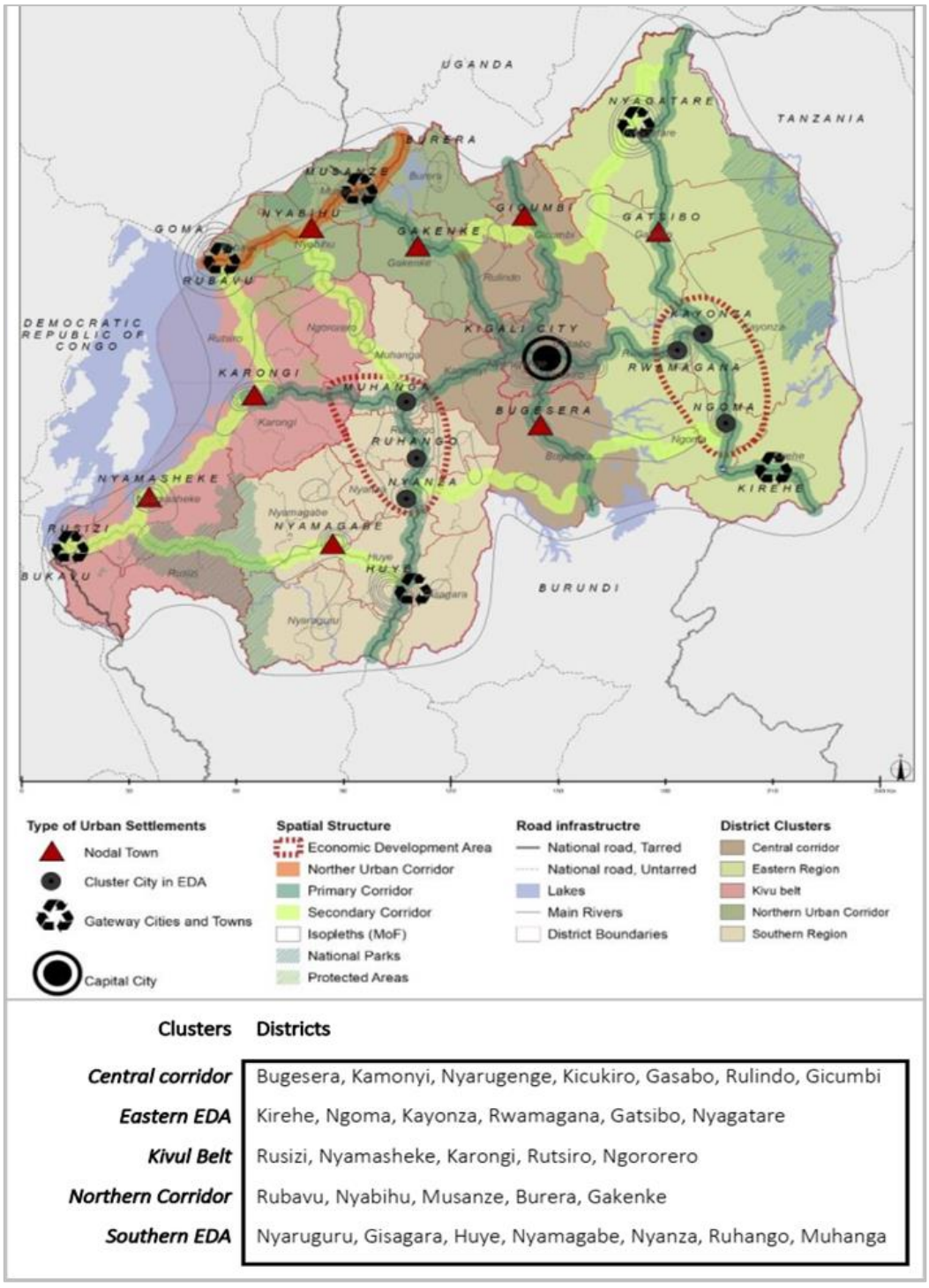


Figure 4. 9: NUP Pillars performance
Source: Rwanda SDF methods – SMCE output, 2016

In 2019, the second phase of the SDF methods (Figure 2. 1) involved the development of a National Strategic Action Plan (NSAP) from the redefined MoF (Appendix 7) to identify the cluster of districts (Figure 4. 10) from the emerging spatial structure (Appendix 2). The NSAP focused on the implementation of all SDF methods recommendations as strategic action plans across the levels of

government to achieve improved spatial development for efficient and equitable socio-economic transformation of Rwanda (UN-Habitat & ITC University of Twente, 2019).

> *"The NSAP makes use of the spatial structure and territorial potentials …, to cluster a certain number of districts together (regional clusters of districts), to identify strategic interventions, aligned with the NST1 and DDS, that will support regional economic development, complementarity for growth and investment attraction"……Respondent 8.*



Clusters	Districts
Central corridor	Bugesera, Kamonyi, Nyarugenge, Kicukiro, Gasabo, Rulindo, Gicumbi
Eastern EDA	Kirehe, Ngoma, Kayonza, Rwamagana, Gatsibo, Nyagatare
Kivul Belt	Rusizi, Nyamasheke, Karongi, Rutsiro, Ngororero
Northern Corridor	Rubavu, Nyabihu, Musanze, Burera, Gakenke
Southern EDA	Nyaruguru, Gisagara, Huye, Nyamagabe, Nyanza, Ruhango, Muhanga

Figure 4. 10: Clusters of District by the SDF methods
Source: Rwanda SDF methods – NSAP output, 2019

4.4.2. What are the Signs of Embedding the SDF methods as a PSS

The adoption of the SDF methods for the spatial translation and implementation of the non-spatial policies (NUP, NST1, and DDSs) at the national and local levels is a sign of embeddedness in Rwanda planning practice. Also, the installation of a semi-mobile decision room in MININFRA has made it possible to adopt the SDF methods for infrastructure planning and implementation. Furthermore, the SDF methods NSAP aims to build systems of processes that will align spatial planning and budgeting to enhance integration and coordination among different levels of government (UN-Habitat & ITC University of Twente, 2019). Thus, the adoption of SDF methods to characterise different types of settlements and infrastructure is to enhance urbanisation and economic prosperity.

> *"The SDF help us to see the Matrix of Functions, the national spatial structure, the situation of the fields: where functions are lacking, the concentration of functions, which functions are important, i.e. the hierarchy of settlement which has helped to identify the gaps in the four pillars of NUP and their performance. We are able to see the existing planning process and compare them with spatial planning at the national level. The comparison of compliance with various country visions such as NST1"……..Respondent 7.*

> *"MoF identified the availability or absence of key functions in all Sectors in Rwanda. Districts could decide which function to create and where it should be located. The emerged spatial structure for Rwanda identifies 6 Secondary cities which are close to the borders/gateway. Kirehe could be considered as an additional one, two Economic Development areas for potential investment; because of the existence of a cluster of urban settlements with an existing concentration of economic activities and functions; to deconcentrating Kigali at the East and West of Kigali, also creating a greater territorial balance in the central region of Rwanda, It also identifies Primary Corridors (i.e. where we should invest first) and secondary corridors"…..Respondent 8.*

> *"MININFRA is taking the lead in using the SDF methods for the spatial planning of infrastructure and other basic services for budget planning"……..Respondent 9.*

4.4.3. What are the Roles of the national government and UN-Habitat in the SDF Methods Adoption

Orlikowski (1992) highlights the ability of individual choices and actions to change expected outcomes in technical systems implementation and the embedding process. However, the implementation of technical systems most times ignore capturing such changes as part of the embedding process (C. U. Ciborra & Lanzara, 1994; Elbanna, 2008).

The collected data identifies issues hindering the SDF methods adoption in the planning process at the national and local levels (Figure 4. 11). The individual level challenges are users knowledge and ability to use geoinformation technology that influences the perception of SDF methods ease of use in planning practice. The perceived usefulness of respondents identifies other challenges that affect individual levels but solving them depends on the organisational level. Such challenges include the lack of spatial data, expert or trained users, hardware and software for SDF methods. Therefore, resolving the issues will require funding, users training and a need for an implementation policy for the SDF methods adopting in annual planning. Though all issues from individual users perception are triggers of drift, solving them requires the organisational level interventions. Thus, undertaking a comprehensive study to identify drift that will embed the SDF methods in planning practice at the national and local levels is required.

