# ADOPTION OF INTELLIGENT TRANSPORT SYSTEMS FOR SUSTAINABLE TRANSPORTATION IN SECONDARY CITIES OF SOUTH AFRICA: A CASE OF PORT SHEPSTONE

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## ABSTRACT

Transportation is one of the major phenomenon which often directs population increase, investments and land use patterns in cities. Most cities, particularly secondary cities often do not entirely plan for future transportation when planning for massive investment developments thus leaving such cities with transportation challenges which include aging transport infrastructure, increased traffic patterns, insufficient parking spaces, high-accidents rates, to name a few. The most ignored transportation solution in secondary cities is the use of technology to manage transportation challenges in which such solutions may include the establishment of Intelligent Transport Systems (ITS). This research study seeks to examine what are the possibilities of using ITS to address the transportation challenges of the secondary city of Port Shepstone, what are the recommendations that can be put forward for establishment of ITS in Port Shepstone. In an attempt to discover these questions, the study conducts a literature review analysis which outlines what others have done in this research area and progressively attempts to provide recommendations on the possible establishment of ITS solutions in Port Shepstone. The literature review focuses on five (5) functional areas (i.e. Advanced Traveller Information Systems (ATIS); Advanced Transportation Management Systems (ATMS); Advanced Public Transport Systems (APTS); Enabled Transportation Pricing System (ETPS) and Data Acquisition Management Systems (DAMS)) which their possibility of being established in the secondary city of Port Shepstone is investigated The literature review analysis is supplemented by semi-structured interviews with various stakeholders within the transportation sector; and their views are constructively analysed to draw converging findings. The empirical findings from both literature review analysis and conducted interviews provide meaningful answers to the research questions and enabled the researcher to draw fundamental recommendations and possible ITS solutions to address the transportation challenges of Port Shepstone.

## DECLARATION OF ORIGINALITY

With this, I declare and confirm that: -

- I am the sole author of the written work herein;
- I have compiled the work in my own words and where other peoples` work have been used, their work have been acknowledged and referenced as per the University referencing guideline;
- I am aware that the work may be screened electronically for plagiarism; and
- This work has not been before submitted to any university.

12 August 2019

Ms G.L. MADIHLABA DATE

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| | | |
|---|---|---|
| APTMS | - | Advanced Public Transport Management System |
| ATIS | - | Advanced Traveller Information Systems |
| ATMS | - | Advanced Transport Management Systems |
| AVL | - | Automatic Vehicle Location |
| BRT | - | Bus Rapid Systems |
| BT | - | Built-transfer |
| CBD | - | Central Business District |
| CCC | - | Central Control Centre |
| CCTV | - | Closed Circuit Television |
| $CO_2$ | - | Carbon Dioxide |
| EFCS | - | Automatic Fare Collection System |
| ERP | - | Electronic Road Pricing |
| ETC | - | Electronic Toll Collection |
| ETPS | - | Enabled Transport Pricing Systems |
| EU | - | European Union |
| FTMS | - | Freeway Traffic Management System |

| | | |
|---|---|---|
| GDP | - | Gross Domestic Product |
| GIS | - | Geographic Information Systems |
| GPS | - | Global Positioning System |
| HA | - | Hectare |
| IDP | - | Integrated Development Plan |
| ITS | - | Intelligent Transport Systems |
| KZN | - | KwaZulu-Natal |
| NDoT | - | National Department of Transport |
| SASTIS | - | South African Society for Intelligent Transport Systems |
| SDF | - | Spatial Development Framework |
| TMC | - | Transportation Management Centre |
| TOD | - | Transit Oriented Development |
| USA | - | United States of America |
| UTCS | - | Urban Traffic Control System |

# CHAPTER 1: INTRODUCTION AND RESEARCH BACKGROUND

## 1.0. BACKGROUND

There are different ways in which the hierarchy of cities is defined and the criteria in defining the hierarchy of cities across the world follow different types of logic. John (2012:11) defines primary cities as areas that appear to have increased population growth and that are much more prominent or influential economically, politically and culturally than other urban centres in the country. Secondary cities are referred to as areas which are seen to be linked to the national classification of primary cities but are alternative urban centres where people live and work in order to relieve the pressure on the country's primary cities (John 2012:11). It is believed that secondary cities play an important catalytic role in their surrounding regions, particularly their rural hinterlands, by providing economic and administrative services, a market for agricultural produce from surrounding farmlands, and links between the hinterland and the country`s primary cities (John 2012:11). Such links in most cases need to be further supported by transport systems and networks which will effectively direct traffic and ensure that traffic congestion is managed and reduced.

Chakwizira *et.al* (2014:806) define traffic congestion as “a condition that occurs as the use of roads increases – characterised by slower speeds, longer trip times, and increased queuing”. This kind of situation is further exacerbated by zones within a town which are attractive to people and which enjoy economic prosperity. Chakwizira *et.al* (2014:806) further state that traffic congestion is mostly caused by many people wanting to move at the same times each day. The efficient operation of both the economic and social sectors requires that people work, go to school, and even run errands during the same hours so that they can interact with each other. Such activities performed at the same time often causes congestion resulting in loss of time, higher costs, accidents and harm to the environment prosperity (Chakwizira *et.al* 2014:806).

Today most secondary cities across the world are becoming more specialised in providing various economic opportunities to people in an attempt to compete for trade, investments and economic opportunities for development like primary cities (Roberts 2014:24). This is due to the availability of technology and Information Technology Communication (ICT)

which has led to increase in trade, business and information sharing between cities thus resulting in most city economic activities spatially concentrated at one point (Roberts 2014:24). The spatial concentration of activities in secondary cities often results in people situated on the outskirts of the city having to commute daily to access those activities thus resulting in an increased negative impact on the transportation system yielding other impacts which may include traffic congestion and more. As much as most secondary cities strive to relief primary cities through provision of specialised activities; they also have a very narrow economic base which make them very vulnerable to changes in one or more development sectors including the transportation sector making them to be extremely vulnerable to international markets trends, national policies, programmes and decisions regarding trade and infrastructure investments (Marais 2014:44).

In an attempt to address the vulnerabilities that come with changing economic environments in cities. The majority of cities have introduced the use of technology to manage vulnerabilities in most sectors of development including the transportation sector through the use of Intelligent Transport Systems (ITS). Intelligent Transport Systems (ITS) are presented as technological applications which provide a variety of tools to better manage transportation infrastructure in cities. These systems “apply various technologies, such as communications, computers and information processing, storage and dissemination, to improve the efficiency and safety of transportation systems and to reduce the harmful effects on the environment” (Gauteng Department of Roads and Transport 2013:5). However, achieving these benefits of the use of ITS in secondary cities is a nightmare due to infrastructure investments often being crippled by the budgetary constraints that exists in government; not to mention the mismanagement of resources that often lead to project failures (Booysen n.d.:1). Even though secondary cities are often characterised by informal transportation systems which is mostly dominated by the minibus or taxi industry often cause complex yet unique transportation challenges. Improving efficiency and regulating such industries through ITS solutions may play a significant role in changing the lives of people by allowing them to be active participants in developing their lives through technology (Booysen n.d.:1).

## 1.1. PROBLEM STATEMENT

Transportation is one of the fundamental aspects of development and pays a significant role in directing other sectors of development in cities which may include economic, residential, civic and social facilities. Chapter 4 of the National Development Plan 2030, recognises transport as one of the fundamental aspects of foundation of social and economic development in South Africa. The South African government has acknowledged the importance of collaborative and integrated transport system for economic development which should be supported by Information Communication Systems (ICT) to play a significant role in becoming an enabler in transport planning and economic development at large (National Planning Commission 2010:189). Transport Planning in South Africa happens in all three spheres of government i.e. National, Provincial and Local government in which prescribed roles and responsibilities of each sphere of government is prescribed in policies and legislation (Pillay *et al.* 2017: vii). Local government in South Africa is at coalface of service delivery and is increasingly imposed with additional responsibilities which also include the delivery of reliable and efficient transport services (Pillay *et al.* 2017:vii). However, this is a nightmare for most Municipalities, particularly those in secondary cities as they are often faced with challenges such as poor leadership; lack of capacity, lack of integrated approaches to provision of reliable and efficient transport systems, funding to name a few (Walters 2014:4). As such, Municipalities; particularly those of secondary cities are often faced with these challenges resulting in poor transportation systems and road infrastructure development which in-turn results in traffic congestion; accidents and negatively impacting on the economic growth of such cities.

These challenges are no different from those in Port Shepstone town located within the jurisdiction of the Ray Nkonyeni Local Municipality, KwaZulu-Natal. It is one of the secondary cities in South Africa which experiences a complex yet unique type of traffic congestion. Port Shepstone is known to be the primary node of the municipality and a secondary node at provincial level. It has a population size of approximately 8 004, making up approximately 2.3% of the total municipal population size of 348 553 (Community Surveys 2016). Land usage in the town includes residential, administrative,

educational, commercial and retail, utilities and transport space. The land usage of the town is summarised below as follows: -

| Broad land use category | Sum of Area_m² | % |
|---|---|---|
| Environmental and open space | 484363.63 | 25.3 |
| Residential land uses | 203582.34 | 10.6 |
| Utilities And Transportation | 660331.79 | 34.4 |
| Commercial, Office And Retail | 294355.37 | 15.3 |
| Civic And Social Land Uses | 275202.99 | 14.3 |
| **Grand Total** | **1917836.12** | **100.0** |

Figure 1: Broad Land Uses (Source: Isibuko Se-Afrika Development Planners, 2016:19)

The town has a strong north-south linkage along the coast, facilitated by the R102 and the N2 linking the town of Port Shepstone to Durban and, further up the coast, to Richard's Bay. The N2 also links Port Shepstone with Kokstad in the Harry Gwala Region as an east-west linkage.

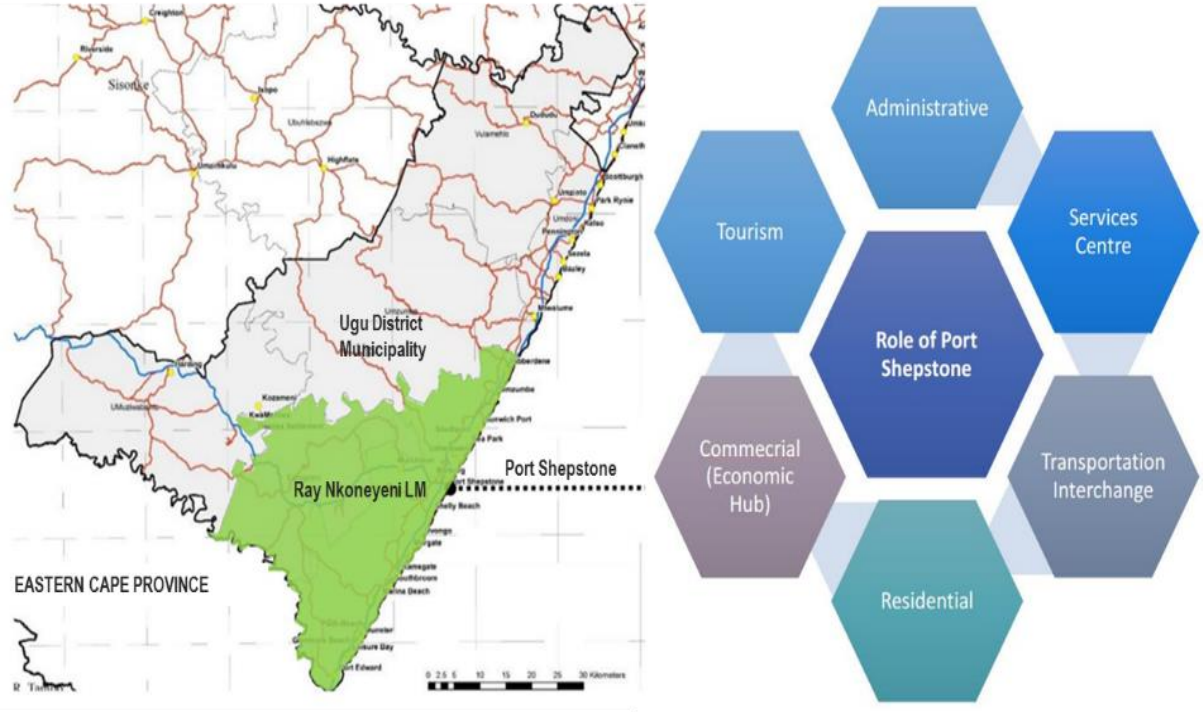



Figure 2: Locality and Role of Port Shepstone (Source: Isibuko Se-Afrika Development Planners 2016:3)

The town has experienced, and continues to experience, enormous increases in both public and private sector investment, yet with limited road infrastructural development

being initiated to support the economic investments of the town (Isibuko Development Planners 2016:7). This has impacted strongly on the functioning of the town as an administrative and commercial hub of the municipality, because it has led to high levels of traffic congestion. The traffic congestion has resulted in loss of time, high costs and an increase in road accidents which happen continuously.

The congestion is also distributed and stretched to other coastal towns of the municipality, which include the towns of Shelly Beach, Uvongo and Margate, especially during peak season. The town is often faced with severe traffic congestion with no basic intelligent transport system or any type of strategy in place to manage and reduce day-to-day and seasonal traffic congestion.

## 1.1. AIM OF THE STUDY

In an attempt to address the transportation challenges of the city of Port Shepstone the study aims: -

*To establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone.*

## 1.2. OBJECTIVES OF THE STUDY

The research will be guided by the following objectives: -

a) To critically identify possibilities of establishing ITS in Port Shepstone;
b) To establish the theories informing ITS;
c) To learn through comparison and/or cross-references from international and local precedents on ITS and secondary cities;
d) To provide recommendations on the use of ITS in Port Shepstone.

## 1.3. MAIN RESEARCH QUESTION

In order to fully achieve the objectives of the research, it is necessary that the research answers the following research question: -

*What are the possibilities of using intelligent transport systems (ITS) to address the transportation challenges of the secondary city of Port Shepstone?*

### 1.3.1. RESEARCH SUB-QUESTIONS

The research seeks furthermore to answer the following sub-questions: -

a) What are the existing theories that inform ITS?
b) What can the secondary city of Port Shepstone learn from international and local precedents in establishing ITS as a tool to address transportation challenges?
c) What recommendations can be put forward for establishment of ITS in Port Shepstone?

## 1.4. RATIONAL OF THE RESEARCH STUDY

The Port Shepstone area experience transportation challenges on a daily basis, which frustrates residents of and commuters to the town of Port Shepstone. The Ray Nkonyeni Local Municipality (2017:7) describes the town as one of the towns in the municipality with public infrastructure and beautiful coastline with blue flag beaches and tourism thus playing a significant role in being an administrative hub for the entire Municipality Ray Nkonyeni Local Municipality (2017:7). The town is further known to be a beautiful place for retirement. With such spatial character, transport challenges have highly impacted on the development of the town and the Municipality as a whole. Karuri-Sebina (2016:196) state that the United Nations projects that 71% of the South African population will live in urban areas by 2030 with almost reaching 80% by 2050. As such, the rapid urbanisation intensities within rural-urban linkages continues to grow as people living in primary cities continue to have a strong connection with the rural areas of origin (Karuri-Sebina 2016:196). This will have a major impact on cities sustainability because of increased demands for services which may include but not limited to water, land, food, access to public transport and human settlements. Therefore, it is important that transport planning be also prioritised in secondary cities to accommodate the projected population growth by 2050.

The role of secondary cities in potentially supporting primary cities to deal with some, if not all, development pressures, needs to be understood; for example, one possibility is to maximise the use of information technology by putting in place smart city strategies

which will respond to development pressures of cities and this should be explored also in secondary cities (Karuri-Sebina 2016:267).

Secondary cities across the world have only concentrated on responding to transport challenges through core infrastructure developments such as the building of roads and not incorporating information technology in the effort to deal with transport challenges. The majority of secondary cities are also characterised by non-efficient and non-inclusive public transport networks which often do not reduce transport related challenges and does not achieve any socio-economic inclusion (Weakly and Bickford 2015:45). This is because such cities are often not characterised by compact land uses which increases access to variety of services and functions that optimises the efficiency and cost of service delivery, promote the use of public transport and create walkable and liveable urban spaces (Weakly and Bickford 2015:2).

Port Shepstone also lack compaction to promote a sense of efficiency in its transport system with no smart technological strategies in place to address transportation challenges of the city. As such, the researcher saw it fit to investigate the complexities of the transportation challenges of Port Shepstone, and to consider how technology may be introduced as a mechanism to respond to such challenges. In undertaking the research, a number of data sources will be taken into account in developing the conceptual and theoretical framework that will inform the research study.

The research study is strongly informed and directed by a number of theories which are driven by the concept of sustainable development, seeking not only to address the issues of mobility but also to shift the focus to changes in urban form and land use that have an impact on the roles and functions of a city (Toth-Szabo and Varhelyi 2012:2036). In addition, the theories explored in this research study are intended to establish a foundation towards exploring the relationship between nodal areas and traffic flow patterns in cities (Sarkar 2013:77). An understanding of social behaviour of transport users in regard to road elements is sought, in an attempt to resolve the transportation challenges of the secondary city of Port Shepstone. Over and above the conceptual and theoretical framework, learning from comparison and/or cross-reference with international

and other local examples of the use of intelligent transport systems (ITS) and secondary cities is one of the fundamental research sub-objectives.

It is understood and acknowledged by the researcher that the planned investigation might not result in the desired outcomes as stated in the research objective, and an adequate response to the research question might not be forthcoming. It is further acknowledged that the incorporation of information technology strategies into the problem of mobility and transportation will not be an easy process to undertake as it requires overarching strategies on public awareness, extensive funding and political support and such processes often require time and strategic thinking. Therefore, secondary cities need to be ready in their thinking which should go beyond policy development and implementation, and should focus more on tackling the issues that come with the increase in population growth, particularly that of transportation.

## 1.5. DISSERTATION STRUCTURE

The structure of this dissertation is arranged in a manner that meets the objectives of the study. It is divided into six (6) chapters.

**Chapter 1** is the introduction to the study and it provides a clear background to the research study by outlining the research problem overarching objectives, and by posing the research question that seeks to be answered. The research Case Study i.e. Port Shepstone is also discussed in this chapter providing a clear understanding on the research objective and question.

**Chapter 2** of the study will provide a conceptual and theoretical framework detailing research concepts which will include the definition of both dependent and independent variables related to the research. The chapter will further outline the theories supporting the significance and relevance of the research focus area (i.e. the importance of Intelligent Transport Systems in secondary cities).

**Chapter 3** will present local and international case studies on the establishment of intelligent transport systems in secondary cities in both developed and developing countries across the world. This is done with the aim of fully understanding the research

focus area and in order to make informed recommendations and conclusions at the end of the research study.

**Chapter 4** will outline the research methodology, which focuses mainly on research methodology philosophies such as the research design in terms of qualitative research, data collection and gathering, sampling techniques, questionnaire design, data analysis, validity and reliability of the research. It will further unpack the ethical considerations and measures to provide trustworthiness, and outlines how the research findings are to be made available to the public.

**Chapter 5** will present the analysis of results and findings of the research study from data collected from both primary and secondary data sources. The findings presented will take note of various development elements such as spatial and land use structure, local economic development and the transportation structure of the town of Port Shepstone. The findings on aspects of development will be linked to those found by means of the conducting of semi-structured interviews and will be presented concisely in this chapter.

**Chapter 6** of the research study provides the final conclusions and recommendations. The recommendations presented will be significantly informed by the overall findings of the research study, which will be based on the data collected from both primary and secondary sources. It will furthermore provide overall conclusions based also on findings, analyses and assumptions derived from the conducting of the research.

# CHAPTER 2: CONCEPTUAL AND THEORETICAL FRAMEWORK

## 2.0. INTRODUCTION

This chapter discusses the conceptual perceptions and definitions of sustainable transport systems in the transportation sector through an analysis and understanding of the adoption of transport technology in secondary cities of South Africa and the world at large. The conceptual framework takes into account the role that transport has played in the formation of cities and how it has significantly influenced the emergence and current structure of cities throughout the world. The chapter will further provide a concise review of the existing literature on theories that have emerged from the concept of transportation, and approaches which have led to the current form of transport systems in the world. The intention is to understand the theoretical arguments which have and not succeeded and possible critiques which emerged from the identified theories and have shaped the existence and maintenance of sustainable transport systems. In concluding this section, various viewpoints are proposed as a substantive means of establishing a foundation to understanding the main research objective and questions to be answered at the end of the research.

## 2.1. CONCEPTUAL FRAMEWORK

### 2.1.1. TRANSPORTATION AND TRANSPORTATION SYSTEMS

According to Mathew and Rao (2007:31) transportation is one of the non-separable sectors of society. It often reveals a most important and close relation to the ways of life and the range and location of activities of people, which might be economic, social, political or environmental. It further plays a significant role in revealing the relation in terms of distance and accessibility of goods and services available for consumption (Mathew and Rao 2007:31).

The evolution of transportation across the globe, which began as early as 3500BC, has been dramatic, and has been present in all areas of human interaction through trade, production and politics, to name but a few examples. The surges of transport revolution which have taken place over the ages have also been influenced by the expansion of empires or territories which could only be connected through transport routes, with people needing to travel for long distances to get from one place to another. It was in early

3000BC that the Sumerians in Mesopotamia invented the wheel, which eventually gave rise to this mode of transport. The first form of wheeled transport was a cart, with the wheels and axle formed from a single piece of wood, and tied under the wagon by leather straps. It was only much later (around 2000BC) that wheels were developed with fixed axles on which the wheels rotated separately (Camillo 2013:1). The expansion of empires was largely responsible for the development of the wheel, with routes serving Mesopotamia as means of trade five thousand years ago, and the empires of Rome, Persia, China, and later the New World rulers were supported by their roads. Later, the trade routes supported the grain trade from the Mediterranean to the East as well as to European countries (Garrison 2003:2).

Since trade became the most influential human interaction between the empires, the revolution of transportation was mostly seen in the European countries from the early 1300s, where networks of trade centres emerged to replace the medieval economies. This was largely due to the Crusades which took place at the time, breaking many medieval barriers to the movement of individuals and trade between the empires (Garrison 2003:3).

The barriers broken down by the Crusades eventually led to further improvements in transportation, which included the building of bridges and later the invention of steam engines in the early 18$^{th}$ century. The first public railway opened in England in the early 19$^{th}$ century. Rail transport became the most important mode of transport in ensuring economic and social development between empires (Camillo 2013:1). The evolution of transportation from road to rail was also influenced by the ever-increasing high road transport costs which often hindered human interaction, making efficient trading hard to achieve. It has been, according to Camillo (2013:2), only in the last forty years that “the mobility of goods by road has gradually taken over the rail, doubling its share from 1970 to date”.

The development of rail transport has now become greatly supported by water and air transport, serving most movement particularly in European countries. While the earliest forms of water transport go back thousands of years, possibly to around 4000BC, the first airplane was invented in 1903. Garrison (2003:3) states that since Europe is well

endowed with waterways and coastlines, river, ocean and marine technologies were maximised. Ocean ports were developed, often by governments, and mechanical aids to material handling evolved. In addition, water inventions further expanded through development of navigation technologies aiding ocean trade, which was supported by the development of river canal systems in much of Europe (Garrison 2003:3). This mode of transport has also been supported by developing technologies in air transport, servicing both the military and recreational sector from the 1920s. The importance of air transport has also grown, supporting trade and industry development, as well as political and government environments (Garrison 2003:45). According to Garrison (2003:45), "Public and private airports have been successfully constructed across the world along with aids to navigations which include AM radio beacons and lighted airways and airspace traffic management".

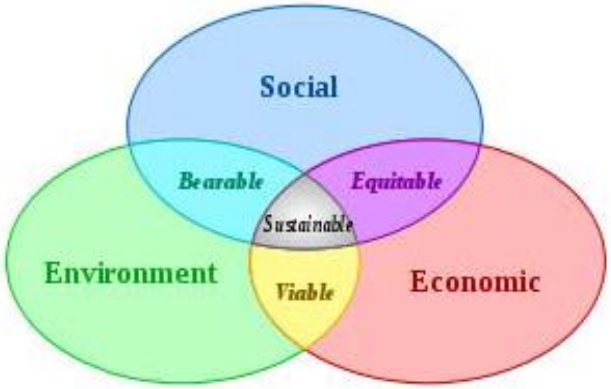



Figure 3: Sustainable development model (Source: Todorov and Marinova 2009:1218)

It is clear that all transport volumes, whether on land, sea or in the air, have and are increasing exponentially across the world, influencing the way people live and travel, and consuming enormous resources in terms of time, cost and effects on the environment. These increases place pressure on governments to expand their scope of technologies to develop sustainable transport systems.

### 2.1.2. SUSTAINABILITY CONCEPT

Sustainable transportation systems are essential to further economic, social and environmental development of secondary towns. The concept of sustainability implies the ability to be maintained into the future.

According to Neuman (2005:17) the term “sustainability” is*:*

> “a debate about how we live. It relates to the way that we rethink our relationships to the cultural construct we call “nature,” to the earth, and to each other. It further refers to the way we think things ought to be and how we ought to live. As such it is a start of a complex dialogue. Sustainability is also a broad, vague term that has many meanings. It’s a platonic idea, a category of the good. As a new idea, there is not yet a clear, single image of what sustainability is. Its fuzziness and many facets contribute to its appeal. It is appropriated without fear of challenge because there is no single accepted image of how to specify it exactly and put it to work, despite one accepted general meaning of a balance among equity, economic, and environmental concerns. Sustainability is not yet branded. There is no patent, trademark or copyright” (Neuman 2005:17).

According to Toth-Szabo and Varhelyi (2012:2036) the term “sustainability” refers to:

> “a vision of the future that provides us with a road map and helps us to focus our attention on a set of values and ethical and moral principles by which to guide our actions”

Toth-Szabo and Varhelyi (2012:2036) further state that sustainability may be considered as having conflicting aspects or goals as it may promote increase in economic growth versus global equity or decreasing resource use. As a result, sustainability mostly relates to people’s values and the value systems of the people making them. The concept of sustainability has many aspects and is connected to a variety of disciplines and decision-making processes, particularly those relating to how people live. “All the definitions of sustainability have to do with living within limits, understanding the interconnections among economy, society and environmental and equitable distribution of resources and opportunities” (Toth-Szabo and Varhelyi 2012:2036).

With this in mind, it is difficult to provide a clear definition of sustainability as it touches on multifaceted aspects of development. However, it should be noted that the concept has

paved way for development, thus demonstrating the recognition for preservation of resources, directing of investments and orientation of technological development and institutional change in societies.

### 2.1.3. SUSTAINABLE TRANSPORTATION

From the perceptions outlined above about sustainability, one may conclude that sustainability relates to development. As a result, to achieve sustainable development, transportation should form part of the vision of sustainable development. Previously, transportation systems, particularly in developing countries, were limited to systems that included animal-drawn carts, water, rail and bus systems; and these became the foundation of sustainable mobility for these societies (Coyle *et al.* 2000:20). These transportation systems often created a good platform for communication, trade and business development. However, for many developing countries, transportation systems do not affect only the economic development of the country, but also the country`s political and cultural, social and community development (Coyle *et al.* 2000:20). As a result, developing countries are often faced with problems of putting into place strategies that will limit negative impacts of transportation on societies, so that all structures of society such as social, political and economic structures, benefit from the strategies of sustainable development implemented.

Previously, transport was primitively evaluated in terms of physical movement or mobility. However, transport is now evaluated in terms of accessibility or people`s ability to access and obtain goods and services (Litman 2008:2). Accessibility suggests the ideology of increasing and enhancing various solutions that can be applied to transport problems. This can be achieved through the improvement of land use, accessibility and telecommunications in addition to accommodating more vehicle traffic (Litman 2008:2).

The majority of the literature on sustainable transportation focuses on motorised transport and its effects which include but are not limited to climate change, congestion, and noise pollution. The different modes of transport such as walking, public transport and cycling often have limited impacts on the environment. Private motor vehicle usage also has a huge impact on the environment and takes up most of the space on the road, resulting in

traffic congestion. Toth-Szabo and Varhelyi (2012:2036) state that one large aspect of the definition of sustainable transportation relates to environmental problems.

According to Black (2004:3), sustainable transportation refers to:

> "Transport that meets the current transport and mobility needs without compromising the ability of future generations to meet these needs".

In addition, William (2007:1) states that sustainable transportation also refers to:

> "mobility that meets the needs of society to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological requirements today or in the future".

The above definitions are taken from the Brundtland Report, published in 1987, which put forward the concept of sustainability and sustainable development which have become established concepts that cannot be dismissed. It is clear from the above definitions that in order to fully achieve sustainability in a city, one will need to take into account the needs of future generations while satisfying the needs of the present generation. Unfortunately, it is difficult to identify the needs of the future generations. Toth-Szabo and Varhelyi (2012:2037) state that even though it might be difficult to determine the needs of the future generations, it is helpful to take into account the delicate balance between social, ecological and economic capabilities depending on the level of development and culture of the city. This can help us determine the needs of the future generations by taking into account the continuous development trends and targets. It is important to understand that transport needs remain at the centre of sustainable development of a city.

Therefore, for most developed and developing countries, sustainable transportation is achieved through the adoption of sustainable strategies that include coordinated approaches to land use and transportation planning. Such approaches and strategies include the implementation of sustainable transport policies which promote development of: -

a) transit oriented developments (TOD);

b) integrated public transport network developments through the establishment of bus rapid transit (BRT) developed in high density mixed use areas;
c) vehicle technology enhancement which often responds to the environmental needs of society, i.e. addressing issues of transport carbon emissions ($CO_2$); and
d) fuel prices and tax reform strategies.

Newman and Kenworthy (1999:144) propose the following five (5) strategies which they believe play a significant role in achieving a sustainable transportation system:

a) ***Traffic calming:*** to slow vehicle traffic and create more urban, human environments better suited to other transportation modes.
b) ***Quality transit, bicycling and walking:*** to create multimodal centres with mixed, dense land use that reduce the need to travel and that are linked to good transit usages.
c) ***Growth management:*** to prevent urban sprawl and redirect development into urban villages.
d) ***Taxing transportation better:*** to cover external costs and to use the revenues to help build a sustainable city based on the above strategies.

The strategies of sustainable transport often advocate the impact of sustainable transportation on community and urban development through limiting the use of private cars and maximisation of the use of non-motorised options which may include walking, cycling and public transport. Such strategies further seek to respond to the real problems of lack of investments in the development of road infrastructure, inadequate road network systems which are not proportional to the development of road traffic resulting in widespread congestion, slowing down the speed of transport, decreasing safety and increasing pollution.

### 2.1.4. SUSTAINABLE TRANSPORT AND URBAN FORM

#### 2.1.4.1. PRIMARY AND SECONDARY CITIES

Beyond the theoretical definitions of cities, the majority of international countries define their hierarchy of cities based on the population threshold or size and the function a city plays in the broader national space economy. Roberts (2014:23) states that the majority

of countries across the globe have “orders or levels” in terms of how they define their hierarchy of cities. Such levels start from primary level, moving to secondary and then to tertiary level. The focus in this research paper is on the “orders or levels” of hierarchy of cities in order to understand the role that intelligent transport systems in secondary cities play towards promotion of sustainable transportation.

Roberts (2014:20) defines a primary city as “the leading city in its country or region, disproportionately larger than any others in the urban hierarchy”. Roberts (2014:20) further states that a primary city is likely to be leading in terms of its political, economic, technological, cultural and educational status. The primary cities are also likely to be referred to as “metropolitan cities”. In countries with small populations, primary cities may have only a few hundred thousand residents, while on a global scale, there are also many smaller primary cities that have lesser status or secondary status yet perform primary city functions within the context of the countries in which they are located (Roberts 2014:20). In addition, some countries which include Australia, Brazil, China, and the USA, for example, have multiple primary cities thus making it difficult to apply and understand the concept of “primacy” in these places.

Secondary cities are linked to primary cities. There is an extensive body of literature covering the concept of secondary cities and there are various definitions of the term. The term has different definitions depending on the context in which it is used. Like primary cities, it also takes into account population threshold, administrative area, and the political, economic and historical significance of areas within its borders. Most of the literature that defines and outlines the characteristics of a secondary city draws mainly on the population size. John (2012:12) states that the population size in secondary cities ranges from approximately 100 000 to 500 000 people. This is also supported by the UN-Habitat which also defines a “secondary city” as an urban area with a population of approximately 100 000 to 500 000 people.

According to Lamia *et al.* (2015:1), secondary cities can be divided into three categories, namely: -

a) **Sub-national cities** – that are focal points or centres of local government, industry, agriculture, tourism or mining.

b) **City clusters** – are associated with expanded, satellite and new towns which surround large urban metropolitan regions; and
c) **Economic trade corridors** – that are urban growth centres or poles planned or developing along transport corridors.

Organisations such as the World Bank and the European Union (EU) have moved away from classifying and defining secondary cities using only the population size. They have begun to look at other characteristics which are considered to be important in defining the role and function of secondary cities in the national space economy. Such characteristics include but are not limited to the level and nature of the economy, technological intensity, income per capita, regional importance of the city, administrative status of the city, education and transport infrastructure, quality of life and urban governance.

Academic literature makes conclusions that secondary cities are believed to play a catalytic role in taking pressure away from primate cities of the countries they originate in, and in playing a distinct and fairly specialised role in the national economy space. They often alleviate demographic pressures from primary cities thus offering better quality of life. However, Roberts (2014:17) states that the majority of small regional secondary cities in developing countries are often faced with the challenges of raising capital, raising local taxes and attracting the new investments needed to build infrastructure, attracting business and creating vibrant communities. They further struggle to create and improve connectivity, logistics and efficiency, as well as to generate employment opportunities. Most secondary cities fall behind in national measures of city competitiveness because of weak strategic infrastructure development, logistics and lack of institutional and governance-base capacity and weak tax-base systems (Roberts 2014:17). In developed countries, secondary cities with rich resource bases are often not manufacturing regions because they struggle to catch up with the demand for land, infrastructure and services, with government facing challenges on how to stimulate, manage, develop and revitalise such cities (Roberts 2014:17). Therefore, it is important for both developed and developing countries to start realising the importance of improving and better managing development of secondary cities, thus ensuring that the definition and the role of such cities is better understood worldwide.

### 2.1.4.2. SPRAWL AGENDA

Transport may be considered to be the key determinant and consequence of social and spatial development of contemporary cities and regions. The spatial representation of modern cities has been shaped by the transportation network and the dependency on private vehicles to access economic services or markets. The relationship between transport and urban form plays a significant role in which people interact socially and economically. As a result, such interactions have related to the urban challenge of "sprawl".

Dieleman and Wegener (n.d.:309) define urban sprawl as:

> "a combined effect of growing affluence, changing lifestyles and the vast advance in personal mobility made possible by the private automobile".

According Tirado (2008: para 1 lines 1-10) sprawl is also referred to as a:

> "development that is geographically dispersed, auto-dependent, single use and impossible to walk to your daily needs, and usually, located along highways. It is related to low-density residential development which often threatens farmlands, open spaces raise, which threatens public service costs, encourages people and wealth to leave central cities, creates serious traffic congestion, and degrades the environment and the quality of life".

Such geographically dispersed areas or cities often find themselves under great pressure to implement transport strategies which will respond to the challenges of urban sprawl. In many instances, small towns or cities are often sprawled-up, making it difficult to travel from one place to the other thus resulting in an embedded belief that travel time needs to be minimised and consequently speeds need to be increased (Moody 2012:22). Hence, decision makers are often faced with the need to increase speed within acceptable limits in order to meet the time delays, and thus resulting in dangerous and poor quality urban environments (Moody 2012:22). Sprawl is therefore considered to threaten the culture of cities as it creates recognisable and negative environmental, social and economic impacts.

#### 2.1.4.3. COMPACT CITY

One of the major concepts responding to the “sprawl agenda” is the compact city approach which has greatly advocated for sustainable transportation. According to Neuman (2005:2), the compact city is the opposite of urban sprawl. The compact city model was identified as one of the fundamental concepts aimed at preventing sprawling of cities. It is also a model that seeks to put forward a strong link between urban form and sustainable development and to suggest that a city must have an appropriate scale of walking, cycling and efficient public transport with compactness that encourages social interaction (Jenks *et al.*1996:5). The compact city further follows three main threads, namely the social, economic and environmental threads.

The ideology behind the compact city approach aims at promoting sustainable urban form and preventing the city from sprawling. Some of the fundamental characteristics of the compact city that Neuman (2005:4) proposed include but are not limited to the following:-

a) high residential and employment densities
b) mixture of and/ or various types of land uses
c) increased social and economic interactions
d) increased urban infrastructure
e) multimodal transportation which promotes accessibility, connectivity and proximity
f) low open-space ratio/ density
g) increased government fiscal capacity to finance and maintain urban facilities and infrastructure.