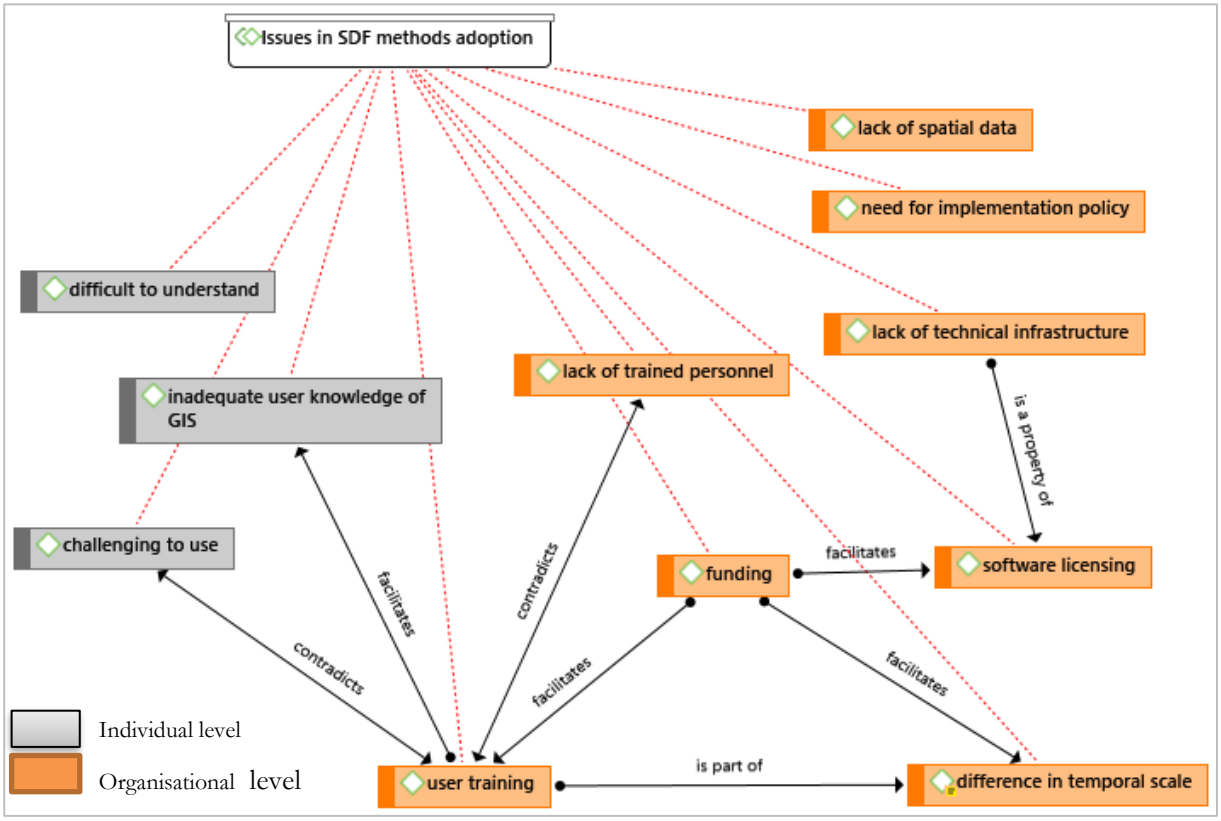


Figure 4. 11: Identified issues for the SDF methods adoption in LUP process.
Source: Fieldwork, 2020.

All respondents identify the SDF methods adoption in the planning process at the national and local levels as essential. Also, secondary data sources present outcomes of adopting the methods in the planning process to buttress the use of the SDF methods as PSS in the planning process (Appendices 2, 3, 7 and 8). However, embedding the SDF methods in the planning process at the national and local levels will be at different timeline according to the identified issues. Therefore, the need to understand the roles agencies in charge of the SDF methods adoption (UN-Habitat and MININFRA) to enhance the adoption across the levels of government.

MININFRA is taking the lead in SDF methods adoption in the planning process. Moreover, MININFRA and UN-Habitat continuously collaborate on SDF methods training and awareness for potential users as well as at the managerial level decision-makers. As of March 2020, the UN-Habitat country team is liaising with the Rwanda Land Management and Use Authority (RLMA) of the Ministry of Environment in charge of the National Land Use Master Plan (NLUMP) review on how to adopt SDF methods. Furthermore, there are ongoing efforts by MININFRA to increase SDF methods awareness among the national level agencies, especially with MINECOFIN the ministry in charge of national planning and budgeting.

During thesis fieldwork, preparation to represent the SDF methods capabilities to incorporate spatial components of planning with budgeting to ensure that identified financial opportunities are viable and adequately prioritised was ongoing.

Moreover, respondents mention MININFRA's continuous capacity building programme for the SDF methods and awareness creation at the national level towards getting approval from the national steering committee for PSS. There are high expectations that the efforts will yield more results soonest. Afterwards, sending the SDF methods to the cabinet for approval is the final stage. Respondents believe that the cabinet approval will enhance the SDF methods adoption at the national level (starting from

MINECOFIN) for the integration of spatial planning and budgeting. Thus, MININFRA is playing the vital role of promoting the adoption of the SDF methods at the national level towards achieving the urbanisation agenda with the spatial implementation of infrastructure according to the NUP.
All respondents identify MINECOFIN as a vital national level authority in charge of funding, monitoring and evaluation for all national planning process in Rwanda. Therefore, efforts are ongoing to include MINECOFIN in the SDF methods adoption to enhance embedding it in planning practice at the national and local levels in Rwanda.

"Its MININFRA who have initiated the SDF right. Of course, it is our policy that requesting the establishment of the SDF. Yes, but MININFRA has to work officially with the ministry in charge of finance and planning. Yeah, here I will mention MINECOFIN of course, and the following step is just to present to the ministry in charge of finance officially. MINECOFIN, even if it is not one, which is the custodian of the land use plan, but remember that all plans, even those relating to land have to be also adopted and financed by MINECOFIN. I can plan good things, but when you have the money, you are the boss that allocate a budget for different things automatically, you are the custodian of all the country planning processes"……..Respondent 6.

"The training and capacity building for follow-up on the SDF methods application is a continuous process"……...Respondent 7.

"Next step is to ensure that the tool is also in use and its results integrated into the revised version of the Land Use Master plan. We are in contact with the responsible person under the Land, Water and Forest Directorate General within the Ministry of Environment, we are in discussion on how to support the Ministry in this regard"…….Respondent 8

All sectors, ministries, districts submit annual development plans to MINECOFIN based on the mandate. Thus, it is important that MINECOFIN adopts the SDF methods in the budget planning process"…….Respondent 9.

5. DISCUSSION

5.1. Introduction

This thesis studies the role of drift in embedding planning support systems (PSS) in planning practice using the spatial development framework (SDF) methods in Rwanda as a case study. It gives an overview of Rwanda land use planning (LUP) process at the national and local levels *to understand the need for the SDF methods adoption in practice*. Also, it adopts the drift actor research to describe the SDF methods users understanding and perceptions (ease of use and usefulness) that trigger *drift in embedding* the methods as a PSS in planning practice. Lastly, the outcomes of the SDF methods adoption identifies *where the methods are embedding* as PSS in practice.

However, the discussions on the findings of the study are strictly within the case study perspective. This thesis results in the discussion are strictly for the SDF methods as a PSS in Rwanda planning practice for two reasons. First, the study is not interpretive research that allows comprehensive results comparison and analysis to establish a broad view of the role of drift in embedding PSS in practice. Second, the limited number of the respondents in this study will not present a broad and accurate representation of potential users of the SDF methods at the national and local levels planning practice in Rwanda. Hence, a need for further research to establish the role of drift in embedding PSS in planning practice, especially in countries with weak planning systems.

Thus, this thesis is a pilot study to prove that ignoring the role of drift is a contributing factor to the implementation gaps of embedding PSS in practice. The research methodology (Section 3.1) discusses other theoretical views for studying drift in technical systems and identifies the interaction-context research that adopts the Actor-Network Theory (ANT) as the comprehensive method to study drift. Section 3.1.1 describes the thesis limitations and the reason for adopting the actor research instead of interaction-context research.

5.2. Need for SDF Methods Adoption in Planning Practice

In chapter four, Sections 4.2.1 to 4.2.3 provides a summary of the LUP process, benefits and limitations at the national and local levels to establish the need for SDF methods adoption as a PSS for planning practice. The results show that adopting the SDF methods as a PSS in the planning practice is a solution to the lack of up-to-date spatial data for the spatial implementation of plans, policies as well as enhance the LUP process. Therefore, according to the results for the *Research Objective 1,* the following are understanding of the SDF methods as a PSS at the national and local levels planning practice. The SDF methods adoption will:

a) Improve spatial data collection and availability at the national and local levels planning practice;
b) Enhance the identification of planning problems and proffer collaborative solutions for the decision-making process;
c) Facilitate spatial analyses to create various intervention scenarios for spatial planning proposals, evaluation of plans and implementation;
d) Improve as well as support public participation in the planning process across the levels of government; and
e) Facilitates the prioritisation and selection of spatial locations for implementation of plans and policies to demonstrate efficient use of available resources for the funding of urban development as well as socio-economic transformation across the country is ongoing.

As mentioned earlier, the strength and usefulness of the SDF methods as a PSS in planning practice for the national and local government levels are known (Boerboom et al., 2017; Musvoto, Lincoln, & Hansmann, 2016; Ruhiiga, 2014; Spaliviero et al., 2019). Likewise, this study shows that the users' knowledge the SDF methods capabilities in the LUP process do not a negative influence on the users' acceptance and embedding process as PSS in planning practice across the levels of government.

However, the users' perceived ease of use and usefulness of the SDF methods that trigger drift to embed PSS in planning practice can enhance or inhibit the success if ignored.

5.3. Drift in Embedding SDF Methods in Practice

The highlighted issues affecting PSS user acceptance in spatial planning processes include lack of awareness; lack of knowledge of PSS capabilities in practice; lack of intention to use; lack of experience in actual use; perceived ease of use (PEOU); perceived usefulness (PU); insufficient organisational support; and lack of spatial data (Geertman & Stillwell, 2009; Vonk, 2006; Vonk & Geertman, 2008). Also, the characteristics of the interdisciplinary background of professionals and stakeholders involved in the planning process have contributed to issues of PSS user acceptance in practice (Pelzer, 2017; Pelzer & Geertman, 2014; Vonk, Geertman, & Schot, 2007). The interdisciplinary background that influences PSS perceptions and acceptance for actual use in planning practice include varying user knowledge of geoinformation technology, experience, existing habit and job relevance, organisational structure and culture, management attitude (Davis & Venkatesh, 2000; Vonk et al., 2005).

According to the conceptual framework (Figure 1. 1), this thesis only considers the individual level user acceptance (perceived ease of use (PEOU) and perceived usefulness (PU)) that triggers drift in embedding PSS in practice. It adopts the drift actor research theoretical view that implements the users' PEOU and PU to predict users' acceptance, intention to use and actual use of the SDF methods during implementation (van Baalen & van Fenema, 2005). Hence, this section discusses *Research Objective 2,* the users PEOU and PU of the SDF methods that trigger drift and influence the organisational and individual levels adoption and actual use in the LUP process across the levels of government.

The results (Section 4.3.2) indicates that the SDF methods PEOU is contributing to the user acceptance even though some of the potential users perceive the PSS as challenging to learn or understand and have not understood the job relevance based on the lack of knowledge and experience in geoinformation technology. In Section 4.3.3, the SDF methods PU has a more positive influence on user acceptance, willingness and intension to adopt the SDF methods as PSS to enhance job performance in the LUP process. It implies that the PU of the SDF methods capabilities influences user acceptance than the PEOU.

Nevertheless, it is vital to highlight factors from the study that can inhibit the SDF methods adoption in LUP process at national and local levels (Figure 4. 11).

a) The lack of geoinformation technology knowledge by some potential users;
b) Inadequate experience with the use of SDF methods especially at the local levels;
c) The SDF methods PEOU as challenging to learn and use at the individual level that can influence the organisational level adoption;
d) The lack of spatial data especially at the local levels;
e) The need for financial and infrastructure support (software and hardware) from the national level for the adoption of the SDF methods at the local levels; and
f) The need for continuous training of users (individual and organisational levels) to increase the number of experienced users and actual use at the levels of government.

Though the highlighted factors (Section 4.3.1 to 4.3.3) fall within the various underlying factors of user acceptance (Appendix 9) limiting the use of PSS in planning practice (Vonk & Geertman, 2008), there are

other factors relating to the planning process at the national and local levels in Rwanda. Such factors reflect a need for adjustments and compromises and if ignored, can lead to the inability of the SDF methods adoption in the local levels planning process (Figure 4. 7).

Therefore, the description of results in Section 4.3.4 serves as an "initial warning" to highlight users' concerns of the LUP process that can trigger drift in the SDF methods adoption for Rwanda planning practice. This thesis adopts the strategies for dealing with drift (Section 2.6.1) to describe strategies to manage the drift to embed the SDF methods as a PSS in Rwanda planning practice.

5.3.1. Strategies for Dealing with Drift

Van Baalen and van Fenema (2005) identifies the complexities in technical systems implementation that triggers unplanned effects that produce drift and propose three strategies to manage drift. The strategies include control, incremental and drift containment.

- **Control strategy** assumes avoiding drift at the organisation adoption stage is possible;
- **Incremental strategy** accepts drift as part of the unpredictable implementation process; and
- **Drift containment strategy** assumes drift is "time-space" bound depending on the implementation process.

The implementation of drift strategies has three approaches: communication, organisational learning and knowledge management. *Communication* is the process for the individual learning (gained experiences through training or actual use) of users on the usefulness of new technology is disseminated among one another and in turn influences acceptance, adoption and actual use. *Organisational learning* combines individual learning and abilities to establish the adoption and use of the new technical system as a routine. Lastly, *knowledge management* is a deliberate process for the collation, storage and dissemination of the acquired knowledge at a particular time and space during the organisational learning stage.

1) **Control strategy:** adopts the *communication* approach for the sharing of information of users experiences from the implementation process to achieve a common understanding of the technical system at the *organisational learning* phase to achieve actual use. The *knowledge management* approach in the control strategy adopts appropriate communication channels to collect, store and disseminate the acquired knowledge to train users.
2) **Incremental strategy:** uses interactive *communication* to understand unplanned outcomes and proffer solution for adaptive *organisational learning* processes and disseminate *knowledge management* for immediate implementation.
3) **Drift containment strategy:** adopts interactive *communication* approach to address unplanned outcomes for deliberate planning at the *organisational learning* phase to create new *knowledge management* and experience for users and adoption during technical systems implementation processes.

An overview of the implementation approaches for dealing with drift from van Baalen and van Fenema (2005) research is in Appendix 10. However, deciding which of the strategies will work in for the case study area requires a comprehensive study of drift in embedding PSS in practice. Meanwhile, according to the strategies overview (Appendix 10) and the issues relating to embedding the SDF methods in the planning practice at the national and local levels (Figure 4. 7) indicates that this thesis can only implement the control strategy (*communication approach*) to proffer solution.

5.3.2. Drift Control Strategy for Embedding SDF Methods as PSS in Rwanda Planning Practice

Vonk and Geertman (2008) describe the low rate of PSS acceptance in planning organisations as a result of inadequate communication between PSS experts and the management of the organisation. Also, Geertman and Stillwell, 2009 study highlights that PSS adoption in government planning organisations in most cases starts from geoinformation experts that identify the added-value in practice (bottom-up) rather

than at the organisation management level (top-down). Consequently, to resolve such issues require experts communication at the organisation levels to enhance PSS adoption in practice. The findings of this thesis support the need to start the SDF methods adoption in practice at the national level in Rwanda. Figure 5. 1 describes a drift control strategy that can be adopted to *communicate* activities that will enhance the *organisational learning* that supports the drift *knowledge management* to embed the SDF methods as a PSS in planning practice at the national and local levels.