Taking into account the above characteristics, the compact city approach has been predominantly visible in most European cities which are densely developed. The development of the European cities has promoted urban containment to provide a concentration of socially sustainable mixed uses that will concentrate development and reduce the need to travel, thus reducing vehicle carbon emission with the concomitant promotion of the use of public transport, traffic calming, walking and cycling being the most popular cited solutions (Jenks *et al.*1996:5).

The main shortfall of the compact city is that it often has a higher likelihood of becoming overpopulated and suffering a consequent loss of urban quality, with limited open space, increased traffic congestion and pollution (Jenks *et al.*1996:5). Therefore, literature reveals that the strategies of the compact city approach often result in problematic local effects. This means that the benefits of promoting density and intensification of cities, particularly where there is a newly upgraded area and an increase in residential densities which lead to more vibrant environments and a higher quality of life, often result in negative local impacts such as over-development of land, urbanisation, loss of sensitive environmental species and open space network, traffic congestion and poor air quality.

Therefore, it is important that residents realise not only the benefits of the compact city, but also take into account the implications that come with it. This can be achieved by involving residents in the development process of the city so that they can also form part of the decision-making process (Jenks *et al.* 1996:94).

#### 2.1.4.4. TRANSPORT BARRIERS TO CHANGE

Transport planning across the world is facing major challenges, particularly in transitioning from an unsustainable to a sustainable transport system. Banister (2007:73) states that the concept of sustainable transportation has embedded four (4) key characteristics which include: -

a) ***Travel time and cost minimisation*** – as travel time always becomes important, especially when travel patterns change. Time becomes a more valued activity. Actual travel costs should always be regulated in terms of external cost through some form of road charging. This will result in a reduced number of trips, reduced trip distance, and a changed modal share, to name but a few examples.
b) ***Land use planning*** – and regulation should be integrated so that restraint measures and development patterns support shorter travel distances and modal split changes.
c) ***Targeted personal pressure and individual marketing*** – are important but often neglected, with acceptability being an essential element of sustainable transport.
d) ***Technological innovations*** – which include making use of alternative transportation modes, transport systems and information systems such as hybrid

vehicles and fuels. This further has the potential to effect behavioural changes to driving as such technologies will make life easier and more efficient in terms of public transportation use.

Even though the characteristics of sustainable transportation are clear and seem to be easy to achieve, this is not the case when it comes to implementation, because of the multitude of barriers and obstacles which hinder the transition towards sustainable transportation in cities. Such barriers include policy and resource constraints which are connected and work together to sustain the unsustainable (Moody 2012:28). Therefore, it is the power and resilience of the "system of auto-mobility" which dilutes any pressure for transition (Moody 2012:28). Such elements diluting the systems of the transition to sustainable transportation include "policies, infrastructure, institutions, attitudes, cultures, ways of life and economic investments which all support the continued existence of car dominated transport systems" (Moody 2012:28). Banister (2007:75) argues that the process of changing the unsustainable system to a more sustainable transport system is beyond the policy and resource constraints but also mentions public acceptability which often drives the political acceptability required for a coordinated sustainable transport transition. This means that lack of involvement of people during the implementation of the transition to sustainable transportation will often result in community opposition and political contestations affecting decision making processes.

Therefore, moving towards a sustainable transportation system is not necessarily simple and comes with its own challenges and barriers. Most developing countries are still trapped in the "car-centric" ideology or approach in which development of transport infrastructure overlooks the aspect of sustainable transport as a whole. Moody (2012:30) argues that this is influenced by the conventional transport paradigm which is considered to be one of the barriers to change as it advocates the prioritisation of car usage. This ideology of "car-centricity" or the use of motor cars is highly influenced by the "social organisation of space characterised by expansive urban sprawl fragmenting different spheres of life such as family home, place of work, entertainment and educational establishments" (Lumsden 2015:2). This has increased the necessity for the use of cars, thus impacting on community life through social exclusion for those who cannot afford to

buy a car, and on health problems related to emissions, accidents, and decreased physical activity (Lumsden 2015:2).

Infrastructure development, particularly road infrastructure which emphasises vehicle needs through street designs, lane widening, smooth surfaces, and synchronised traffic signals, to name a but few, often reduces the importance of the establishment of sustainable transportation elements which may include development of cycling lanes, bus lanes and pedestrian walkways. Therefore, infrastructure design is important as it guides the behavioural culture and attitude of the communities for which the infrastructure is planned in order to create a willingness on the part of the people to move away from the "car-centric" ideology towards that of sustainable transportation.

### 2.1.5. INTELLIGENT TRANSPORT SYSTEMS (ITS)

The research study aims at establishing the possibilities using intelligent transport systems (ITS) to address transportation challenges in the secondary city of Port Shepstone. As such, it is important that the concept of ITS be well understood in order not only to respond to both the research aim and question, but also to understand the sub-objectives of the research which seek to comprehend the role that ITS plays in secondary cities to promote sustainable transportation, as well as understanding ITS effectiveness and the existing approaches that cities of developing countries such as South Africa can adopt in order to promote sustainable transportation in secondary cities. In an attempt to address the research aim, it is acknowledged that secondary cities do not all have similar transportation challenges, do not perform the same in terms of development and are structured differently. Therefore, in an attempt to understand the role of ITS in secondary cities, it is acknowledged that some of the generic characteristics that normally directs transportation will not generally be the same for all secondary cities in South Africa or across the world at large. Careful consideration of the unique genetic makeup of the Port Shepstone town will provide a clear understanding in analysing ITS in secondary city of Port Shepstone.

The intelligent transport systems (ITS) concept emerged in the early 20$^{th}$ century. Its main focus was on improving vehicle-specific navigation and route guidance systems (Auer *et al.* 2016:2). However, at that stage, technology was developed opportunistically and there

was a limited number of manufacturers. In the late 1940s, further developments emerged in vehicular technological advancement. These developments included technologies on traffic management systems such as the traditional three-coloured traffic signal and the first parking meters (Auer *et al.* 2016:2). From the early 1980s up to the present, transit agencies across the world, particularly those in the United States, adopted a number of intelligent transports systems which did not only focus on safety and efficiency but also promoted sustainable development in cities (Auer *et al.* 2016:2).

The ITS ideology is supported by the Lang(n.d.:8) which states that intelligent transport systems often "improve traffic efficiency and safety, with positive outcomes for sustainable development". It is mostly utilised by cities in developed countries which include but are not limited to the USA, Japan and a number of European countries. However, the majority of developing countries which are confronted with urgent needs to improve traffic systems also prioritise the use of ITS in managing and controlling traffic congestion and promoting sustainable transportation.

Most people across the world assume that improving the transport system of a country depends solely on improving road infrastructural development. Ezell (2010:8) states that the future of transportation lies beyond the development of concrete and steel, and can rather be found in the implementation of technology particularly in networks of sensors, microchips, and communication devices that collect and disseminate information about the functioning of the transportation system. Ezell (2010:8) further states that transportation systems are actually about networks and the value of a network is contained in its information. The value of a traffic signal network that is capable of identifying traffic problems which may include such incidents as road accidents and lane destruction, for example, is clear.

## *DEFINITIONS*

**Intelligent Transport System** seeks to: -

"empower actors in the transportation system from commuters, to highway and transit network operators, even down to the actual traffic l ights themselves with actionable information (or, intelligence) to make bette informed decisions, whether it's choosing which route to take; when to travel; whether to mode shift (take mass transit instead of driving); how to optimize traffic signals; where to build new roadways; what the true cost of roadways are and how best to price their use; or how to hold providers of transportation services accountable for results"(Ezell 2010:8).

It is also defined as a concept which applies: -

"a broad range of diverse technologies (including computers, information processing, communications, control, and electronics) to improve the effectiveness of transport systems and maximise the use of the existing road infrastructure" (Thomas 2014:392)

and which, according to the Gauteng Department of Roads and Transport (2013:6) is the: -

"application of data processing, data communications, and systems engineering methodologies with the purpose of improved management, safety and efficiency of the surface transportation network".

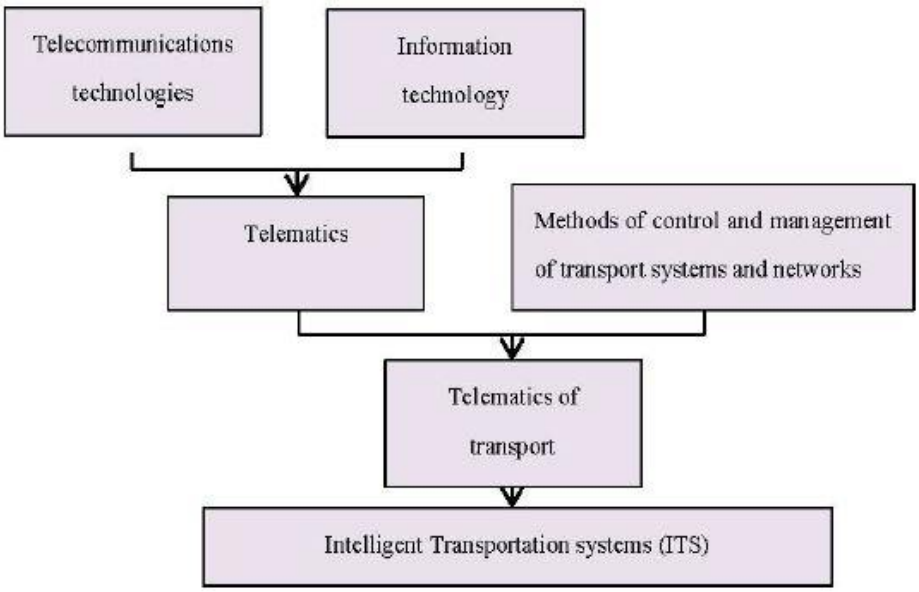



Figure 4: The counterparts of Intelligent Transport Systems (Source: Stawiarska and Sobczak 2018:3)

Besides the definitions of ITS stated above, it should be noted that there is no single, combined definition for ITS and that transport agencies and countries across the world prefer to adopt definitions that suit their specific needs, situation and objectives. Most ITS in developed and developing countries have been tailored according to the physical infrastructure and policy environments for each place, as well as according to their state of urban development and their level of willingness to accept and use ITS ( n.d.:11). Even though most countries may use ITS to address traffic challenges, each country still needs to deal with these differently because they do not experience similar problems. In other words, what works for one country might not work for the other. Therefore, ITS applications can be categories in various ways depending on their expected use which include but not limited to: -

a) Demand and access management (including pricing);
b) Traffic management and control;
c) Travel and traffic information;
d) Driver assistance and cooperative systems;
e) Logistics and fleet management;
f) Safety and emergency systems.

(Source: Jonkers and Gorris 2015:9)

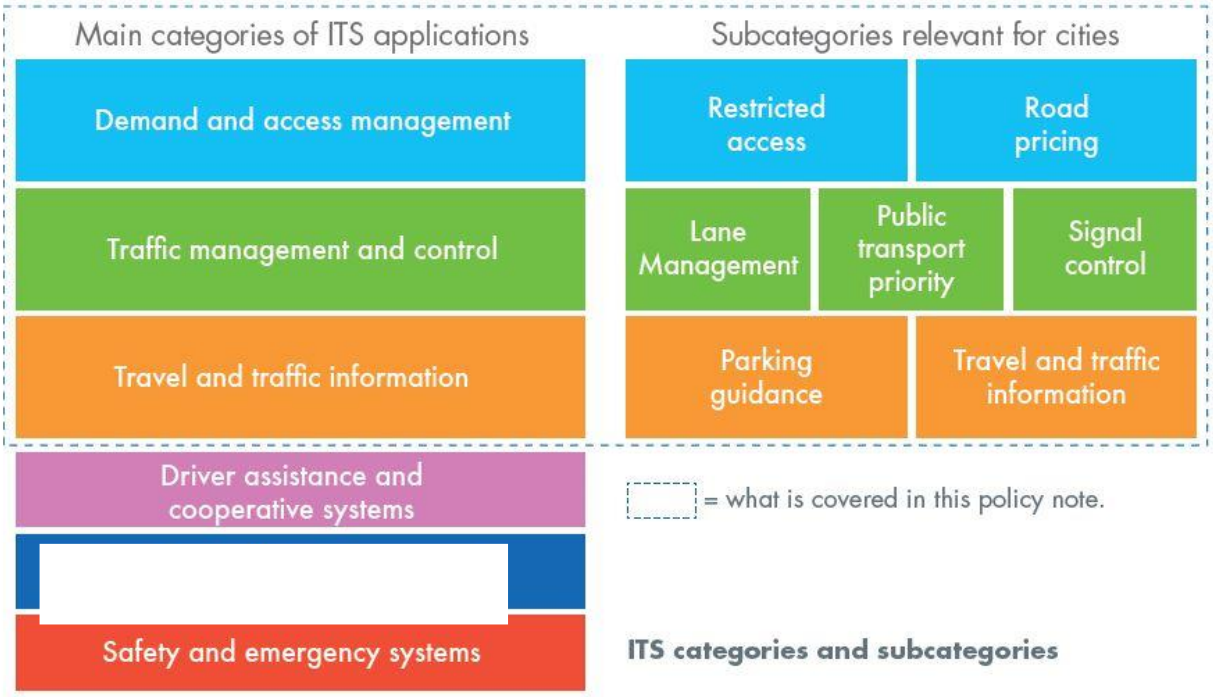



Figure 5: ITS Categories and Sub-categories (Source: Jonkers and Gorries 2015:11)

Thomas (2014:392) states that the most common types of ITS used in cities of developed and developing countries include: -

a) advanced traffic management applications for urban networks, including adaptive traffic control systems, to provide priority for surface-based public transport vehicles;
b) electronic tolling systems;
c) smart card systems such as electronic fare collection and integrated ticketing for
d) public transport, to promote seamless travel for commuters between different transport modes;
e) supply chain management of goods using smart tags for asset tracking;
f) road and rail route planning by providing traveller information to facilitate trip planning;
g) air and rail traffic systems management;
h) traveller information systems to improve efficiency of use of public transport systems;

i) vehicle tracking systems, to reduce theft, improve efficiency of freight movement and improve public transport operations;
j) in-vehicle navigation and information systems to assist drivers to reduce unnecessary travel;
k) freeway management and information systems to reduce delays due to traffic incidents;
l) cross-border operations for more efficient monitoring and processing of freight; and
m) travel demand management, to ensure efficient journeys for the community as a whole.

Literature tells us that the benefits of ITS are mostly felt in cities of developed countries rather than in developing countries and are dependent on the specific needs of each city. Thomas (2014:396) mentions some of the common benefits enjoyed by cities of developed and developing countries which include amongst others: -

a) promotion of road capacity effectiveness for improved traffic congestion and road accidents management;
b) selected use of travel routes at specific and appropriate times to enable commuters to plan their trips ahead;
c) improved facilitation of driver's information for traffic management, road user charging and maximised enforcement to enable engineers to increase efficiency of road networks;
d) increased use of public transport resulting in a response to environmental problems such as a decrease in $CO_2$ emissions from cars; and
e) promotion of safety, efficiency and sustainable urban development.

In addition to benefits stated above. Ezell (2010:12) also highlights five (5) fundamental benefits of ITS in the transport system which include: -

a) increased safety of drivers and pedestrians;
b) improved transport network operational performance through reduced congestion;
c) improved personal mobility and convenience;

d) delivery of environmental benefits, and
e) improved productivity and expanding of economic and employment growth.

The majority of the researchers discovered the benefits of the use of ITS during the 1980s. Most of these benefits were discovered in the USA through unique experiences on ITS applications such as advanced traveller information systems (ATIS) and advanced public transport systems (APTS), for example (Ercan 2009:6). Such experiments ensured that citizens were provided with sustainable transportation that helped in mitigating problems such as traffic congestion, air quality and safety, without constructing new road infrastructure (Ercan 2009:5). Literature furthermore reveals that there are a number of benefits that emanate from the implementation of ITS in the transport sector which might have been overlooked. It has also been realised that in most countries ITS have maximised the capacity of existing infrastructure and to some degree reduced the need for provision of new transport infrastructure, particularly in terms of building additional road infrastructure such as new lanes and or bridges (Stawiarska and Sobczak 2018:3). It is therefore important that developing countries start to realise the benefits of ITS in the transport system and to explore the possibilities of limiting transport investment on new road infrastructure, while maximising investment on incorporating ITS into existing infrastructure in order to enhance the performance of the country`s transport system which will result in increased economic growth and development.

#### 2.1.5.1. FUNCTIONAL AREAS OF ITS

Taking into account the wide range of intelligent transport systems, it will be useful to organise the research discussion in categories that arrange them by their primary functionality whilst acknowledging that various ITS applications have multiple functional intentions and purposes.

The table below illustrates the areas to be discussed briefly in the research paper: -

Table 1: Five (5) ITS functional areas to be investigated

| ITS Functional area | Specific ITS applications |
|---|---|
| 1. Advanced traveller information systems (ATIS) | Real-time traffic information provision |
| | Route guidance/Navigation systems |
| | Parking information |
| 2. Advanced transportation management system (ATMS) | Transportation management centre (TMC) |
| | Adaptive traffic signal control |
| | Dynamic message signs |
| | Ramp metering |
| 3. Advanced public transport system (APTS) | Real-time status information for public transit systems (e.g. bus, train, taxi, etc.) |
| | Automatic vehicle location (AVL) |
| | Electronic fare payments (e.g. smart cards) |
| | Environmental management ($CO_2$ reduction) |
| 4. Enabled transportation pricing systems | Congestion pricing |
| | Electronic toll collection (ETC) |
| | Viable parking fees |
| 5. Data acquisition and management systems | GPS |
| | Sensors |
| | Automatic vehicle location (AVL) |

(Source: Ezell 2010:8)

### a) Advanced Traveller Information Systems (ATIS)

Advanced traveller information systems (ATIS) provide transport users with travel-related information to assist in decision making on route choices, real-travel time and congestion and other roadway hazards which may include bad-weather events (Vanajakshi *et al.* 2010:12). This is achieved by providing transport users with various technologies which include amongst others:

- GPS enabled in-vehicular navigation systems;
- dynamic road messaging signs for real time communication information on traffic congestion, accidents, alternate route closures during accidents and road maintenance; and
- other roadway hazards which may include bad-weather events. (Vanajakshi *et al.* 2010:12).

ATIS is commonly used by the majority of transport users, particularly those that are often faced with traffic challenges daily.