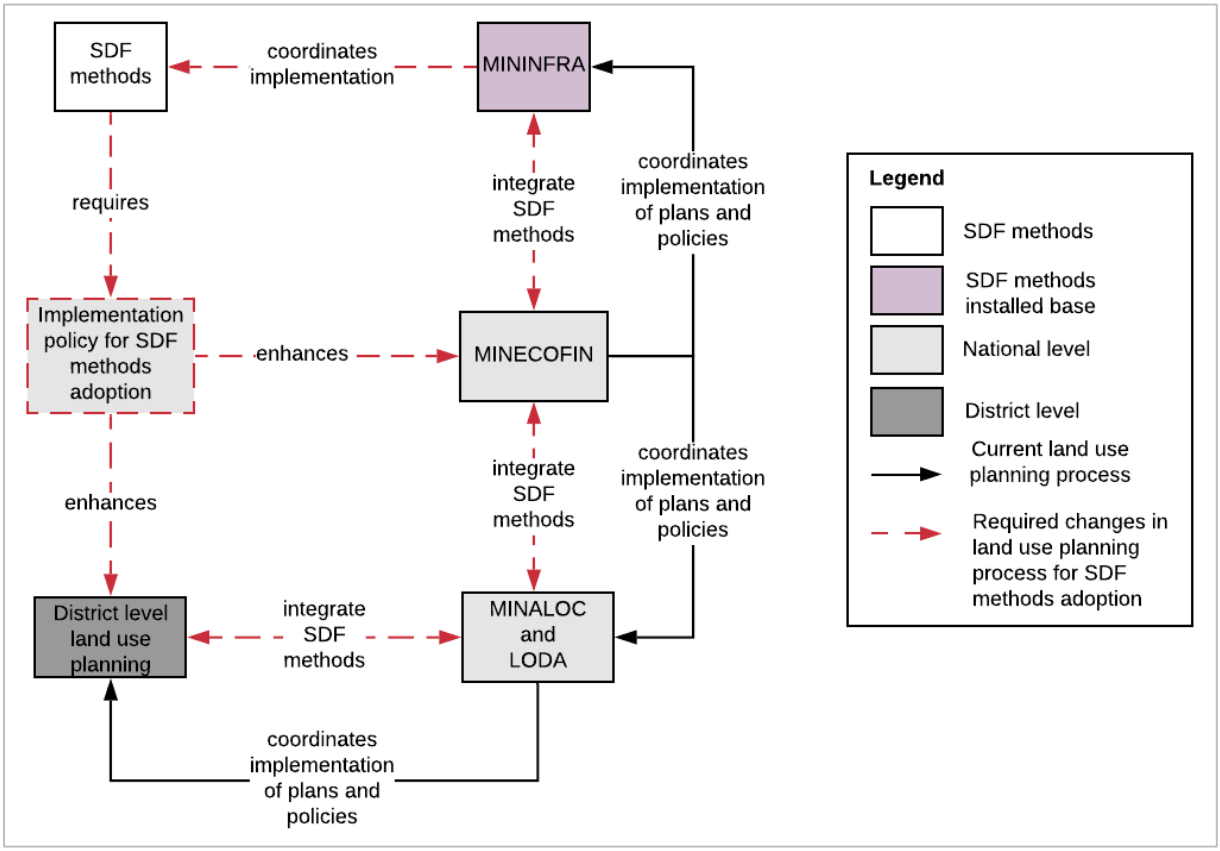


Figure 5. 1: Required organisational level changes in SDF methods adoption for the LUP process
Source: Author, 2020.

Though at the Ministry of Infrastructure (MININFRA) the SDF methods is a PSS for spatial translation and implementation of national policies such as Vision 2050, National Urbanisation Policy and the National Strategy for Transformation (NST1), more is required to embed the SDF methods in Rwanda planning practice. According to Section 4.3.4, a significant change is the inclusion of other national level authorities in the SDF methods adoption. At the national level, the ministry in charge of national planning and budgeting for the implementation of development plans and policies at all levels of government is the Ministry of Finance and Economic Planning (MINECOFIN). Therefore, including MINECOFIN in the SDF methods adoption will enhance embedding it in planning practice at the national and local levels. Also, it will require additional improvements in the capabilities of the SDF methods and incorporate new components that will align spatial planning and budgeting as well as enhance coordination and collaboration among all levels of government (UN-Habitat & ITC University of Twente, 2019).
Moreover, Figure 5. 1 further highlights the need for the Ministry of Local Governments (MINALOC) and its affiliated agency, Local Administrative Entities Development Agency (LODA) adoption of the SDF methods. LODA is responsible for the LUP processes budgeting, funding and implementation at the local levels and will need to be involved in the organisational adoption of the SDF methods to ensure the actual use of the methods at the local levels.

Ciborra (2002a) framework on technical systems implementation (Figure 2. 5) highlight that users' resistance required new implementation tactics to enhance compromises at the individual and organisational levels of adoption for actual use. According to Figure 4. 11 identifies the need for implementation policy for SDF methods adoption as a tactic at the national level that will enhance SDF methods adoption in the annual budgeting processes at the national and local levels (Section 4.3.4). The policy will be part of the standards in the "*Budget call circular*" issued MINECOFIN for annual budget planning, evaluation, approval and funding. The annual budget planning involves all ministries, departments, agencies (MDAs) at the national level and local levels. Hence, the national level adoption of the SDF methods from MINECOFIN will enhance embedding the methods as a PSS for planning practice in Rwanda.

5.4. Where the SDF Methods are Embedding as PSS in Rwanda

Among other goals to rebuild Rwanda and achieve economic transformation, is the quest to have a 35% urbanised country by 2024 (Republic of Rwanda, 2012). According to *Research Objective 3*, MININFRA is adopting the SDF methods for the spatial implementation of non-spatial national policies to actualise the vision (Section 4.4). The SDF methods capabilities as PSS for the spatial implementation of the National Transformation Strategy (NST1) at the national and the local levels (Figure 2. 3). Section 4.4.1 highlights the adoption of the SDF methods for the spatial analyses of the settlement and categorise them according to available potentials. Also, the evaluation of the NUP pillars performance improves interventions for annual sectoral development plans for infrastructure. Such the annual development plans have spatial locations for interventions which are mitigating the duplication of functions and efficient use of available resources.

Moreover, efforts are ongoing to adopt the SDF methods to integrate spatial planning components with the annual budget planning at the national and local levels. Hence, the adoption timeline is another vital component in embedding the SDF methods as a PSS in Rwanda planning practice. For instance, continuous training for potential users of the SDF methods has availed some officials in charge of reviewing the National Land Use Master Plan (NLUMP) the knowledge of the SDF methods and its capabilities for the tasks to enhance LUP processes. However, adopting the SDF methods for the NLUMP review was not possible as the approval by the cabinet is pending. Same applies to the annual budget planning for 2020-2021 at the national and local levels. Therefore, to commence the adoption of the SDF methods for the 2021-2022 annual development plan and budgeting at all levels of government, the cabinets approval of the SDF methods as PSS before the budgeting process starts in October 2020.

The SDF methods capabilities and usefulness in the planning process explains the eagerness for actual use in the District Development Strategies (DSS). Nevertheless, respondents at the local levels reiterate that the instruction to adopt the SDF methods for DDS development must be included in the '*Budget call circular'* as a statutory directive otherwise it is impossible to use based on individual user acceptance. Thus, the adoption of the SDF methods for spatial planning and budgeting is pending because the cabinet is yet to approve the SDF methods for planning practice. The political validation and approval by the Rwanda government cabinet mark the end of the SDF methods implementation process (Figure 2. 1) and the adoption as a PSS for planning practice commence fully.

5.5. Research Limitations

At the onset of the thesis, the research frame for data collection identifies the importance of interdisciplinary backgrounds of potential users of the PSS. The selection of respondents at different stages of the planning process (national and local levels), identifies the management level respondents

from MININFRA, UN-Habitat, MINECOFIN, Ministry of Local Governments (MINALOC), Local Administrative Entities Development Agency (LODA), Heads of Departments from the local levels and One-Stop centres. However, during the fieldwork, potential users knowledge of the SDF methods were restricted to fifty-four training and workshops participants held between 2018 and 2019 who were not part of the managerial levels at the national and local levels. Hence, the modification of the research structure to consider selecting respondents from trainees at the local levels and existing users of the SDF methods at the national level (MININFRA). The research could not establish the insights of other potential users across all the national and local levels planning process.

Also, the language was a barrier during fieldwork because some respondents declined being interviewed or preferred no audio recording because they prefer responding in Kinyarwanda or French and not English. It is an assumption that if the researcher communicates fluently in Kinyarwanda or French, respondents might provide a more detailed explanation of the interview questions. Though, a control measure explored during data collection is the use of an interpreter; interviews with the aid of an interpreter were not very fruitful as interpreted responses were brief and mostly out of research context.

Moreover, the transcription of the recorded interviews was challenging because the respondents' pronunciations are different from the English translations of the transcription software. All interviews were transcribed in two phases (software and manual) to ensure accuracy in data analyses and results.

Lastly, though the internship opportunity attached to fieldwork present the opportunity to explore data collection by participation and observation. However, the occurrence of the pandemic (COVID – 19) led to an abrupt end of internship and fieldwork that deprived participation and observation in the scheduled collaboration workshop on SDF methods adoption with other national level ministries. The workshop participation would have presented an ample opportunity to understand the SDF methods from the management level perceptions.

6. CONCLUSION

6.1. Conclusion

This thesis presents an overview of the role of drift in embedding PSS in planning practice. It explores the drift actor research to understand the users' acceptance that triggers drift in embedding PSS in practice. It further predicts unplanned changes that can hinder the actual use of PSS in practice at the national and local levels planning processes in Rwanda.