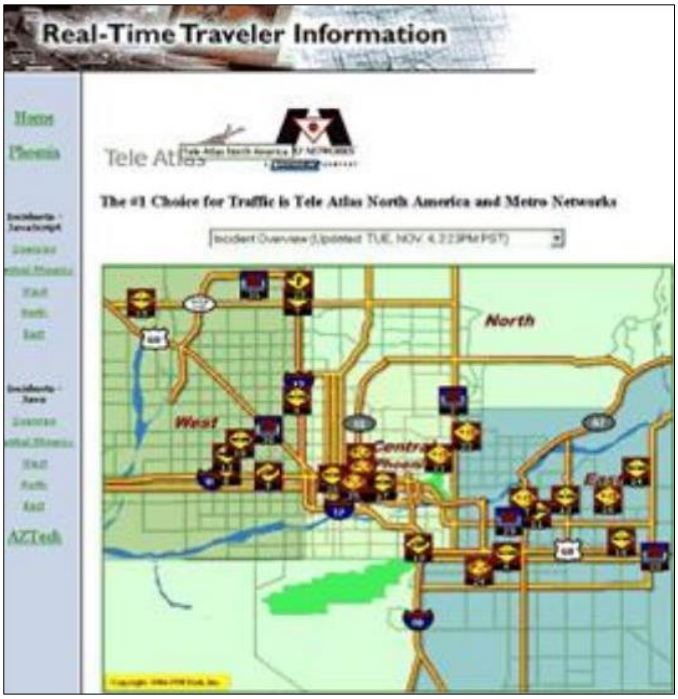



Figure 6: Examples of ATIS (Source: Vanajakshi *et al.* 2010:11)

### b) Transportation management systems (ATMS)

The advanced transportation management systems (ATMS) integrate different sub-systems focusing on traffic control devices which include but are not limited to closed circuit television (CCTV), vehicle detection, communication, ramp metering, and other dynamic messaging means which provide transport users with real-time messaging about the traffic status on the road (Ezell 2010:10). ATMS are mostly common on highways.


Figure 7: Examples of ATMS (Sources: Vanajakshi *et al.* 2010:11)

Most transport organisations, particularly in the United States, use ATMS to control traffic and to predict high traffic zones in particular areas of a region. This is often successful, particularly in terms of controlling and adjusting the traffic light signals at critical intersections which are prone to experiencing high traffic volumes during peak hours. However, the use of ATMS to control traffic is mostly dependant on the type and relevance of data collected to achieve the desired traffic levels. If the data collected is not organised or arranged correctly, traffic might still be a nightmare to travellers.

### c) Advanced public transport system (APTS)

Advanced public transport systems (APTS) simply focus on public transportation management and information technologies to public transport systems in order to improve operations efficiency and safety (Vanajakshi *et al.* 2010:12). This include applications such as Automatic Vehicle Locations (AVL) which enable the detection of transit vehicles such as a bus or a train making it simple for operation managers and public transport users to determine and view real-time travel status. It further includes electronic fare payment systems for public transport users which may include the use of smart cards applicable for different modes of transport, to name a few (Ezell 2010:12). APTS are common in South Korea, Japan, Washington, Paris, Tokyo and other Asian and European countries (Ezell 2010:12).


Figure 8: Examples of APTS (Source: Vanajakshi *et al.* 2010:13 )

### d) Enabled transportation pricing systems

The enabled transportation pricing systems (ETPS) play a significant role as a transportation funding strategy for most developing and developed countries in the world. These systems focus on transport charges that serve as penalty measures for car ownership. Systems of ETPS include tolls, congestion, fuel, vehicle and parking charges or fees (Gauteng Integrated Transport Master Plan 2013:2). ETPS plays a major role in enhancing the importance of the use of public transport by fostering higher subsidies and faster travel time through the introduction of rapid transit systems. Most developed countries such as Australia and Japan have introduced the use of a “single national ETPS standard, obviating the need to carry multiple toll collection tags on cross-country trips because various highway operators ETPS lack inter-operability” (Ezell 2010:11). Having such standard practices often increases the quality of service in terms managing and dramatically reducing traffic congestion.

Most developing countries across the world has attempted to introduce various traffic


Figure 9: Example of ETPS (Source: Vanajakshi *et al.* 2010:15)

pricing schemes which include charging for entry into an urban centre during peak hours. This is introduced not only to reduce traffic, but also to generate needed resources for public transport investment and to reduce negative impacts on the environment (Ezell 2010:11). Countries which have successfully implemented ETPS are mainly Singapore, Stockholm, London, Oslo, and Jakarta.

**e) Data acquisition and management systems**

It is always important that transport data be acquired and stored in a manner that will make it easier for users to access it easily in order to solve their transport problems.

It is stated by the Gauteng Department of Roads and Transport (2013:20) that: -

> "transport related data has always existed in abundance but, until recently was collected and stored manually, making it impossible to access freely. Technology has provided the means to manage data storage effectively to the extent that we are now drowning in knowledge and information".

Based on the statement quoted and the functional areas described herein, it is clear that ITS through the use of technology can bring some sort of relief to the transport system. However, the trick is in the manner that data is acquired and disseminated to reach to transport users. In addition, it also depends on the type of technology used to acquire or

disperse information that will help transport users to escape from the nightmares of facing traffic, dealing with unforeseen road accidents, and so forth.

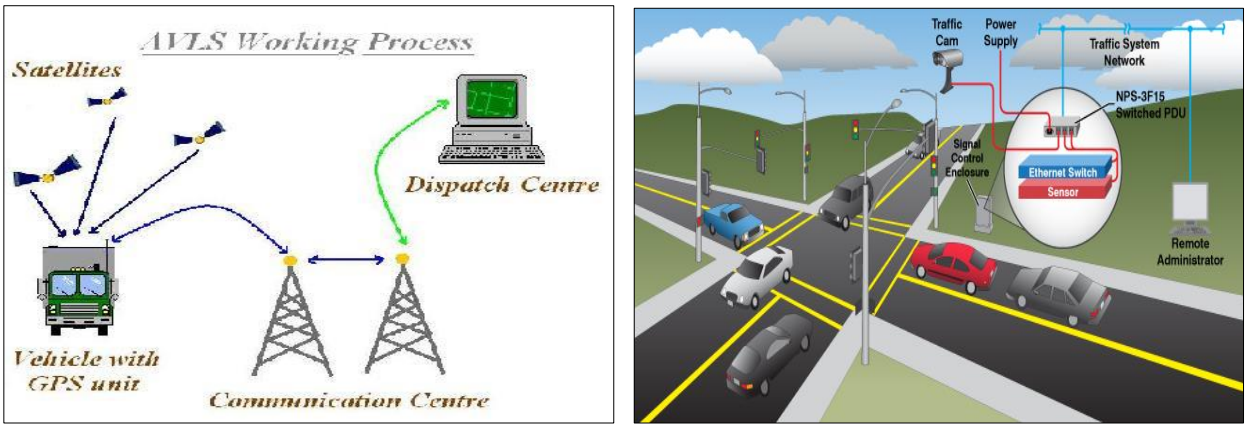



Figure 10: Data acquisition and management systems (Source: Vanajakshi et al.2010:16)

The use of traffic management tools which improve the flow of traffic and speed distribution to reduce accidents, parking information systems which reduce the number of vehicles in traffic streams, the advancement of technology in vehicles, and infrastructure development all play significant roles in data acquisition and management. Data acquisition and management tools combine "tested hardware and software that collect reliable information on which to base further ITS activities" (Vanajakshi *et al.* 2010:15). Such tools include advanced vehicle technology such as global positioning systems (GPS)-based automatic vehicular locators (AVL), cameras, sensors and detectors used on highways for traffic counts and surveillance. These tools are also important for real-time monitoring and strategic planning, particularly in promoting efficient and reliable transport systems; they are also seen as being advanced traveller information systems (ATIS).

### 2.1.5.2. ITS BARRIERS TO CHANGE

Like every technological advancement in the world, there are certain benefits and challenges associated with ITS. One may inquire as to why ITS have not yet been deployed more broadly, particularly in developing countries such as South Africa. ITS deployment across the world is faced with major challenges which range from technical failure and political opposition, to institutional and community opposition and lack of funding.

### a) Project funding

For most countries, funding seems to be one of the major challenges in achieving sustainable transportation through the use of ITS. In most cases, government does not understand the significance or the value of ITS in the transport sector, particular in terms of improving energy conservation, decreasing air pollution and/or enhancing air quality, traffic congestion and adopting new ITS solutions which will positively contribute to the regional economy (William and Ankner n.d.:2). Many countries, including the United States, have under-invested in implementation of ITS projects and have deployed insufficient ITS solutions in the country's regions. Part of the reason for this is that "transportation funding is allocated without consideration of performance, giving local and state transportation planners little incentives to give preference to investments that can have maximum impact on optimising system performance" (Ezell 2010:19).

In addition, most countries have also invested in improving transportation infrastructure and not in improving and managing the transportation network. "Yet combined with bureaucratic inertia and a lack of vision, some government transportation agencies see themselves as "builders of pieces" and not "managers of a system" and place more emphasis on building roads than on ensuring the system functions optimally" (Ezell 2010:19).

In South Africa, particularly in the Gauteng province, most ITS projects have seen the light during the past couple of years and have created opportunities for a fledgling ITS industry in the country (Gauteng Department of Roads and Transport 2013:23). However, like other countries with experienced and inexperienced ITS industries, challenges faced are mostly felt in the sustainable operations and maintenance area, as well as funding thereof. Particularly "the provisions of dependable power supply as well as communications connectivity via a redundant backbone are hampered by cable theft activity as well as roadside construction damage" (Gauteng Department of Roads and Transport 2013:23).

One of the roles that the public sector together with the private sector needs to demonstrate is how funding can play a major role in the establishment and implementation of sustainable mobility initiatives; they also need to demonstrate the value

that funding adds to the success of these implementations. Giorgi (n.d.:1) states that the "reluctance of public administration to invest in new environmentally friendly transport infrastructure, in view of the latter's high costs and limited state budgets, has tended to aggravate the situation and has definitely reduced the policy options". This attitude has led to lack of public infrastructure funding, so that quite often the public sector must look for new sources of revenue to finance transportation – with tax being one of the least reliable sources of long-term funding.

**b) Public acceptance**

During the implementation of most transportation projects, participatory democracy is often ignored. This is because civil society and the poor are not often included in the process of implementing the projects. As a result, this may create a loss of public acceptance which drives political support and ultimately leads to loss of funding as private agencies will often withdraw from investing in those projects (Teglasi 2012:97). It seems necessary therefore, that, when implementing ITS projects, it is advisable to understand the implications and expectations of individuals and the public as a whole. In order to promote public acceptance for implementation of ITS projects, it is important that government initiate mitigating strategies which will help to enhance the livelihoods of the community by offering community enhancement, for example, which may include the provision of employment opportunities which will respond to poverty and economic development, as such projects often lower the cost of travel and enhance both economic and social opportunities.

**c) Institutional and political opposition**

The benefits of ITS projects in a country strongly requires institutional and political realisation. The majority of developed countries such as the USA, Asia, Europe and Australia have wrestled in making the benefits of ITS a reality for their citizens. ITS face various thorny institutional barriers which also include jurisdictional challenges such as having to establish which level of government – national, provincial or local government has the responsibility for jurisdiction over ITS deployments.

One of the major challenges that South Africa is facing in deploying ITS projects is coordinating all of the activities involved, which include various traffic engineering

aspects, undertaking feasibility studies and having to source funding for implementation, amongst others. However, in other developing countries, the national government manages this role and has put a successful ITS infrastructure in place. Unfortunately, in South Africa, while the national government fully supports ITS, the National Department of Transport (NDoT) in particular, does not participate in the management and coordination of ITS in South Africa. Rather, municipalities provide for this in their transport planning and are expected to work closely with the South African Society for Intelligent Transport System (SASTIS) for implementation of ITS projects.

In essence, countries need to understand the need for institutional jurisdiction for implementation of ITS projects. Lack of establishment of institutional jurisdiction for implementation often results in political opposition. Institutionalisation of ITS should be recognised and the responsibility for ITS planning, funding and implementation should be dealt with under one roof (Thomas 2014:397). It is important that relevant stakeholders and civil society work in partnership to establish and analyse the problem that the ITS project seeks to address. This will result in the initiated project being effective, efficient and legitimate, with limited political opposition attached to it.

Therefore, it is important to identify potential conflicts and pitfalls which may arise during the implementation of the project, which may jeopardise decision-making related to the project. In addition, it is important that the public sector take into account the interests of civil society during the decision-making stage, in order to prevent community opposition such as protests, for example (Priemus 2010:20). The issue of misinformation may also lead to major political opposition which could result in the failure of the project. It is therefore important that the relevant stakeholders or parties decide on the mechanism that will be used to handle information, and that they will implement mechanisms of accountability to avoid unresolved agency conflicts and community protests.

**d) Project technical failures**

ITS projects are often faced with technical failures which include issues such as lack of cost-benefit analysis and misleading cost estimates, which are likely to contribute to major technical failure where project designs or initiatives are not approved by the relevant

stakeholders and community. Such technical failures may also result in loss of political support or lack of funding for the project (Teglasi 2012:78). Most countries are faced with lack of expertise within local and regional transportation agencies with regard to the technologies underlying ITS and the implementation thereof. This means that there is an increased lack of technical standards for ITS technologies which makes it difficult to ensure that systems purchased by different entities can be integrated (Ezell 2010:24).

Barriers to change towards implementation of ITS need to be taken into account. Literature reveals that urban planning should continually focus on making the lives of citizens easier, without creating extensive transport demand environments caused by the "car-centric" ideology and urban sprawl. Such initiatives might be difficult for some countries to implement or to execute due to various barriers to change and might require enormous resources. The challenges of ITS are dynamic and might not be similar for different countries; and for this reason, strategic solutions need to be applied that respond to the specific transport needs faced at the time. Therefore, ITS might not be a solution for everyone to adopt, and it should be applied selectively after due consideration (Thomas 2014:396). This is because ITS is normally effective up to a certain point and thereafter any further implementation is a waste of money (Thomas 2014:396).

Implementation of ITS should therefore always be carefully considered by correct institutional structures through different implementing techniques which might include policy development and extensive public consultation processes. Such activities might assist in creating awareness of the needs and constraints of sustainable transportation stakeholders such as public transport users, cyclists and pedestrians.

## 2.2. THEORETICAL FRAMEWORK

One of the core research objectives and enquiry is to understand the critical theoretical components which underpin the ideology of intelligent transport systems in the secondary cities of developing countries like South Africa. This does not intend to be a historical account, but rather an attempt at the understanding of discourses that provide reasoning towards the theoretical groundwork of intelligent transport systems under the theme of sustainable transport; and the prospects that exist in the planning theory which can be considered in providing for better planning direction for innovative work in the transport sector.

### 2.2.1. ECO-CITY DEVELOPMENT THEORY

The eco-city development theory is mostly driven by the conceptual framework on sustainable development. Previously, transport networks were only focused on the need to move goods and services from one place to the other (Litman 2008:2). However, the focus has currently shifted to the impacts that changes in urban form and land use have on the environment (Litman 2008:2).

According to Lundqvist (2007:12) eco-city refers to: -

“a framework of ideas on how cities can develop more sustainably today and in the future”

Zhang, Ma, Zhan and Lu (2012:2408) defines “eco-city” as: -

“a city designed and built with a well consideration of environmental impact and inhabited”; and

Saad *et al*. (2013:58) describes an “eco-city” as: -

“a human settlement modelled on the self- sustaining resilient structure and function of natural ecosystems providing more (renewable) resources than healthy abundance to its inhabitants without consuming it produces, without producing more waste than it can assimilate, and without being toxic to itself or neighbouring ecosystems and its inhabitants’ ecological impact reflect planetary supportive lifestyles; its social order reflects fundamental principles of fairness, justice and reasonable equity.”

Lundqvist (2007:12) states that the eco-city theory was developed in the early 20th century and was highly influenced by other movements that developed over the same period, which include development of healthy communities, good and appropriate technology, community ecologic development, social ecology, the green development, bioregionalism, native world views and sustainable development. Saad *et al.* (2017:55) state that modern urban areas are based on integrated complex infrastructure systems to ensure comfort and healthy environment to their residents. Such infrastructure systems may include but not limited to electrical, water and waste water, transportation, and sewage networks (Saad *et al.* 2017:55). This is mostly achieved through the eco-city model which promotes the sustainable management of resources which minimises the consumption of natural resources (Saad *et al.* 2017:55).

Yigitcanlar and Han (2009:12) state that the eco-city theory sees development from the point of view of ecosystem interactivity. The theory promotes the basic idea according to which city development focuses on fully exploiting the potential of ecological construction under the influence of existing resource environment to promote efficiency, harmonious, healthy and wealthy cities (Yigitcanlar and Han 2009:12). This means that it takes into account the elements that exist in the city and the needs required to develop a city sustainably. The theory rejects the concepts of low productivity and the modern ways of excessive resource consumption, thus solving urban problems by considering ecological aspects of development in order for the city to operate in a sustainable manner. Therefore, the eco-city concept benefits the ecological, environmental and social systems in a society (Yigitcanlar and Han 2009:13).

One of the major elements of transformation towards the development of the eco-city aims at promoting sustainable transportation systems through adoption of green solutions or strategies. Such solutions include de-emphasising the car-centric ideology; promotion of public transportation systems with more emphasis on bus and rail systems; increasing pedestrianised systems such as developing walking and cycling infrastructure; and putting forward strategies that will act as catalysts in reducing the carbon emissions in cities (Kenworthy 2006:68). Such strategies may also include the development of environment-friendly technologies for transport such as enhancing of vehicle systems to

reduce emissions and adoption of policy systems that will regulate transport systems and development in cities.

In supporting the eco-city development theory, Kenworthy (2006:72) conducted a study which aimed at promoting eco-city development by focusing on various transport planning dimensions for sustainable city development which assumed, amongst other things, that:-

a) a city has mixed-use urban form that uses land efficiently and protects the natural environment and food production;
b) the natural environment permeates the city's spaces and embraces the city, while the city and its hinterland provide a major proportion of its food needs;
c) freeway and road infrastructure are de-emphasised in favour of transit, walking and cycling infrastructure, with a special emphasis on minimising rail, car and motorcycle use;
d) extensive use should be made of environmental technologies for water, energy and waste management;
e) central cities are increased human centres which absorb different modes of transport other than the automobile and absorb high employment, residential growth and are a high quality public realm meeting human needs;
f) all decision-making is sustainability-based, integrating social, economic, environmental and cultural considerations as well as compact, transit-oriented urban form principles. Such decision-making processes are democratic, inclusive, empowering and engendering of hope.