The main findings of this study show that respondents identify the need for the SDF methods in planning practice at the national and local levels planning practice. The users' understanding and perceived ease of use and usefulness highlight the willingness and intention to use the SDF methods as a PSS to enhance job performance in the planning practice. It identifies the signs of embeddedness of the SDF methods in the national level planning process, specifically at the Ministry of Infrastructure (MININFRA). However, the users' acceptance highlight changes in the adoption process that triggers drift to embed the SDF methods as a PSS in the national and local levels planning process.

The drift highlights the vital role and influence of the SDF methods installed base on the adoption process, and actual use. The study results (Section 4.3.4) emphasise the need to include the Ministry of Finance and Economic Planning (MINECOFIN) in the SDF methods adoption process to enhance the planning process at the national and local levels. The importance of the SDF methods adoption by MINECOFIN is because it is responsible for the planning and budgeting for the implementation of development plans and policies at the national and local levels (Section 5.3).

Hence, the continuous collaboration between MININFRA and MINECOFIN towards the adoption of the SDF methods as a PSS to integrate spatial components of the planning process with budgeting is vital to achieving the actual use of the SDF methods as PSS in Rwanda. It will result in the improvements of the SDF methods capabilities to incorporate additional components to achieve the integration of budgeting planning with the spatial components of development plans to enhance coordination and collaboration among all levels of government. It is of note to mention that, getting the cabinet approval for the SDF methods adoption for the planning process in Rwanda before the end of 2020 will enhance the use for the 2021-2022 annual budget planning.

In summary, this thesis establishes the SDF methods usefulness in practice as PSS to undertake predefined tasks as well as having the potentials to improve the capabilities to achieve other interdisciplinary planning processes. The emphasises on the actual use of PSS to attain the development vision of an urbanised Rwanda by 2024 can be further explored to enhance the SDF methods capabilities and usefulness in the planning process at the national and local levels.

6.2. Contributions to Research

The PSS scientific community, identify implementation gaps for the limited use of PSS in practice as issues relating to instrument capabilities, the mismatch between capabilities and users expectation, as well as user acceptance. Vonk and Geertman (2008) describe a cycle of mismatch between PSS development and adoption in planning practise (Appendix 11). The cycle explains that the lack of adoption of developed PSS results in the lack of knowledge and experience in usage required to improve the PSS capabilities for actual use in practice. However, none of the existing research considers the role of drift that limits PSS adoption in practice. Therefore, this thesis explores a new perspective that considers user acceptance of PSS capabilities and usefulness that triggers drift as a contributing factor for actual use and embeddedness in practice.

According to the cycle of mismatch in PSS development and use, exploring the role of drift in embedding PSS in planning practice is a method to identify improvisations and compromises to achieve actual use. Thus, this thesis considers drift as a crucial phase to embed PSS adoption in practice. It contributes to the knowledge of "*how*" PSS adoption triggers drift to establish the "*why*" of limited PSS use in practice and identify "*what*" must be done to achieve actual use of PSS in practice.

Though the thesis timeline limits the research methodology (Section 3.1) as such, it is not a comprehensive study of the role of drift in embedding PSS in practice. It establishes a new research perspective on the role of drift in embedding PSS in practice. Consequently, this thesis can inspire comprehensive interpretive research on existing PSS adoption in practice to verify the role of drift in embedding PSS in practice around the world. Hence, researchers in the following fields can validate the findings of this thesis.

- Urban planning and development;
- Planning Support Systems;
- Geoinformation Science and Technology Infrastructure;
- Spatial Planning Decision Support Systems Infrastructure.

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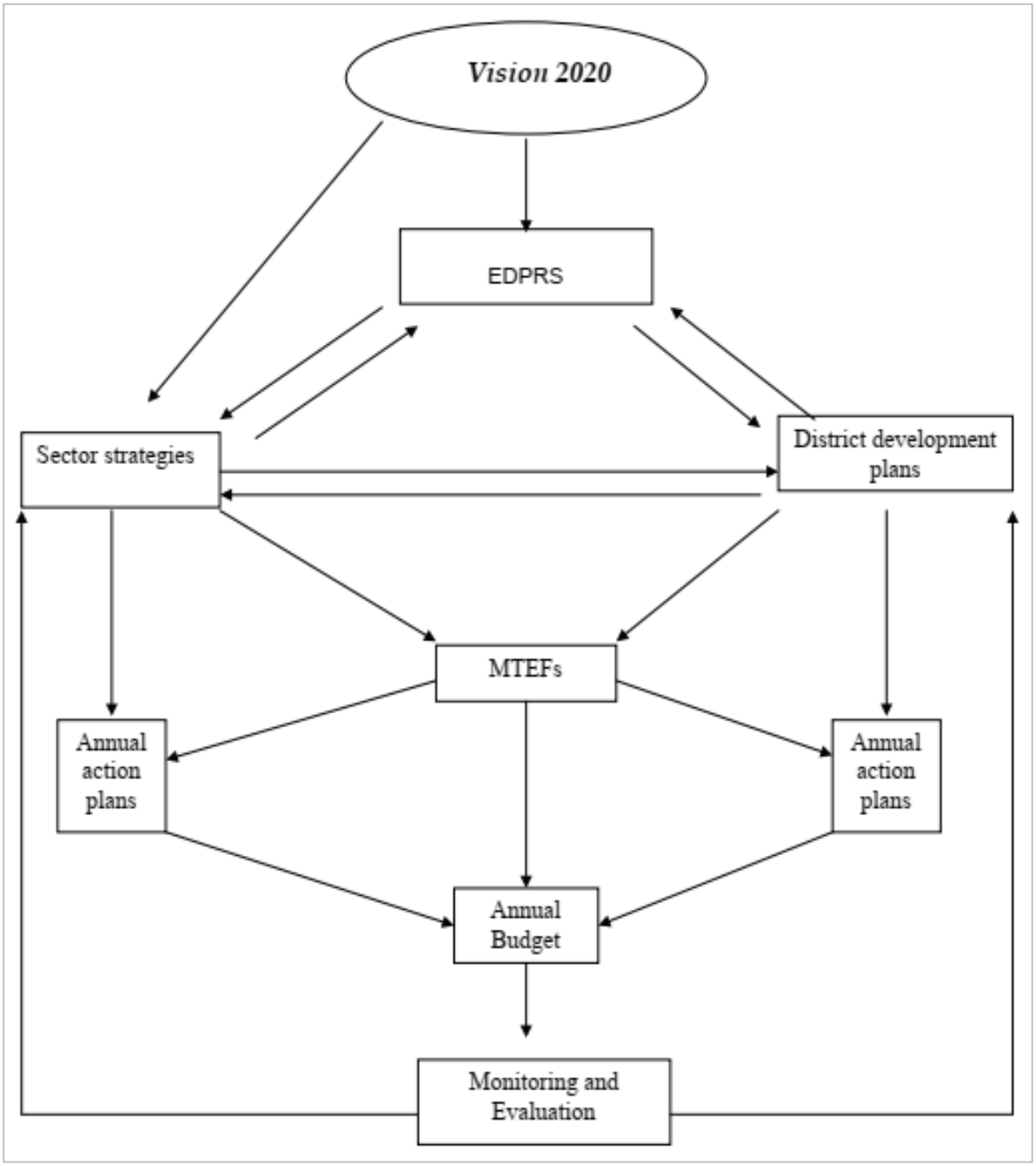
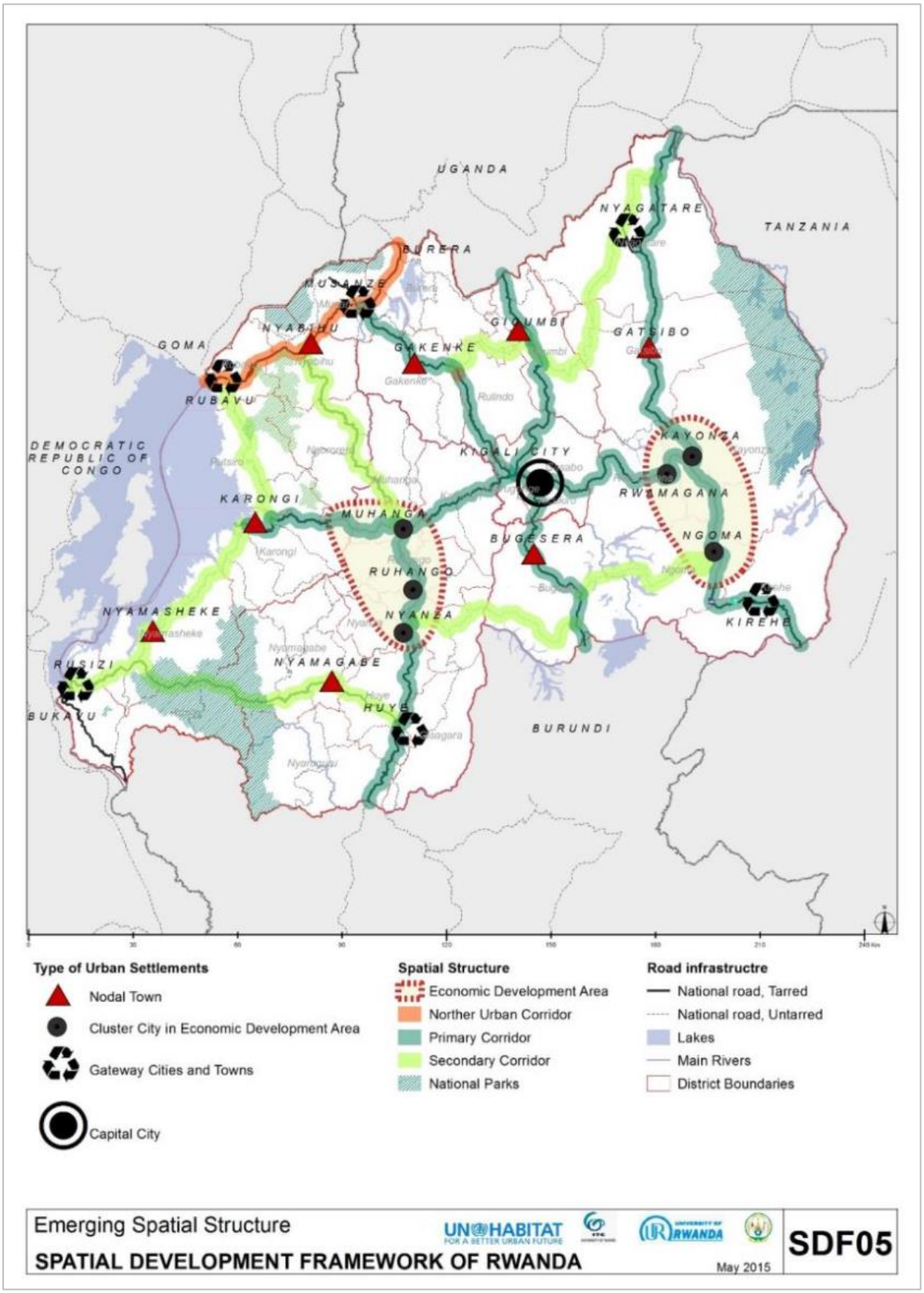
APPENDICES

Appendix 1: The Medium-Term Expenditure Framework (MTEF)

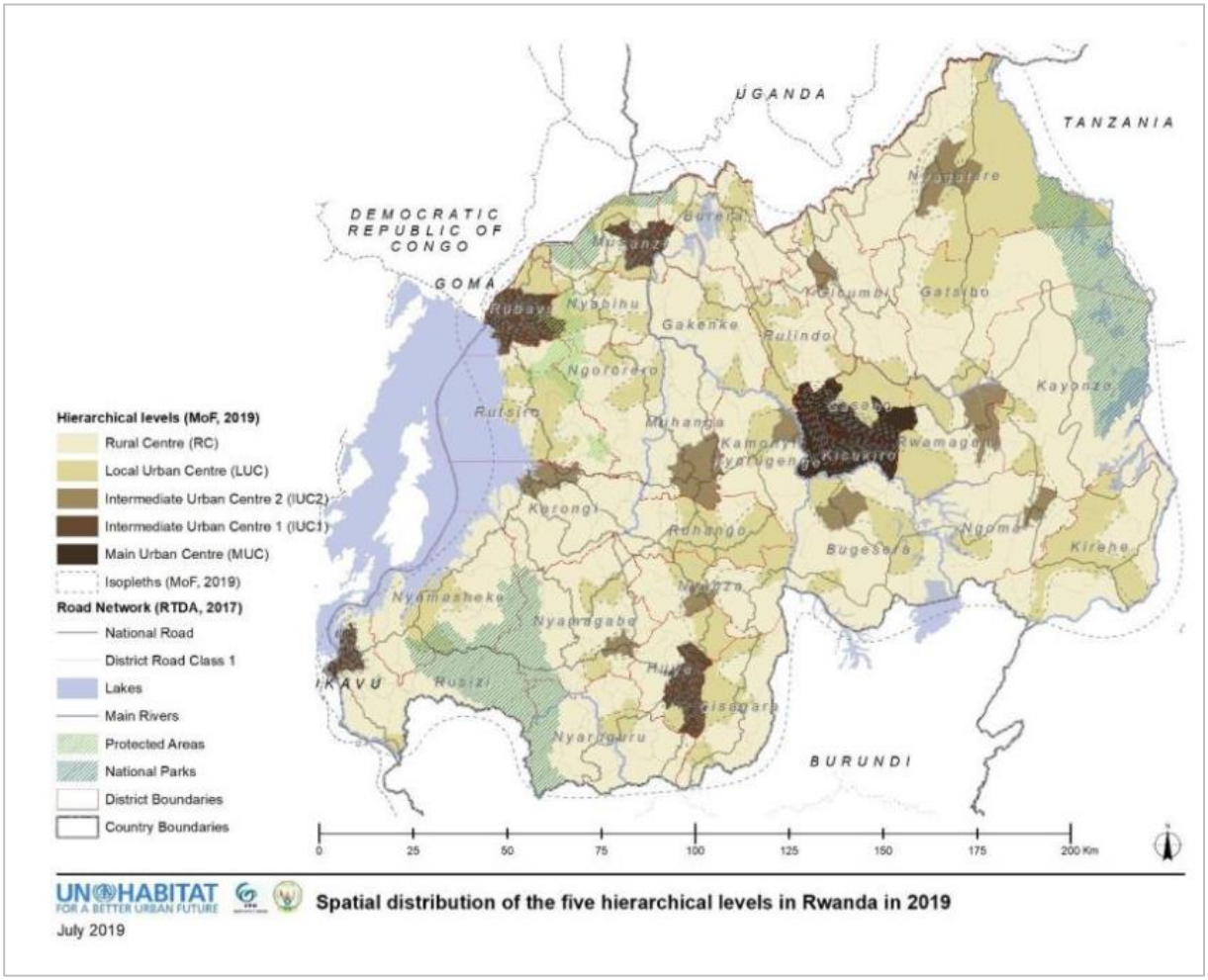


Sources: Republic of Rwanda (2012, p. 20)

Appendix 2: The Emerging Spatial Structure of Rwanda, 2015.



Appendix 3: Settlement Hierarchies in Rwanda, 2019.



Appendix 4: Research Information Sheet for Respondents.

Informed consent form

Research Information Sheet

Purpose of the research

The MSC. research titled ***Embedding Planning Support Systems (PSS) in local levels spatial planning process: The case of the Spatial Development Framework (SDF) methods in Rwanda.*** It is a study to understand the success of making planning support systems (PSS) a routine in spatial planning processes at the local levels. The case study for the research is the Spatial Development Framework (SDF) methods in Rwanda.

The research objective is to understand the role of SDF methods in spatial planning processes such as spatial policy formulation, evaluation, implementation and monitoring in Rwanda and how it can be become a routine across the levels of government. This is aimed bridging the gaps in spatial policy implementation, monitoring and evaluation at the local levels.

As a respondent, your participation in the interview will contribute immensely to achieving the research objective.

Benefits and risks of participating

The following points highlight the likely benefits and risks of participating in the interview. The responses in the form will express your consent as a respondent.

- The research has been reviewed and approved by the ITC Ethics Committee.
- You are free to withdraw from the study by notifying the interviewer to stop.
- No personal information about participants will be collected, processed.
- The usage of the interview data will be restricted to use for the research, while maintaining confidentiality and anonymising data.
- Controlled access to data, especially in relation to data archiving and reuse, ways of dissemination, data archiving and possible publishing will be ensured by the researcher and the university.
- Retention period for the research data, or if that is not possible, criteria used to determine that period

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Appendix 5: Consent form for Respondents.

Consent Form
for
Embedding Planning Support Systems (PSS) in local levels spatial planning process: The case of the Spatial Development Framework (SDF) methods in Rwanda.