In support of the identified Kenworthy`s eco-city transport planning dimensions for sustainable development model, Saad *et al.* (2017:66) identifies the following fundamental eco-city principles: -

a) Urban from;
b) Mobility;
c) Biodiversity;
d) Ecological Industry;
e) Economy; and

f) Social Sustainability.

The mobility principle is emphasized by not only moving people from one place to the other rather by emphasizing the need to decrease transportation costs by producing majority of the needs required by the city and also reducing ecological footprints (Saad *et al.* 2017:66). The mobility principle further promotes the use of public transport and the city is designed to be transit orientated supported by working and social facilities located within a walking and cycling distance. Therefore, it discourages the use of private cars that burns fossils and reduce carbon emissions considering the fact that the transportation system is the majorly responsible for carbon emissions (Saad *et al.* 2017:66).

Taking into account the mobility principle on eco-city as described by Saad *et al.* (2017:66), Kenworthy's eco-city development model puts forward the ideology which assumes that development of an urban form and transport are at the core of the development of an eco-city and are led by sustainable technologies, economic and urban design. The model also assumes that development of a mixed urban form is important and that it must always ensure that the city protects and promotes green space developments, including natural areas and food-producing areas. It furthermore promotes development of higher density urban centres which must be linked to public transport systems with focal points for population and employment growth (Kenworthy 2006:84). In addition, the model also assumes that first class public transportation systems and cycling environments should be given priority, with increase in road capacity being minimised or discouraged. Emphasis on economic growth through creativity, innovation and information technology systems, for example, are to be promoted (Kenworthy 2006:84).

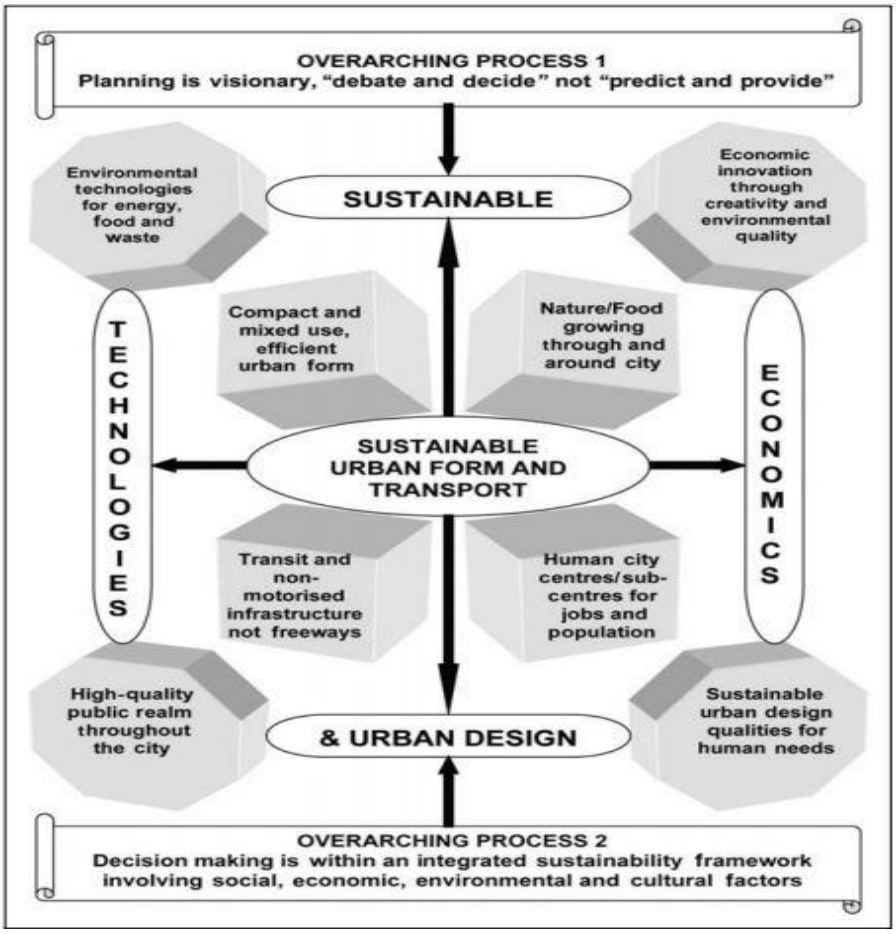



Figure 11: Kenworthy's eco-city model based on urban planning, transport planning and urban design considerations (Source: Kenworthy 2006:85)

However, Kenworthy (2006:84) states that the dimensions operate in two fundamental processes which involve vision-oriented, reformist thinking "debate and decide" rather than extrapolation of existing trends "predict and provide", and a strong, community-oriented sustainability framework for decision-making. Therefore, the Kenworthy study comes to the conclusion that ignoring these two processes will result in failure to improve human life, and compromising the ability of the future generations.

In addition to the two fundamental processes that Kenworthy identifies as the key success tools in building an eco-city development. Saad *et al.* (2017:59) identifies two main challenges of building an eco-city which mainly include lack of awareness and having fragmented institutions. In terms of lack of awareness, Saad *et al.* (2017:59), highlights

that the principles of the eco-city model have not yet been fully agreed on and as such, this always confuses policy makers on what needs to be done when building an eco-city. In addition, it is highlighted that an eco-city development requires coordinated and concerted efforts from different sectors of development; particularly in terms of addressing cross-cutting issues such as integrated land and transport planning. Such is often hampered and results in failed coordinated sector-based approach (Saad *et al.* 2017:59).

#### 2.2.1.1. GARDEN CITY MODEL

The modern Eco-City ideology directly originates from Howard's theory of Garden City which was developed in 1903 by Ebenezer Howard revealing the ecological charms of harmonious development of a city and nature (Saad *et al.* 2017:57).

Dan and Sawab (2011:18) defines the Garden City as: -

"a town designed for healthy living and industry; of a size that makes possible a full measure of social life, but not only larger; surrounded by a rural belt; the whole of the land being in public ownership or held in trust for the community".

The Garden City model has the following essential eight (8) features or characteristics which Gossop (2006:2) has adequately defined: -

a) **Organised planned dispersal** of industries and people to towns of sufficient size to provide the services, variety of occupations, and level of culture needed by a balanced cross-section of modern society.
b) **Limit of town size** (to around 30,000) in order for people to reside near work places, shops and other facilities located within a walking distance.
c) **Spaciousness of layout** providing for houses with private gardens, enough space for schools and other functional purposes, and pleasant parks and parkways.
d) **A close town/country** relationship with a firm definition of the town boundary and a large area around it reserved permanently for agriculture, providing a ready market for farmers and access to the countryside for residents.

e) **Pre-planning of the whole town framework**, including functional zoning and roads, the setting of maximum densities, the control of building as to quality and design while allowing for individual variety, skilful planting and landscape design.
f) **The creation of neighbourhoods** as developmental and social entities.
g) **Unified land ownership** with the whole site which will include agricultural zone, under trust ownership; enabling planning control through leasehold covenants, and capturing land value for the community.
h) **Progressive municipal and co-operative enterprise** without abandoning a general individual freedom in industry and trade.

With these Garden City features in mind. The concept has included a variety of social objectives which are reflected in the design of the city model. As such, the model promoted harmony between society and nature, thus creating an interconnected, self-sufficient and mutual coordination between places of work and public spaces by building gardens around the central city and using traffic links between the central city and the satellite towns (Youzhen and Longlong 2012:268). The Garden City model does not only attempt to reduce and solve the social problems that cities have, but it also attempts to solve bad housing caused by rapid urban growth during the industrialisation period through the promotion of sustainable development (Dan and Sawab 2011:19).

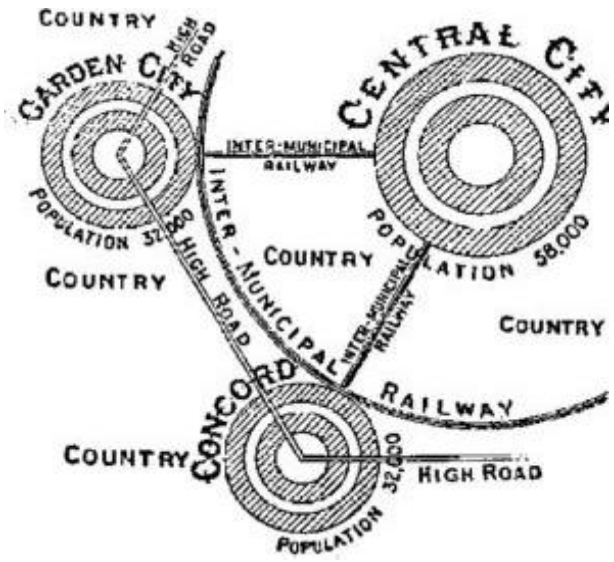


Figure 12: Howard`s concept of city growth – Social City
(Source: Dan and Sawab 2011:21)

The Garden City came from different angles in which Howard also saw the problems of competing advantages and disadvantages between city environments and small rural towns (Eckert 2009:54). The concept integrated the two different city environments taking into account advantages that each has to offer and disregarding the disadvantages (Dan and Sawab 2011:19).

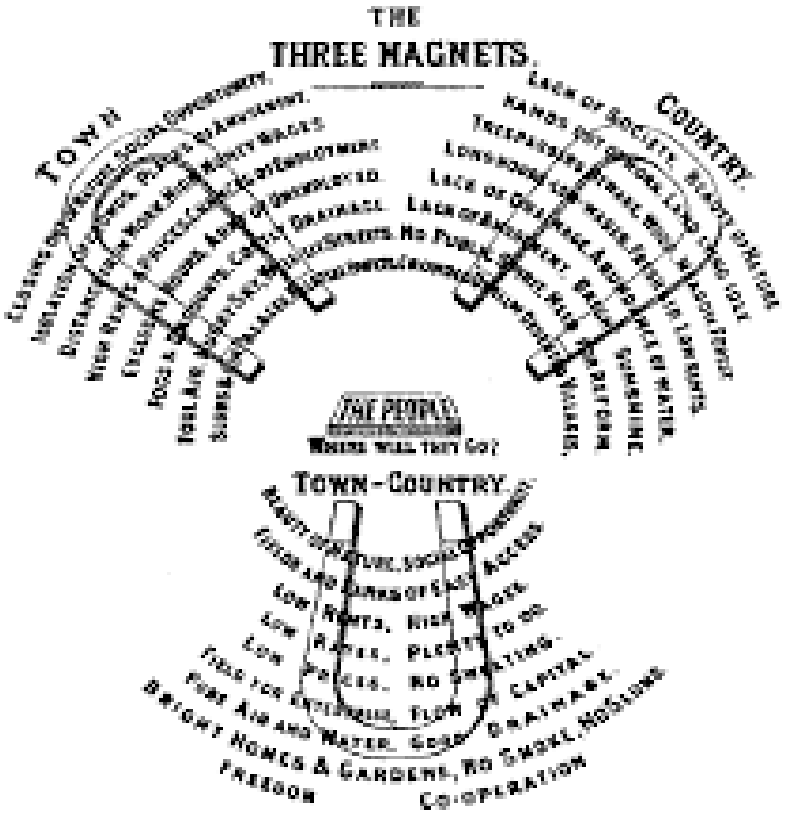



Figure 13: The Three Magnets Diagram (Source: Dan and Sawab 2011:19)

The disregarding of the disadvantages was done so as to provide unique opportunities for small towns to prevent pressures on local service infrastructure provision by taking control of development, integrating planning to decide where best to locate developments and ensure public services, green spaces and amenities are integrated into designs from the beginning of development at a large scale (Parhan and Boyfield 2016:6). Even though Howard`s concept of the Garden City promoted socialism, it sounded possible in theory but was impractical when initiated on the ground (Gossop 2006:3). Howard believed that the Garden City concept would overtake capitalism and replace it with a new civilisation that is purely based on mutual cooperation. However, Howard`s revolutionary vision for

decentralisation and cooperation of socialism ended after the development of just two cities (i.e. Letchworth and Welwyn both located in England) which did not result in the envisioned Garden City model (Dan and Sawab 2011:26). Even though the two cities became adequate cities for people to live in. They were still a complete failure in terms of social revolution and the concept has set-out a perfect example of how socialism might not always preferably be a viable alternative to capitalism and democracy (Gossop 2006:8). Therefore, the Garden City has a valuable contribution to evolution of urban and regional planning approach, but has no valuable contribution towards the contemporary planning approach which is mostly directed by politics, institutionalisation and capitalism, particularly in developing countries such as South Africa (Dan and Sawab 2011:26).

### 2.2.2. GRAPH THEORY

The graph theory emerged in the early 20$^{th}$ century and is one of the fundamental theories used as a "device for modelling and description of real world network systems such as transport, water, electricity and internet" (Kharazi and Pourhadi 2015:23). In the transportation sector, the graph theory is mainly used to reduce travel costs and distance from one place to another. It further uses mathematical applications which include alpha, beta, gamma and cyclomatric numbers, amongst others. The use of mathematical applications in the graph theory simply provides meaningful simplification and understanding of complex problems in transport networks, thus illustrating the degree of efficiency and connectivity in the transport network (Sarkar 2013:77). Furthermore, it also provides us with a structural analysis of transport networks through the use of different components which include the use of "vertices" or "nodal" points and "links" or "edges" used to study the pattern of traffic flow and other transportation network problems which may include such aspects as: -

a) traffic generated by nodes;
b) flow along links;
c) degree of accessibility and connectivity;
d) spatial extent of network;
e) network association along routes; and
f) influence of one place on other places on a route in a network

(Bisen 2017:1764).

With this in mind, the graph theory uses two basic types of measurements to solve complex transport problems by means of which a single number is used that describes the aggregate pattern of the network as a whole, and a vector of numbers which measure the relationship between individual elements (vertices or edges) and the whole network (Sarkar 2013:77). One of the major advantages of the use of graph theory is its comparison of different sets of networks through the use of topological basic graph measurements which include sub-graphs, vertices and edges. The transport networks analysed through the use of graph theory often allow for a realistic presentation of geographical features which presents an opportunity for human interaction and reveals important aspects of development which may include changes in land use development such as changes in settlement pattern, clustering of economic activities, places of work, transport-hub clusters, and so forth. Graph theory, therefore, responds to human behaviour and interaction.

One of the common problems in relation to which graph theory has been used with success in road transport has been the determination of one-way streets. The ideology behind the use of graph theory has been used to determine streets that qualify to be one-way in order to respond to issues of waste energy and air pollution. Therefore, changing certain streets into one-way streets in a city often results in more efficient traffic flow and the alleviation of fuel impacts on the environment (Monteiro *et al.* n.d:2). Over and above its dominant use in managing and directing traffic flow and other transportation networks problems, the theory is useful in other real world network systems which include work operation schemes in the process of production, manufacturing and construction (Kharazi and Pourhadi 2015:23).

### 2.2.3. SMALL-WORLD NETWORK THEORY

The Graph theory is also supported by the “small world network theory” which is known to govern human behaviour by shaping the level of connectivity and unity among participants embedded in a system (Uzzi and Spiro 2005:3). Lamanna (n.d.:1) states that the theory consists of complex networks which are defined as “systems whose structure is irregular, complex and dynamically evolving in time”. These complex networks often include social relationships, phone calls, Internet, and transport, to mention but a few

(Lamanna n.d.:1). The networks in the small world theory are defined or characterised by their degree of connection of nodes, by having relatively short paths between two nodes and by the existence of interconnected groups of nodes which are called “clusters” (Katz *et al.*2004:308). The theory is mostly related to social sciences, and other types of network systems to measure their closeness and their stability in communication between paired nodes (Katz *et al.*2004:308). In most transportation cases which include road, rail, air and water transport; the theory seeks to create short-cuts or to shorten paths between two identified nodes by: -

a) increasing connectivity efficiency through travel schedule coordination;
b) shortening the distance between the nodes;
c) reducing travel times through communication or providing traveller information;
d) improve network interconnection by introducing shorter routes to enable users to travel to various places in shorter times (Hsu and Shih 2008:124).

Like the graph theory, the transportation network systems often depend on the small world network theory in producing traffic information and studying the social behaviour of transport users. Lamanna (n.d.:2) states that the extension of complex network theories in transportation cases requires most mathematical instruments of the typical graph theory, along with some natural changes adopted in order to analyse constraints such as travel times and frequencies. Travel time is considered to be the most significant determinant in the formulation of models for analysing the mobility and accessibility of any transport alliance network (Hsu and Shih 2008:125). Therefore, the small-network theory advocates for three fundamental aspects in the transportation sector that is namely: -

a) Centrality;
b) Efficiency; and
c) Increased information diffusion
(Watts 1999:494)

Literature reveals that there are various models of the small world network theory which have been developed to analyse transportation networks in cities, particularly the metropolis public transport networks. However, the majority of the existing models of the small world network theory in analysing metropolis public transport networks have overlooked most engineering time-related features of the system which include travel times and frequencies of services (Lamanna n.d.:2). It should be noted that even though the theory advocates for centrality, efficiency and increased information diffusion; it still seems to have some shortfalls particularly in increasing information diffusion in larger networks and the minimisation of costs that comes with implementation (Watts 1999:494). This is because it is often difficult to create strong ties in larger networks which will efficiently respond to various transportation challenges in the city (Katz *et al.*2004:321). Implementation of the small-network models should explore some of the useful measures which have been developed recently which consider the flow, behaviour and cost in a vulnerability analysis on different elements of a network which include the equilibrium flow of the transportation network, different modes of transport and time-related communications (Lamanna n.d.:2).

### 2.3. CONCLUSION

Human interaction and behaviour have played a significant role in defining spaces in our cities and having to understand the role that transport plays in spatial restructuring of cities across the world. Such restructuring may be in the form of change in settlement patterns, which may also result in evolution of transport systems and the impact that these have on the broader space economy in terms of trade and production. From the conceptual analysis, it may be understood that the basis of the evolution of transport systems across the globe is highly dependent on the ideology of sustainable development which seeks to fulfil the needs of present-day citizens without compromising the needs of future generations (Black 2004:3). However, preserving of resources for future generations always comes with its own barriers which often hinder transition. The barriers to change are mostly felt by developing countries, particularly in having to move from unsustainable to sustainable ways of life. In the modern day, the most sustainable ways of life, especially in the transport sector, are defined by the use of technological innovation and strategies aimed at making the lives of people easier Banister (2007:73). This is

revealed through the introduction of intelligent transport systems which generally promote efficiency and sustainability. The benefits of the use of technological advancement such as ITS have been overlooked, particularly in secondary cities of most countries (Ezell 2010:12). The tardiness of secondary cities to explore the use of technology to respond to traffic issues often results in primary cities experiencing difficulty in catering for their enormous population growth as there is often no secondary city ready to absorb the excess population without continuously feeling the need to invest in new infrastructural development and increasing the "car-centric" ideology in people's lives (Moody 2012:30).