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I have read and understood the study information dated [__/__/____], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
I understand that taking part in the study involves an audio-recorded interview, transcribed as text for research analysis and archived for research purposes only.	☐	☐
Use of the information in the study		
I understand that the information I provide will be used for research outputs for ***Embedding Planning Support Systems (PSS) in local levels spatial planning process: The case of the Spatial Development Framework (SDF) methods in Rwanda.***	☐	☐
I understand that personal information collected about me that can identify me, such as [role and task], will not be shared beyond the study team.	☐	☐
I agree that my information can be quoted in research outputs	☐	☐
I agree to be audio recorded.	☐	☐
Future use and reuse of the information by others		
I give permission for the anonymised transcripts of the audio recording that I provide to be archived in [*ITC data repository*] so it can be used for future research and learning.	☐	☐

Signatures

_____	_____	_____
Name of participant [printed]	Signature	Date

For participants unable to sign their name, mark the box instead of sign

I have witnessed the accurate reading of the consent form with the potential participant and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

_____	_____	_____
Name of witness [printed]	Signature	Date

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Appendix 6: Declaration of the Researcher's Ethical Responsibility.

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands what they are freely consenting to.

_____	_____	_____
Researcher name [printed]	Signature	Date

Study contact details for further information: [*Name, email address*]

Deborah Oyeku, d.a.oyeku@student.utwente.nl

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee of the Faculty of Geo-Information Science and Earth Observation: ec-itc@utwente.nl

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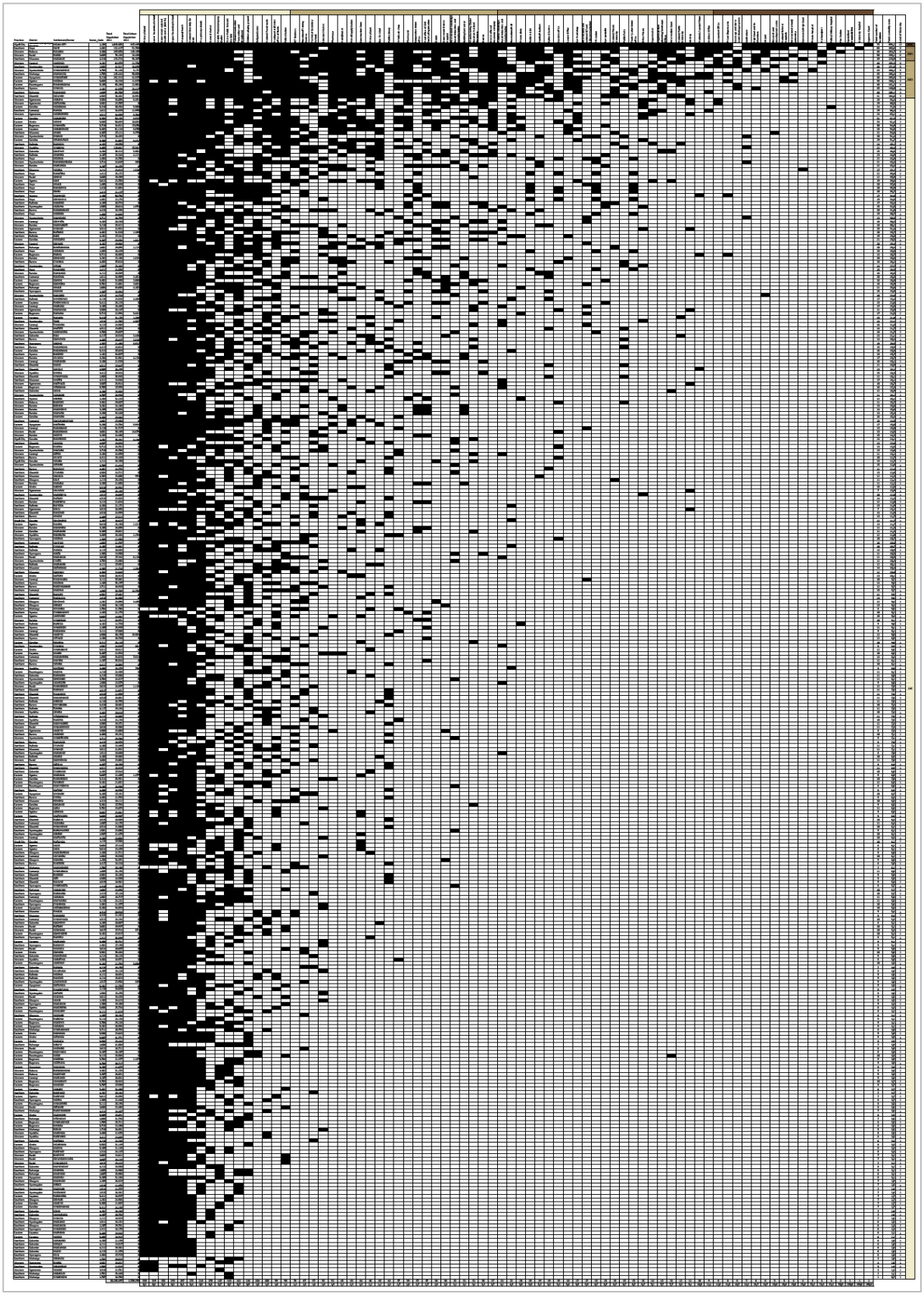
Appendix 7: Matrix of Functions (MoF) of Rwanda.



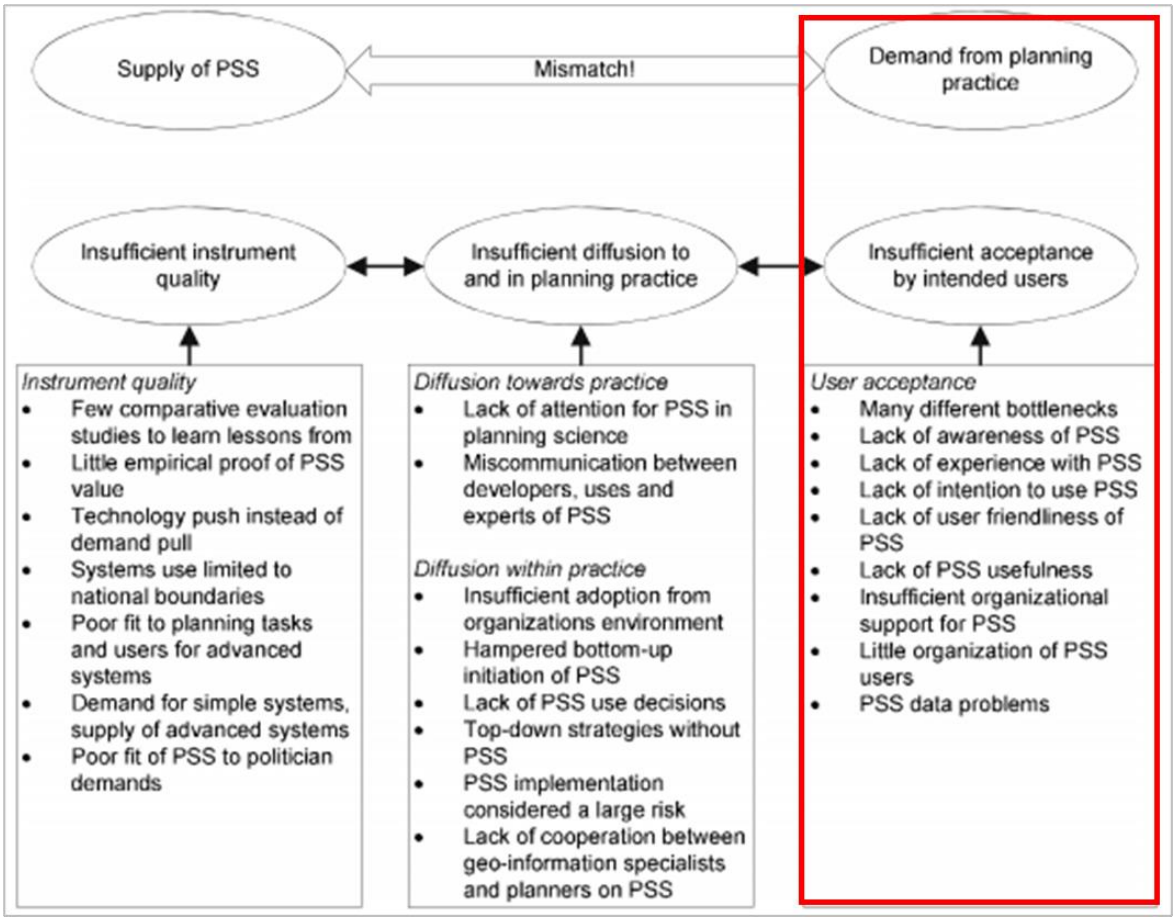
Source: Rwanda SDF - Matrix of Function (MoF), 2016.

Appendix 8: Hierarchy of Settlements in Rwanda.