The inquiry of the theoretical framework has revealed the prospects of transport planning through the use of ecological and mathematical models which have sought to resolve transport issues. The eco-city theory emerged from the garden city theory, driven by the ideology of sustainable development. The two theories (eco-city and garden city) theories are seen to be the ideal models in creating utopian spaces, particularly for urban development (Saad *et al.* 2017:57). This, however, may be a nightmare for most developing countries as such countries often require more money in investment as well as to promote green initiatives, which may also take time to implement (Dan and Sawab 2011:26). In addition, institutionalisation of green concepts in secondary cities of developing countries is still a big question to answer. Over and above the eco-city and garden city theories, the graph and small-world theories promote the importance of centralisation, efficiency and increased information diffusion (Watts 1999:494). They are driven by cost-effective and short-distance ideologies which often present opportunities to reveal realistic presentation of geographical features and human interaction.

However, from the literature analysis undertaken, it is difficult to respond to the tangible shortcomings of both the graph and small-world theories in transportation networks, except that they require specification of habitat quality threshold to measure connectivity in terms of traffic generated within an identified node. In addition, critical dispersal distances are only measured in the identification of edges or links that connect two or more places within an identified territory. Therefore, determination of the quality of connectivity between identified nodal points located in a large scale environment is often hard to achieve, especially when dealing with different types of human behaviour and

interactions (Katz *et al.*2004:321). It is important that transport planners appreciate and not overlook the shortcomings of these theories when solving transport problems, particularly in large-scale environments. Consideration of emigration and immigration components of spatial population dynamics, time-related features, costs and other components which often determine the levels of connectivity in a specific territory, also always need to be undertaken when solving transport problems.

# CHAPTER 3: PRECEDENT STUDIES

## 3.0. INTRODUCTION

Africa is deemed to be one of the fastest growing continents in the world. It is projected that a large number of people across the world will be living in urban areas by 2050 with Africa having almost 1.3. billion living in urban areas and 25% of the 1.3 billion people will aged 60 or over by 2050 (Karuri-Sebina 2016:18). This poses great challenges, but also great opportunities in terms of tackling poor service delivery, transport infrastructure, climate change, poverty, resource depletion and environmental degradation (Karuri-Sebina 2016:18). Sustainable transportation and investment in sustainable urban and regional infrastructural development will have a great impact on the social and regional economies, and investment in transport will play an increasingly significant role in improving the economies of scale and productivity in cities because of traffic congestion which acts as a decentralisation force in economic activities.

The population increase across the world by 2050 will mean that more people will be utilising cars than adopting sustainable ways of transport which may include cycling and public transport usage. China alone gained an additional 17 million new cars in 2014, taking ownership of a record total of 154 million (Lang n.d.:8). The most obvious consequences of this is increased road congestion which can be expected to become trickier to deal with and which will result in high negative environmental (climate change), social (housing, education, etc.) and economic impacts (employment opportunities).

Most literature reveals that one way to mitigate the impacts that come with population growth is through the use of applications of information and communication technology in the transport sector which has led to the development of intelligent transport systems (ITS) (Stawiarska and Sobczak 2018:2). For most developed countries such as the United States, Japan, Singapore, and the United Kingdom, Intelligent Transport Systems have been increasingly used to respond to traffic issues. However, for developing countries such as China and India, ITS are increasingly tailored to respond only to the specific needs of the country (Vanajakshi *et al.*2010:50). This is also seen to be the case in South Africa. The most specific needs that are being addressed in developing countries are

mostly influenced by the analytical power offered by open and " big data" evolutions (Lang n.d.:8).[1]

With this in mind, this chapter attempts to reveal both the successful and unsuccessful cases of intelligent transport systems in developed and developing countries, also taking into account cases in South Africa in which intelligent transport systems have been applied to facilitate transport from a sustainable development perspective.

## 3.1. INTELLIGENT TRANSPORT SYSTEMS IN DEVELOPED COUNTRIES

Literature reveals a number of examples of both successful and unsuccessful implementation of intelligent transport systems across the world. Some of the factors that have led to successful implementation of ITS include, but are not limited to, strong advocates and public support; weak opposition; a single agency overseeing the ITS project; a good public transportation system in place; simple and affordable pricing systems using proven technology; environmental monitoring and protection; and comfort factors that create confidence amongst users (Hommes and Holmner 2013:195). Besides these success factors, there have also been failures that have come with the implementation of ITS which include lack of information on ethical considerations of ITS; privacy, security and societal issues; policy challenges from political powers; extensive deployment costs; and funding constraints to mention but a few (Hommes and Holmner 2013:198).

### 3.1.1. SUCCESS CASES OF ITS IN LONDON, SEOUL AND SINGAPORE

#### a) ITS in London

One of the major success stories of the implementation of ITS can be seen in London, through its introduction of the congestion charge that was implemented in 2003. The congestion charge system aimed at charging motorists for using the road in certain congestion zones around central London, in order to reduce traffic and encourage the use of public transport or car pools (Hommes and Holmner 2013:195). The London model is notable for the way it was initially implemented and the way it is currently managed

[1] "Big Data" is a term for a family of techniques and technologies that many businesses are increasingly using to improve and streamline their business practices, and it hold real promises of management and analysis connected to transportation data (Cuddy et.al 2014:16).

(Hommes and Holmner 2013:195). The charge that was implemented was standardised across all vehicle types with discounts given to residents of the town and to citizens with special needs such as physically disabled people. Motorists are only
charged during peak congestion times which are mostly between 7:00 and 18:30, particularly in the congestion zones (Hommes and Holmner 2013:196). The charge scheme reported a 6% increase in bus use and a 20% drop in road traffic (ITS United Kingdom n.d:6). Also notable was the attitude of London society, which did not oppose the implementation of the initiative as the public was more open to change after the long

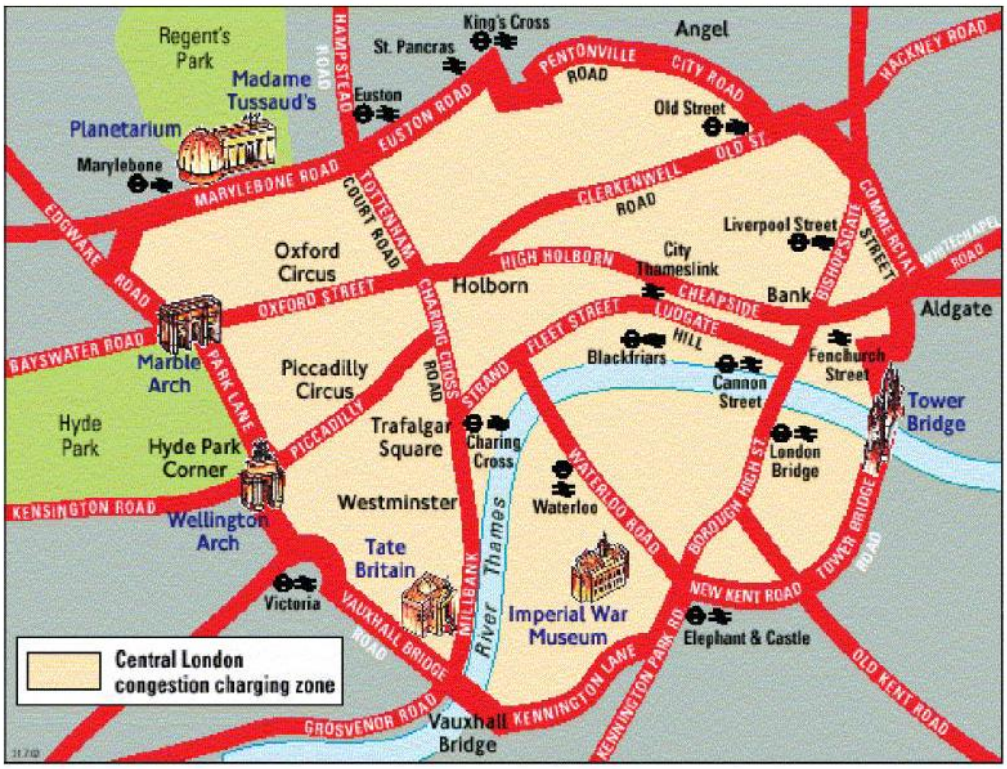



Figure 14: London Congestion Charge Scheme (Source: ITS United Kingdom n.d:6)

struggle of experiencing gridlock congestion. The transition to the system was made easier as London has an excellent public transport system, including government subsidised buses, trains, subways and taxis with profits generated from the system being reinvested into public transport development and improvements and was thus politically supported (Hommes and Holmner 2013:19).

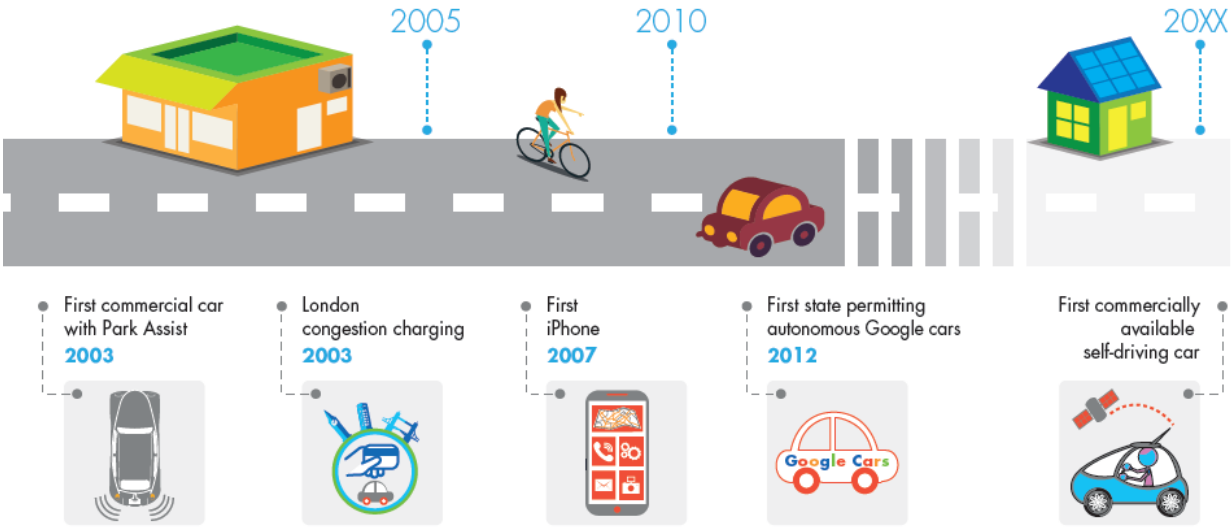



Figure 15: Info-graphic timeline with important traffic and Intelligent Transport System Moments

(Source: Jonkers and Gorris 2015:12)

### b) ITS in Seoul

Seoul, situated in the jurisdiction of South Korea, adopted the use of ITS through the maximisation of the efficient use of "big data" systems which aimed at creating new bus routes and expressway to manage and reduce traffic congestion and respond to public demands. The use of the big data systems was visible through the Freeway Traffic Management System (FTMS) project which maximised the use of different technologies to disseminate information to transport users (Lee 2017:1). The city developed a plan for the construction of an Urban Expressway Traffic Control Centre which commenced in 1990 when ITS began to gain attention (Lee 2017:2).

The use of big data was initiated through the combination of public data from transit cards about start-destination points and public transport data from mini-taxis and other forms of public transport. The combination of data was mainly drawn from individual smartphone application systems and through the use of Geographic Information Systems (GIS), which enabled traffic engineers to map and illustrate the daily travel patterns or habits of public transport users (Lang n.d.:25).


Figure 16: Traffic Management and Information Dissemination Korea (Source: Whon Yu and Ajou 2017:76)

The highest information usage by transport users was mainly through internet in which in 2013, statistics shows that FTMS information was used at least 11.7 million times indicating a drastic increase from 2007 which recorded 4.6 million. The number of information searches using smart mobile phones has also increased in 2013 due to the surge of transport users having easy access to smart mobile devices (Lee 2017:9).

| Category | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total no. of usages | 2,256,940 | 2,780,286 | 3,026,974 | 4,276,123 | 4,593,626 | 4,862,232 | 5,930,403 | 10,449,609 | 18,117,411 | 13,612,320 | 11,777,260 |
| Internet | 2,025,411 | 2,584,203 | 2,822,365 | 3,932,823 | 4,059,065 | 4,294,350 | 5,337,458 | 9,904,212 | 17,759,764 | 13,364,052 | 5,726,604 |
| Mobile | Uncounted | | | | | | | | | | 5,811,771 |
| ARS/FAX | 222,342 | 185,664 | 192,151 | 321,624 | 501,039 | 528,204 | 545,110 | 491,263 | 316,693 | 178,101 | 122,922 |
| Telephone Inquiries | 9,187 | 10,419 | 12,458 | 16,742 | 16,493 | 14,335 | 12,955 | 10,077 | 7,709 | 6,226 | 4,972 |
| Feature Phone, PDA | - | - | 518 | 4,934 | 17,029 | 25,343 | 34,880 | 44,057 | 25,155 | 54,753 | 7,794 |
| Twitter | - | - | - | - | - | - | - | - | 8,090 | 9,188 | |

Figure 17: The use of FTMS Information by each medium in Seoul (Source: Lee 2017:8)

The analysis of the data led to the establishment of ideal bus routes, confirmation of real-time intervals and bus stop locations. Such initiatives reduced the usage of night-time bus routes by 25% compared to that of buses operating during day time (Lang n.d.:25). In addition, social benefits which include reduced responding times to incidences, energy consumptions and environmental air quality were highly visible (Lee 2017:8).

Over and above the visible social benefits generated by the system. There were some

| Category (Year/ Benefits) | Reduced Travel Time in Mainline | Route Change (Bypass) | Reduced Time In Responding to Unexpected Incidents | Reduced Energy Consumption (Operational Costs) | Improved Environment (Air Quality) | Sum |
|---|---|---|---|---|---|---|
| 2003 | 16,634 | 472 | 3,910 | 5,647 | 565 | 27,229 |
| 2004 | 16,673 | 532 | 4,906 | 5,709 | 597 | 28,418 |
| 2005 | 25,181 | 765 | 6,201 | 9,579 | 963 | 42,689 |
| 2006 | 45,319 | 4,935 | 7,739 | 10,769 | 1,053 | 69,815 |
| 2007 | 72,382 | 7,793 | 10,942 | 6,679 | 649 | 98,445 |
| Total | 176,189 | 14,497 | 33,697 | 38,383 | 3,829 | 266,595 |
| Percentage (%) | 66.1 | 5.4 | 12.6 | 14.5 | 1.4 | 100.0 |

Figure 18: Social Benefits Generated by FTMS (Source: Lee 2017:8)

challenges that the city faced in the rolling-out of the project which included the performance of the applied technology which required to be supplemented in terms of providing real-time information taking into account the frequency it takes for the system to update commercial data and for it to appear on the electronic map of traffic information centres and for the data collected from vehicle detection system to be disseminated to the road (Lee 2017:9). In addition, there were also challenges in securing adequate

[2] "Big Data" is a term for a family of techniques and technologies that many businesses are increasingly using to improve and streamline their business practices, and it hold real promises of management and analysis connected to transportation data (Cuddy et.al 2014:16).

funding to maintain deteriorated facilities and having an advancement plan that will link the freeway with the arterial roads that will results in the provision of real-time information for transport users (Lee 2017:10).

### c) ITS in Singapore

Adding to the London and Seoul ITS success stories is the Singapore user-pay model which was developed in, and has been used since, 1975. The user-pay model has resulted in Singapore successfully reducing its peak traffic demand, particularly in restricted zones of Central Business District (CBD) and congestion, carbon emissions and fuel use (Hommes and Holmner 2013:196). The user-pay model was never based on technical feasibility; rather it was notable for its cost effectiveness and public acceptance (Hommes and Holmner 2013:196).

| Time (hours) | Traffic (March 1975) | Traffic (May 1976) | Traffic (May 1979) | Traffic (May 1983) |
|---|---|---|---|---|
| **Cars** | | | | |
| 07:00-07:30 | 5,384 | 5,675 | 5,723 | 6,413 |
| 07:30-10:15 | 42,790 | 10,754 | 13,181 | 15,473 |
| 10:15-10:45 | n.a. | 6,459 | 5,527 | 7,069 |
| | | | | |
| **All vehicles** | | | | |
| 07:00-07:30 | 9800 | 10,332 | 10,596 | 11,280 |
| 07:30-10:15 | 74,014 | 35,787 | 49,606 | 57,035 |
| 10:15-10:45 | n.a. | 13,441 | 15,179 | 16,490 |

Figure 19: Singapore Traffic Effects of the User-pay Model (Source: Yuan n.d:10)

Even though the table above details an increase in a number of vehicles entering the CBD during peak hours. A survey conducted in 1989 revealed that the number of vehicle entering the CBD restricted zone during morning peak i.e. 07:30-10:15 was 51,000 compared to the recorded 74,000 in 1975 (Yoan n.d:10). This illustrates a very significant decrease considering that Singapore is one of the world`s economic hub which has experienced 68% increase in vehicle population since 1975 (Yoan n.d:10). during which vehicle population has increased by 68% since

In 1998, Singapore switched to an Electronic Road Pricing (ERP) which is based on the "pay-as-you-go" principle system according to which drivers are charged automatically through a short range, using real-time variable pricing in which charges are calculated based on traffic conditions, locations, vehicular type and time of the day with historic traffic data to predict the amount of congestion expected. The money generated from the fee collection is used for construction, road maintenance and the development of a better public transport infrastructure (Hommes and Holmner 2013:196). The Singapore pay-as-you-go system is considered to be the cheapest and most cost-effective model, particularly with the real-time pricing system (Hommes and Holmner 2013:196).