Type	**Local Urban Centre (LUC)**
Main characteristics	**Small Towns** providing **basic services and infrastructure** to the rural population.
Name of settlements	More than 95% of the sectors across the country are classified as *Local Urban Centres (LUC)*.
Functional complexity	The analysis of the **type of functions covered, mainly basic services and public facilities**, shows the current dependency of the population of this type of settlements mainly from agriculture activities rather than industrial/commercial activities.
Population characteristics	According to the 2012 Census, the sectors belonging to this category show an urban population around **10,000 inhabitants**.
Spatial distribution and urban structure	The spatial analysis shows that sectors belonging to **level 1** are **widespread all over the country and have, in general, no access to main roads**; meanwhile, the sectors belonging to the **level 2 are located along the national roads, with built-up areas characterised by linear commercial buildings** on top of the hills along the national roads and houses spread across the hills
Type	**Intermediate Urban Centres 2 (IUC2)**
Main characteristics	"**Medium-sized towns**" providing a range of **services and opportunities for employment** within the urban population and the surrounding rural sectors.
Name of settlements	*Ruhango, Gicumbi, Nyanza, Rwamagana, Ngoma, Karongi, Nyamagabe, Nyamasheke, Muhanga and Nyagatare. Muhanga* and *Nyagatare*, which are Secondary Cities, belong to this category.
Functional complexity	The presence of functions categorised as *Road Connection and Transportation Services* allows the presence of more functions than the previous typology, thus it is considered the **third level socio-economic and urbanisation development**.
Population characteristics	These sectors have experienced a strong population growth since 2002. Some settlements belonging to this category were *Urban Centres* already by that time, with an urban population ranging between **10,000 and 60,000 inhabitants**.
Spatial distribution and urban structure	In general, these settlements are **strategically located at the cross-junctions of the main national roads**. Their **built-up areas are characterised by a commercial centre located at the cross-junction and spreading of planned and unplanned residential areas**.
Type	**Intermediate Urban Centres 1 (IUC1)**
Main characteristics	**International cross-border towns** providing a range of services and opportunities as international/national gateways and employment within the surrounding areas
Name of settlements	*Rubavu, Rusizi, Musanze* and *Huye*
Functional complexity	**Second level of urban settlements**, as they provide a higher range of social, economic, infrastructure and support facilities than the previous typology.
Population characteristics	According to the 2012 Census, urban population was estimated between **30,000** (Rusizi) and **150,000 inhabitants** (Rubavu)
Spatial distribution and urban structure	The analysis of the urban structure shows an **"older" grid area (generally from the colonial times) with a mix of residential and commercial activities.** These cities have generally grown either with planned or unplanned residential areas.
Type	**Main Urban Centres (MUC)**
Main characteristics	**Capital city of the country, and international** hub considering its air connectivity in and even inside Africa
Name of settlements	**Kigali City**
Functional complexity	**Highest level of socio-economic and urbanisation development**, covering the highest number of functions and the most unique ones
Population characteristics	The population of Kigali City grew from **34,319 inhabitants in 1960 to close to 1 million inhabitants in 2012**.
Spatial distribution and urban structure	Its central location and access to most districts in no more than three-hour drive has enabled Kigali to develop the **strongest urban structure of the country**.

Source: Rwanda SDF - Matrix of Function (MoF), 2016.

Appendix 9: Underlying Factors for Mismatch in PSS User Acceptance



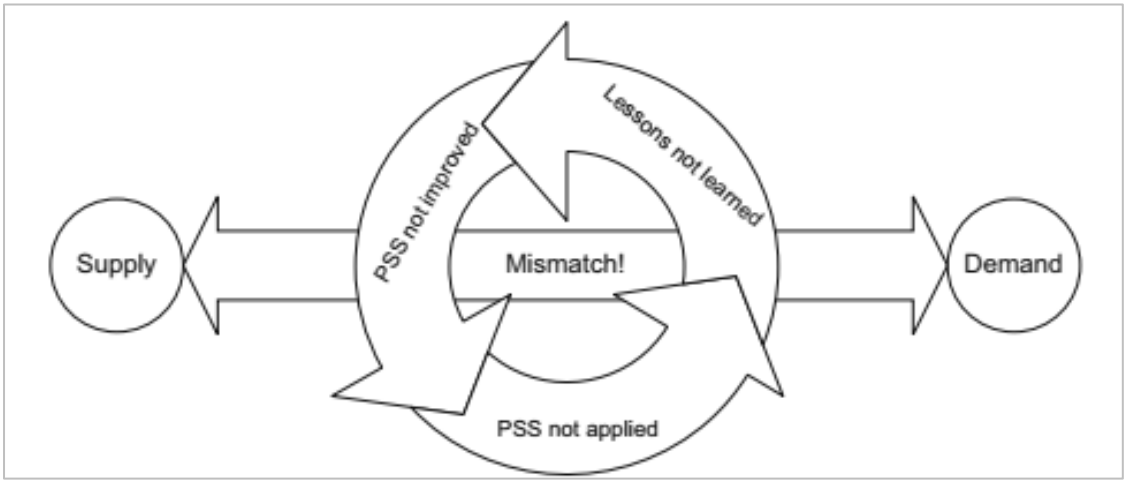
Sources: G. Vonk and Geertman (2008, Figure 3).

Appendix 10: Overview of the Strategies for dealing with drift.

	Communication	Organizational learning	Knowledge Management
Control strategy	Communication activities aiming at getting the same ('best') way to conduct the project.	Oriented to programmed learning to prevent people deviating from the project planning.	Up-front collecting of information in order to inform people before the project starts.
Incremental strategy	Interactive communication activities aimed at finding solutions to local problems.	Oriented to adaptive learning to solve local problems.	Oriented toward knowledge creation and sharing for application in the immediate implementation practice.
Drift containment strategy	Interactive communication activities aimed at finding solutions to local problems and to connect to strategic intentions.	Oriented to adaptive learning to solve local Problems, while at the same time reflection on local implementation practice.	Oriented toward knowledge creation and sharing for application in the immediate implementation practice. Creating new knowledge during the implementation process that might be useful in new projects.

Source: Vonk & Geertman (2008)

Appendix 11: Cycle of Mismatch between PSS Development and Adoption



Sources: G. Vonk and Geertman (2008, Figure 1).

Appendix 12: Interview Guide.

Interview Guide

For

Embedding Planning Support Systems (PSS) in local levels spatial planning process: The case of the Spatial Development Framework (SDF) methods in Rwanda.

Local level respondents

1. What is your role in the district?
    a. The responsibilities include
2. What is the land use planning process in the district?
3. How is geo-information technology being used in the land use planning process?
4. How will you evaluate the land use planning process in the district?
    a. What are the benefits?
    b. What are the limitations?
5. Can you please describe any of the SDF methods you are familiar with.
    a. How can the SDF method(s) be made part of the land use planning process across the levels of government?
6. From your experience, how will the adoption of SDF methods contribute to the land use planning process in the district?
7. What are likely challenges that can delay the adoption of the SDF method(s) in the land use planning process?
8. What is your perception of the SDF methods ease of use?
9. What is your perception of the SDF methods usefulness?
    a. To enhance your performance
    b. To enhance the land use planning process?
10. What suggestions do you have to enhance the adoption of SDF methods for land use planning process at the district levels?

National level respondents

1. What are your responsibilities?
2. What is the land use planning process at the national level?
    a. What are the benefits?
    b. What are the challenges?
3. How is MININFRA involved in the land use planning process?
    a. National level?
    b. District levels?
4. What is the role of the SDF methods in the land use planning process?
    a. What is your perception of the SDF methods ease of use?
    b. What is your perception of the SDF methods usefulness?
5. What are the outcomes of adopting SDF methods in the land use planning process? (Please, specify the application process).
6. How can the SDF methods be embedded in the land use planning process?
    a. At the national level?
    b. At the district levels?
7. What are the roles of MININFRA towards the adoption of SDF methods for land use policies implementation?
    a. At the national level?
    b. At the district levels?
8. What are the limitations of embedding the SDF methods for land use planning process?
    a. At the national level?
    b. At the district levels?
9. How can the SDF methods become embedded in the land use planning process at the district levels?

Management level respondent - MININFRA

1. What are the outcomes of adopting the SDF methods in the land use planning process in Rwanda?
2. What are the achievements of adopting the SDF methods for policy implementation in Rwanda?
3. What is the role of MININFRA towards embedding the SDF methods in the land use planning process at the national and district levels?
4. What are the challenges being experienced in integrating the SDF methods in the land use planning process at the national and district levels?

Management level respondent - UN-Habitat

1. What are the achievements of the SDF methods for National Urbanisation Policy (NUP) implementation?
2. What is the role of UN-Habitat towards embedding the SDF methods in the land use planning process?
3. What are the challenges of integrating the SDF methods in the land use planning process?