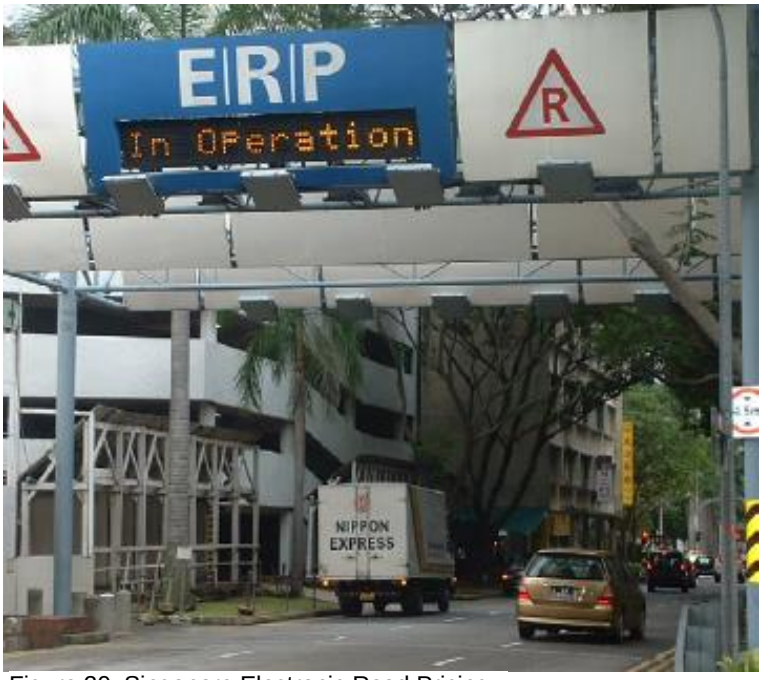


Figure 20: Singapore Electronic Road Pricing
(Source: Sayeg and Charles 2005:20)

Singapore is notable for its successful implementation of the Singapore ITS Master Plan named "Smart Mobility 2030" in 2014, which was developed by the Singapore Land Transport Authority in collaboration with ITS Singapore (Lang n.d.:27). The master plan aimed at responding to the changing transport needs and to provide strategic leadership, guidance and support in facilitating "a connected transport community" (Lang n.d.:27). Therefore, with these strategies and initiatives, Singapore remains one of the oldest success cases; particularly in promoting public and private sector collaboration for the implementation of ITS. The Land Transport Authority also played a significant role in ensuring maximisation of citizen participation in innovative solutions for commuters, which drew on their own experiences with local transportation (Lang n.d.:27).

### 3.1.2. FAILURE CASES OF ITS IN GREATER MANCHESTER

Although there have been success cases such as those of London, Seoul and Singapore, there have also been major failure cases in the implementation of ITS, such as those in the Greater Manchester and Edinburgh, cities in the United Kingdom. The London congestion charge model set a precedent for developed countries such as the United Kingdom and the United States. However, not every city was able to implement ITS and the failure cases have mostly been associated with the lack of public acceptance of ITS initiatives and lack of faith in the political environment to implement ITS.

Greater Manchester, using London as a precedent case, also proposed the congestion charge system in 2008. The Manchester congestion charge system mainly proposed the "e-tag" system in which motorists are charged automatically as they drive through a barrier. The revenue generated from the system was intended to partly reduce road congestion and to develop a more extensive public transport system (Hommes and Holmner 2013:197). The system was further proposed to be implemented only after 80% of the proposed public transport improvements had been completed. However, the introduction of the Manchester congestion charge system was subjected to major rejection by both the public and the local council. This rejection of the system resulted in high fuel prices which weakened the country`s economy. Therefore, the failure of the country's IT system was due to the high level of political rejection that the project received. Similar rejection was also seen in Edinburgh, where the failure of the ITS project was mainly due to lack of public acceptance and faith in the political environment to implement ITS (Hommes and Holmner 2013:197).

## 3.2. INTELLIGENT TRANSPORT SYSTEMS IN DEVELOPING COUNTRIES

For most developing countries across the world, the development of intelligent transport systems is still difficult to fully implement, especially in cities of developing countries. Literature reveals that most Asian-Pacific countries such as India and China are still faced with challenges of ITS implementation which require extensive financial support, acceptability to the public, technological and infrastructural improvements. For most developing countries, implementation of ITS cannot follow that of the developed countries because what works for one country does not necessarily work for another country,

particularly if the countries do not share similar characteristics in terms of the range of cultural, lifestyle and physical differences. Such differences often make it difficult to learn from the different cases across the world thus resulting in a greater chance of failure than of success.

**a) ITS in India**

The failure of ITS implementation can be seen in India, where the advancing economy of the country has resulted in a phenomenal increase in the use of private vehicles. Ribeiro *et al*. (2007:332) state that vehicle usage increased by approximately 12.17% between April 2007 and March 2008 amounting to approximately 9.6 million cars being sold by end March 2008. This indicates that the increase in vehicular usage in India happens on a daily basis taking into account the short period it takes for the country to increase car sales. It is expected that the country will surpass China as the fastest growing motor vehicle market in the world (Vanajakshi *et al.* 2010:50). The economy-induced motor vehicle increase has been exacerbated by the increase in population, particularly because of rural-urban migration which continually puts pressure on government to invest in transport infrastructure, and even more so in already overpopulated regions.

Vanajakshi *et al.* (2010:50) state that the World Bank reports that the major challenges facing the deployment of ITS in developing countries like India are the undeveloped road networks, severe budget restrictions, increased urbanisation and growth, lack of resources for maintenance and operation, decreased demand for automation, lack of interest among government decision-makers and lack of awareness, to name but a few. In other regions of India which include New Delhi, Pune, Bangalore, and Indore; small-scale ITS projects have been introduced which focus mainly on parking information, area-wide signal control, advanced toll collection and web-based traveller information Vanajakshi *et al.* (2010:50). These small-scale projects are however executed as pilot projects, and they do not have a major impact on traffic management and control. However, they play a significant role in highlighting the promise and potential of ITS deployment across other regions of the country and provide empirical evidence on transportation data management, as well as methodological, practical and research challenges for Indian traffic conditions. Therefore, the increase in population growth in

developing countries such as India is continually putting pressure on policy makers and engineers to implement ITS to deal with transportation challenges Vanajakshi *et al.* (2010:50).

**a) ITS in Hong Kong, China**

Countries such as China are faced with challenges which include amongst many others the inability to meet evolving national ITS standards for different ITS applications and components; for example setting out a national clearing house that documents ITS projects with details on design, implementation, lessons learned or best practices, and cost benefit details; setting out of an operational traffic management centre responsible for the coordination of urban and regional ITS activities; details on the development and implementation of automated traffic data collection methodologies; development of a national ITS data archive; and development of models for ITS implementation and institutionalisation of ITS, particularly in terms of fostering interaction between academia, industries, and government agencies to generate more interest and in turn projects in the ITS area Vanajakshi *et al.* (2010:50).

Notable resistance in the implementation of ITS is seen in Hong Kong, where rejection was experienced. Hong Kong introduced the user-pay system which included e-tags and CCTV cameras. Citizen rejection on ITS projects in the country was related more to privacy and security issues on highways, however, because the citizens believed that the system promoted invasion of privacy. The user-pay project was an initial pilot project which aimed at demonstrating the effectiveness of ITS for traffic management. However, it experienced major public rejection which led to a massive government campaign emphasising the fairness of the system. The system was met with opposition over high costs, privacy issues and uncertainty resulting in the system being reconsidered (Hommes and Holmner 2013:197).

Most ITS in China depend mainly on public funding for implementation as well as to sustain or maintain the project going forward. Even though local authorities seek to attract private investors from outside the public sector, relying on a built-transfer (BT) model to mitigate financial risks, it is still difficult for the country to fully implement ITS projects (Lang n.d.:29). This is because Asian countries such as China lack guidelines for ITS

implementation, with absence of IT regulation, lack of ITS data repository and high sunk, ongoing implementation costs (Lang n.d.:32). Therefore, the current trends in implementation of ITS must emphasise the importance of implementation costs, ITS policy and regulation that will address concerns on financial costs, standardisation, capacity development and master planning at a central level (Lang n.d.:32).

### 3.3. INTELLIGENT TRANSPORT SYSTEMS IN SOUTH AFRICA

The South African Business Tech online newspaper state that the most congested cities in South Africa Cape Town, Johannesburg, Pretoria, Durban, Port Elizabeth and Bloemfontein. The Numbeo 2019 Traffic Index indicates that in 2018, Cape Town had an index score of approximately 95 which translate to 162 hours lost in congestion every year or just under a week, ahead of Pretoria with 143 hours (5.95 days) and Johannesburg with 119 hours (4.95 days) (Numbeo. 2019).

Numbeo. (2019) defines the Traffic Index as a "composite index of time consumed in traffic due to **job commute, estimation of time, consumption dissatisfaction, $CO_2$ consumption estimation** in traffic and overall inefficiencies in the traffic system". It further indicates that the four indices which are used to calculate the Traffic Index are subject to change and are quite complex empirical formulas which are written in the Java programming language which reads as follows: -

```
" protected void calculateIndex() {
    index = new TrafficIndex();
    index.time = overall.getTimeOverall();
    double tooMuchTime = 0.0;
    if (index.time > 25.0) {
      tooMuchTime = index.time - 25;
    }
    index.timeExp = index.time + Math.pow(tooMuchTime, Math.E);
    double co2 = 0.0;
    co2 += overall.time_bus * 20.0; // bus produces 20g of CO2 per minute (for each
passenger)
    co2 += overall.time_driving * 133.0; // car produces 133g of CO2 per minute
(assumes only driver)
    co2 += overall.time_train * 10.0; // train produces 10g of CO2 per minute (for
each passenger)
    co2 += overall.time_tram * 15.0; // tram produces 15g of CO2 per minute (for each
passenger)
```

[3] Numbeo is world's largest database of user contributed data about cities and countries worldwide. It provides current and timely information on world living conditions including cost of living, housing indicators, health care, traffic, crime and pollution (Numbeo. 2019) (https://www.numbeo.com/common/)

```
    co2 += overall.time_other * 10.0; // other produces 10g of CO2 per minute
    co2 += overall.time_motorbike * 80.0; // motorbike produces 80g of CO2 per hour
    index.co2 = 2 * co2;

    index.main = index.time + Math.sqrt(index.timeExp) + Math.sqrt(index.co2) +
Math.sqrt(index.inefficiency);}"
```

In terms of the $CO_2$ Consumption, it is assumed that 240 days of commuting during the year results in one (1) tree absorbing approximately 48lb. per year of $CO_2$ thus being calculated using the following Java programming formula: -

```
" double co2CommuteConsumptionYearly = 240 * index.co2;
    double treesNeededForCommute = (co2CommuteConsumptionYearly / 1000) /
21.77;  //each tree absorbs about 21.77kg of CO2"
```
(Numbeo.2019).

The table below depicts the top five (5) South African most congested cities as per the Numbeo`s Traffic Index Score for 2018.

Table 2: South Africa's most congested cities

| Rank | City | 2018 Impact Rank (2017)[4] | Hours Lost in Traffic | Year over Year Change (%) |
|---|---|---|---|---|
| **1** | Cape Town | 95 (96) | 162 | -4 |
| **2** | Pretoria | 64 (71) | 143 | 9 |
| **3** | Johannesburg | 61 (63) | 119 | 3 |
| **4** | Durban | 141 (133) | 72 | -8 |
| **5** | Port Elizabeth | 75 (77) | 71 | 1 |
| **6** | Bloemfontein | 165 (174) | 62 | 8 |

(Source: Business Tech,2019)

In South Africa, the advantages of ITS was highly recognised and maximised during the 2010 Soccer World Cup. Its emergence was however first initiated in 2001, and it has evolved over the past 16 years, particularly in the field of urban traffic control systems (Thomas 2014:394). The ITS system includes monitoring road conditions through CCTV and responding to events by changing variable speed and message signs or even updating motorists via in-vehicle monitors (Thomas 2014:394).

[4] The Impact Ranking in brackets () depicts the 2017 ranking. While the year of year change depicts the improvements in percentage on traffic congestion in each city between 2017 and 2018 respectively.

The most recent ITS solutions that South Africa has realised towards solving and promoting sustainable transportation include the following fundamental projects: -

- installation of solar road studs by the KwaZulu-Natal Provincial Department of Transport (KZN DoT);
- the eThekwini Intelligent Transportation Systems (ITS) Freeway Management System incorporating, amongst others, variable message signs and camera monitoring on the N2, N3, M4 and other major routes within eThekwini, Durban Inner City Distribution Systems;
- development of the Gautrain Rapid Rail Link launched in February 2000 which links Pretoria, Johannesburg and OR Tambo Airport;
- Cape Town's transport tracking system, incident management centre, smart card applications for parking, inner city public transport and metro transport information call centre;
- the Gauteng electronic toll collection (E-Toll) system with drive-through lanes being developed in the Gauteng Province (Thomas 2014:392).

The majority of these ITS projects have been successfully implemented across the primary cities of the country. The projects have also played a significant role in reducing poverty by increasing economic efficiency and lowering the cost of travel and improving employment and social opportunities (Thomas 2014:395).

**a) ITS in Gauteng, the City of Johannesburg, Tshwane and Ekurhuleni**

In 2013, the Gauteng Department of Roads and Transport developed the Gauteng Transport Master Plan which focussed on Intelligent Transport System Planning that aimed at "assisting planning, funding and deployment of ITS technology which will facilitate the integration of transportation systems and promote possible utilisation of existing and future transportation networks" (Gauteng Department of Roads and Transport 2013:3). The Gauteng Department of Roads and Transport Master Plan

identifies five (5) fundamental ITS functional areas which will be prioritised to support and promote sustainable transportation. These functional areas are mainly:

- travel demand management (TDM)
- public transport planning (in particular, public transport information)
- non-motorised transport (NMT)
- freight logistics
- environment.

These ITS initiatives are seen in the already deployed projects which include the following: -

- ***Bus Rapid Transit Projects***

The **Rea Vaya Bus Rapid System**, 2013, in the City of Johannesburg in which its most notable ITS deployment is seen through the automated fare collection, CCTV surveillance, fleet management and control, traveller (passenger) information, operations centres and communications between devices and control (Gauteng Department of Roads and Transport 2013:23). The Rea Vaya BRT connects areas that make up the City of Johannesburg Metro which include Braamfontein, Parktown, Soweto, Dobsonville, Belleview, amongst others.


Figure 21: Rea Vaya Buses at the Johannesburg Depot (Source: McCaul and Ntuli 2011:9)

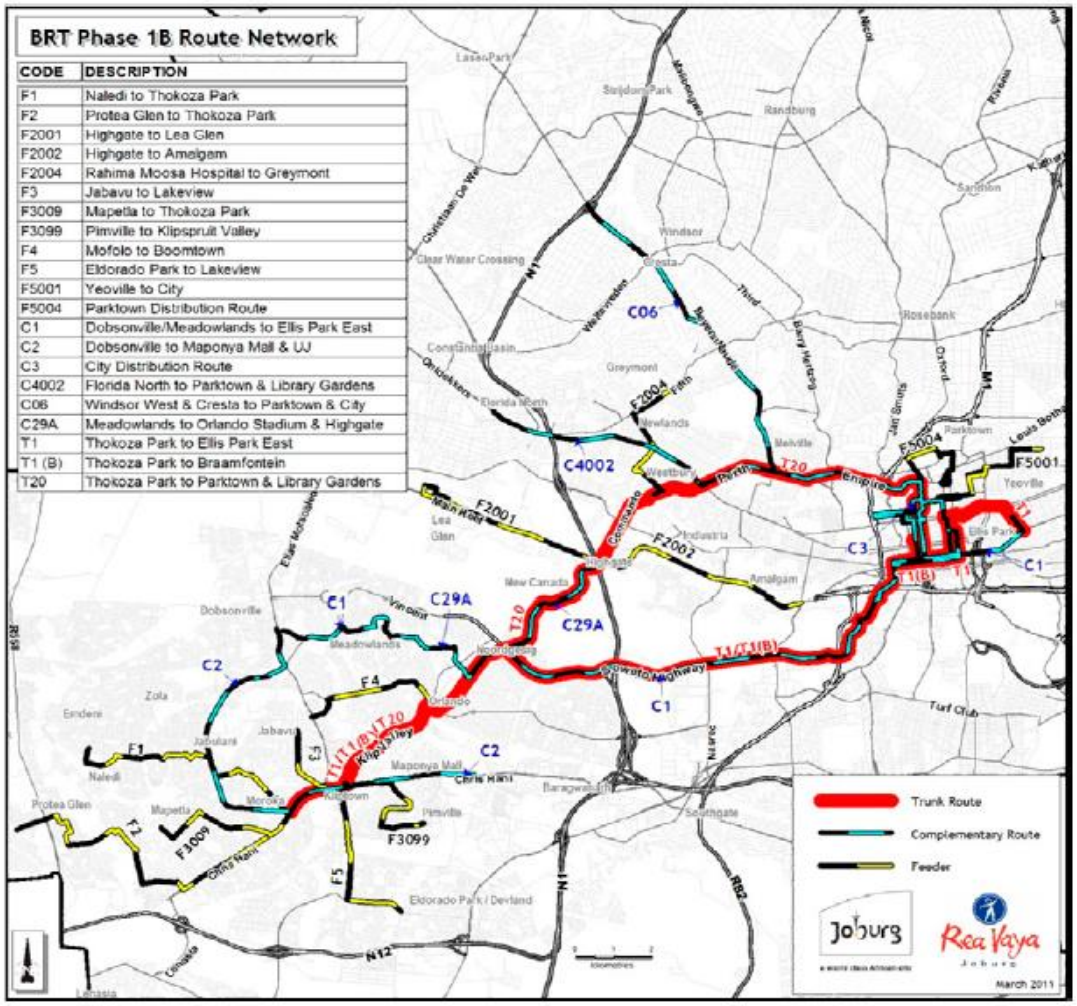


Figure 22: Rea Vaya Service Routes (Source: McCaul and Ntuli 2011:8)

The **A Re Yeng Bus Rapid System**, deployed in 2015 by the City of Tshwane, which also notably promoted ITS through automated fare collection, development of a Central Control Centre (CCC), Urban Traffic Control System (UTC), Advanced Public Transport Management System (APTMS), Automatic Fare Collection System (AFCS), amongst others (Vorster 2013:1). The A Re Yeng BRT covers areas that make up the City of Tswane Metro which include Pretoria CBD, Hatfield, Mamelodi, Wonderboom, Groenkloof, for example.

The Rapid Transit Structure consist of a number of elements which enable the system to function efficiently which includes but not limited to: -

- Line 1A CBD to rainbow junction of 9.3km servicing 9 stations,
- Line 2A CBD Hatfield of 7km servicing 10 stations;
- Line 2B Hatfield to Menlyn of 10km servicing 9 stations;
- Interim Control Centres;
- 200 traffic signals with new controllers and central/ adaptive control bus priority;
- 20 Variable Message Signs on Major Routes;
- Parking Guidance Additional Fibre Optic Network;
- 6 Depots; and
- 174 Buses

(Vorster 2013:6).

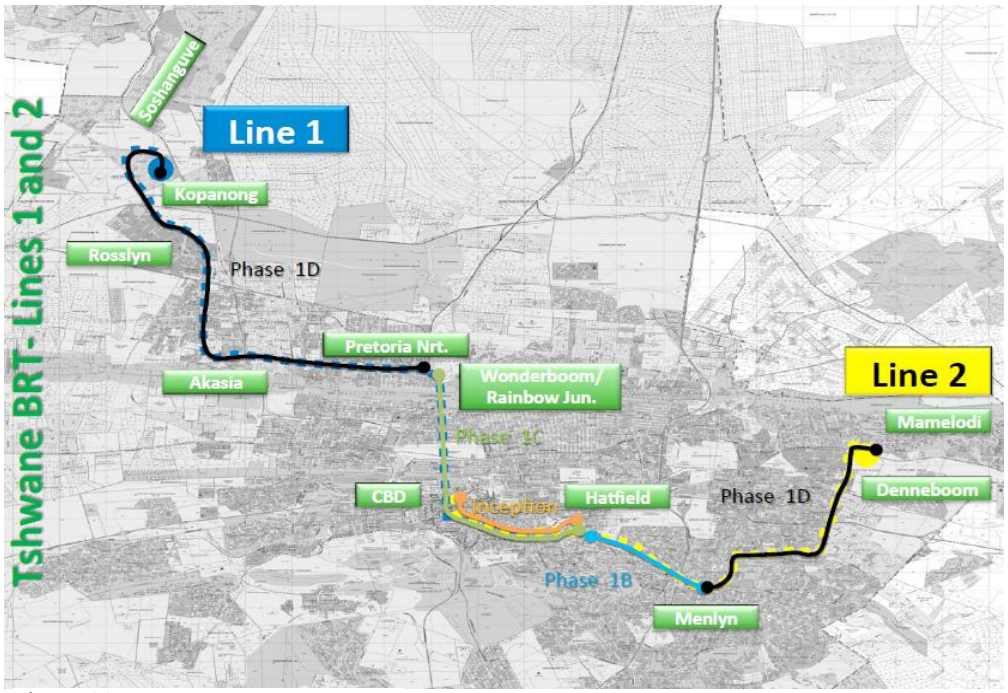



Figure 23: A re Yeng BRT Route(Source: Voster 2013:5)

The **Harambee Bus Rapid System**, of the City of Ekurhuleni deployed in 2017, also encompasses ITS functionalities similar to the Rea Vaya and A Re Yeng BRT systems. The Harambee BRT system connects areas that make up Ekurhuleni Metro which include Benoni, Germiston, Springs, Kempton Park, Edenvale, Nigel, Brakpan, Boksburg and Alberton.


Figure 24: Harambee BRT Route
(Source: City of Ekuhruleni Municipality, 2019)

- ***Gautrain Rapid Rail Link***

Gautrain is the first Gauteng high-speed metropolitan transport megaproject that South Africa implemented prior to the hosting of the 2010 World Cup. The project was implemented in order to address the issue of traffic congestion in the Gauteng region, particularly serving mostly the cities of Johannesburg and Pretoria. Over the years, since the apartheid era, the City of Johannesburg has been predominantly characterised by urban sprawl and separation, with traffic congestion due to people migrating and commuting into the city to work or to look for job opportunities. As a result, transportation became one of the significant issues that the South African government needed to address. The Gautrain rapid rail system was launched in February 2000, and it links Pretoria, Johannesburg and OR Tambo Airport. The system travels between Johannesburg and Pretoria at a speed of 180km/h in an estimated time of 35 minutes. This obviates the need for one to travel along the Ben Schoeman Highway, which with congestion can take up 2 hours by motor vehicle (Van der Westhuizen 2007:336). The Gautrain network comprises two lines, one of which links Johannesburg

and Pretoria, and the other links Sandton and OR Tambo Airport and has two anchor stations at Pretoria Train Station and Johannesburg Park Station. The system further consists of seven other stations in Hatfield, Centurion, Midrand, Marlboro, Sandton, Rosebank and Kempton Park (Van der Westhuizen 2007:336). The Sandton, Rosebank and Park Stations consist of underground stations which are between 20 and 45 metres below the surface of the road. The Gautrain is expected every 12 minutes during peak hours from 06:00-08:30 and from 15:30-18:00. During off peak hours it is expected every 20 minutes: from before 06:00 in the morning, between 08:30-15:30, and after from 18:00. Over weekends and on holidays it is expected every 30 minutes (Van der Merwe 2011:31). There are also 125 buses available to transport passengers over a radius of 6 kilometres from the various train stations (Van der Merwe 2011:31).

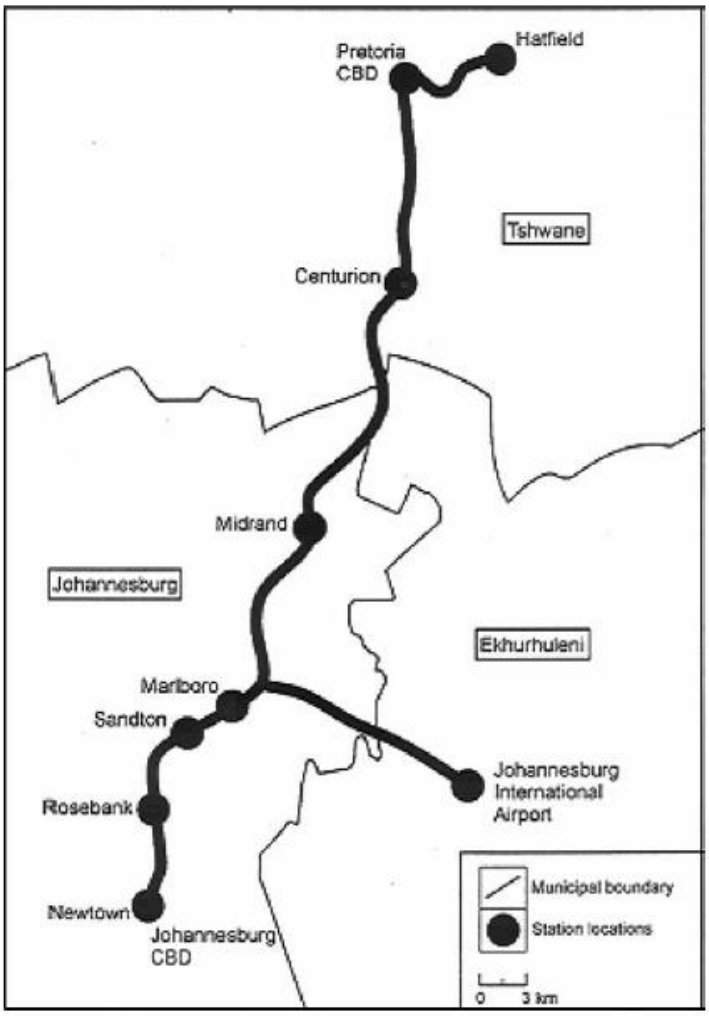


Figure 25: Gautrain Route (Source: Van der Merwe 2011:337)

Therefore, the Gauteng Rapid Rail Link has made a major positive change in the public transport image of the Province. The Gauteng rail network system will be expanded to include the following areas: -

Table 3: Gauteng Rail Network Proposed Upgrades

| Rail Type | Proposal |
|---|---|
| **High Speed** | 1. Provide for Terminal Stations |
| **Rapid Rail/ Metro** | 2. Mabopane-Pretoria-Germistone-Park-Naledi/Midway (upgrade – Modernisation)<br>3. Mamelodi – Tshwane East- Samrand-Ruimsig- Roodepoort-Naled (Soweto)<br>4. Sandton –Rumsig<br>5. Rhodefield –East Rand Mall – Boksburg<br>6. Tshwane Ring Rail (upgrade) |
| **Commuter Rail** | 7. Hammanskraal – Pretoria (upgrade)<br>8. Leralla (Tembisa) – Midrand<br>9. Mamelodi – Pienaarspoort – Rayton/Bronkhorspruit (Upgrade)<br>10. Dayveton – Etwatwa<br>11. Baralink<br>12. Moloto- Pretoria |

(Source: Gauteng Department of Roads and Transport 2013:49)

The Gautrain uses extensive ITS applications which support the day-to-day operations of this high quality transport mode (Gauteng Department of Roads and Transport 2013:23). The ITS applications that Gautrain uses include automated fare collection, CCTV surveillance systems, traveller information, communication systems and centralised operations. However, it is clear that "the fare collection system does however not use bank-based contactless smartcards operating on the principle of pre-authorised debit" (Gauteng Department of Roads and Transport 2013:23).

- ***SANRAL electronic toll collection (e-Toll) and open-road tolling***

The e-Toll is only on selected roads and toll lanes, with other roads still on the open road tolling (ORT). Both the e-Toll and the ORT are supported by various ITS applications

along the gantries. Some of these applications include CCTV surveillance, communication systems, supporting software systems and centralised operations (including violator processing and transaction clearing) (Gauteng Department of Roads and Transport 2013:23).

- ***SANRAL freeway management system (FMS)***

These systems have been deployed on large portions of the Gauteng freeway network, covering most of the national roads within Gauteng (Gauteng Department of Roads and Transport 2013:23). The systems have been expanded and improved, and consist of typical ITS application areas which also include CCTV surveillance, vehicle detection systems, traveller information, travel time prediction, communication systems and centralised operations.

**b) ITS in Western Cape, the City of Cape Town**

- ***MyCiTi Bus Rapid Transit System***

In responding to the traffic congestion, the City of Cape Town established the MyCiTi bus rapid transit (BRT) system in 2007. The MyCiTi service was completed in two fundamental phases: Phase 1 of the service comprised the West Coast along the R27 between Atlantis in the North, to the CBD and surrounding areas, and further south to Hout Bay. The routes were expanded to a route along the N2 which runs from the Civic Centre to the Cape Town International Airport, Khayelitsha and Mitchell's Plain (City of Cape Town 2017:27). Phase 2 of the MyCiTi bus system was extended from Khayelitsha and Mitchell's Plain through Philippi to Wynberg and Claremont (City of Cape Town 2017:7). Currently, the bus system consists of 42 stations with four (4) routes having the highest number of passengers during the morning peak time, i.e. 06h00-09h00 which are:-

- ✓ Dunoon – Table View – Civic Centre – Waterfront (4,206 passengers)
- ✓ Atlantis – Omuramba (3,030 passengers)
- ✓ Atlantis – Table View – Civic Centre (1,971 passengers)
- ✓ Waterfront – Civic Centre – Table View – Dunoon (1,923 passengers)


Figure 26: My City Bus Routes (Source: Sustainable Energy Africa 2017:137)

The My Citi Service Routes will also be expanded to two more phases i.e. Phase 3 and Phase 4 which will largely cover areas at Stellenbosch.

- ***Passenger Rail System***

The City of Cape Town has 125 passenger rail stations located in the functional area of the city, and nine radial routes originating from the Cape Town station (City of Cape Town 2017:37). Of the nine (9) radial routes, at least 5 main passenger routes are the Southern Suburbs line, the Cape Flats Line, the Central Line, the Malmesbury-Worcester Line and the Northern Line (City of Cape Town 2017:27).

According to City of Cape Town (2017:27), the 2012 Rail Census showed that approximately 622 000 passenger trips were made across the Cape Town rail network on an average weekday with most popular routes being:

- ✓ Chris Hani to Cape Town via Esplanade and Mutual (133,765 trips),
- ✓ Simonstown to Cape Town (96,770 trips),
- ✓ Wellington to Cape Town via Woodstock (91,380 trips) and
- ✓ Kapteinsklip to Cape Town via Woodstock and Pinelands (72,481 trips).

- ***Smart Card System***

In support of the passenger rail system and the bus rapid system, Cape Town has released 25 000 smart cards for sale to daily train commuters using the rail service between Cape Town and Mitchell's Plain (Thomas 2004: 394). Cape Town has recently implemented their public transport tracking system, incident management control centre, multi-modal smart card applications for parking, and inner-city public transport and a metro transport information call centre (Thomas 2004: 394).

These innovations have played a significant role in promoting the use of intelligent transport systems in the city and have resulted in the successful promotion of sustainable transportation. The integration of the smart card system, electronic fare collection and integrated ticketing for public transport, has also resulted in the promotion of seamless travel for commuters between different transport modes (Thomas 2004: 394).


Figure 27: Example of Electronic Fare Collection System (Source: Voster 2013:5)

**c) ITS in Limpopo, the City of Polokwane**

The main objective of this research was to analyse the possibilities of adopting existing ITS approaches in the secondary city of Port Shepstone to aid in traffic management and to promote sustainable transportation. As such, it is important that both successful and unsuccessful cases in the cities of South Africa be taken into account in order to arrive at an understanding of the complicated yet unique cases of traffic management in different cities of the country. In doing this, it is important that secondary cities also be looked into in order to gain a clear understanding of how traffic management is executed in such places by all spheres of government, and not only by local government.

The City of Polokwane, located in the province of Limpopo, is one of the fastest growing secondary cities in South Africa in terms of population growth and development, much

like our primate cities such as Johannesburg, Pretoria and Cape Town. The current growth rate of the town is approximately 2.15% as per South African Statistics, 2011 census data, with a population of approximately 656 387 (Polokwane Local Municipality n.d.:24). By 2050, the population of Polokwane Local Municipality will be at approximately 1 475 190, provided it continues to grow at 2.15% annually (Polokwane Local Municipality n.d.:24). Polokwane as a secondary city also experiences complex yet unique traffic congestion which requires extensive investment in transport infrastructure and management.

- ***Integrated Rapid Public Transport Network (IRPTN)***

The Limpopo government, in 2007, developed an Integrated Rapid Public Transport Network Plan which will connect the five district municipalities in the province i.e. Capricorn, Mopani, Waterberg, Sekhukhune and Vhembe districts. The IRPTN was developed in preparation for the 2010 World Cup.

Polokwane Municipality, located in Capricorn district, is one of the municipalities which have successfully implemented the Integrated Rapid Public Transport Network Plan (IRPTN). The Polokwane IRPTN, named *Leeto la Polokwane,* consists of eight (8) major trunk routes with segregated bus lanes on Church Street and Nelson Mandela Drive, with two multi-module bus rapid transport (BRT) stations in Church Street and one in Thabo Mbeki Street. Five other stations are situated in Hospital Street, Nelson Mandela Drive (industrial area), Seshego circle, Seshego stadium and the end of Moledji. The IRPTN is also connected to the railway system or network of the municipality (Mabilo *et al.* 2010:1).

As part of the IRPTN, the Limpopo government established an intelligent transport system

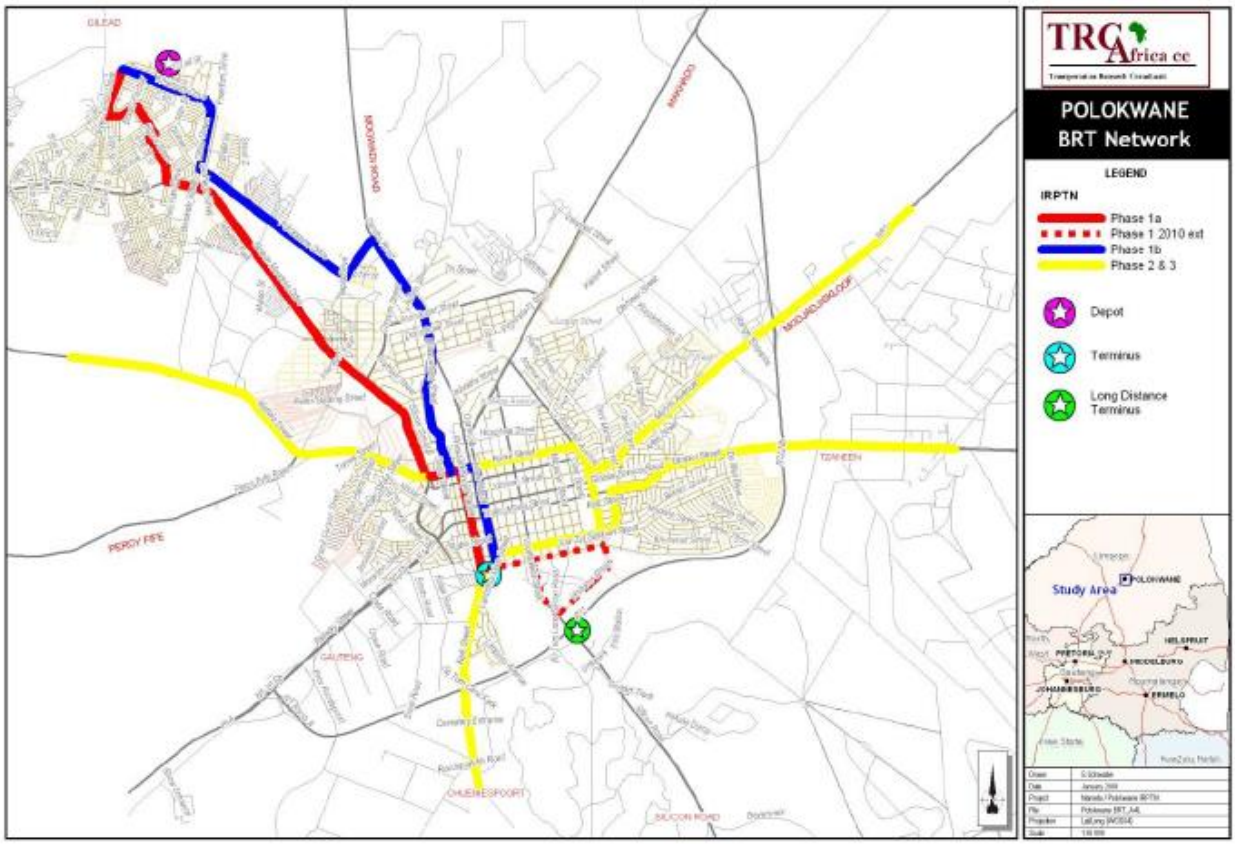



Figure 28: Polokwane IRPTN Routes (Source: (Mabilo *et al.* 2010:16)

which was developed to run the city during the 2010 World Cup tournament for the smooth running of transport as well as easy access to routes (Mabilo *et al.*2010:25). Part of the initiative to include ITS as part of the IRPTN development was to aid traffic management in the city of Polokwane, and it has been aligned with the transport infrastructure plan of the city (Mabilo *et al.*2010:25).

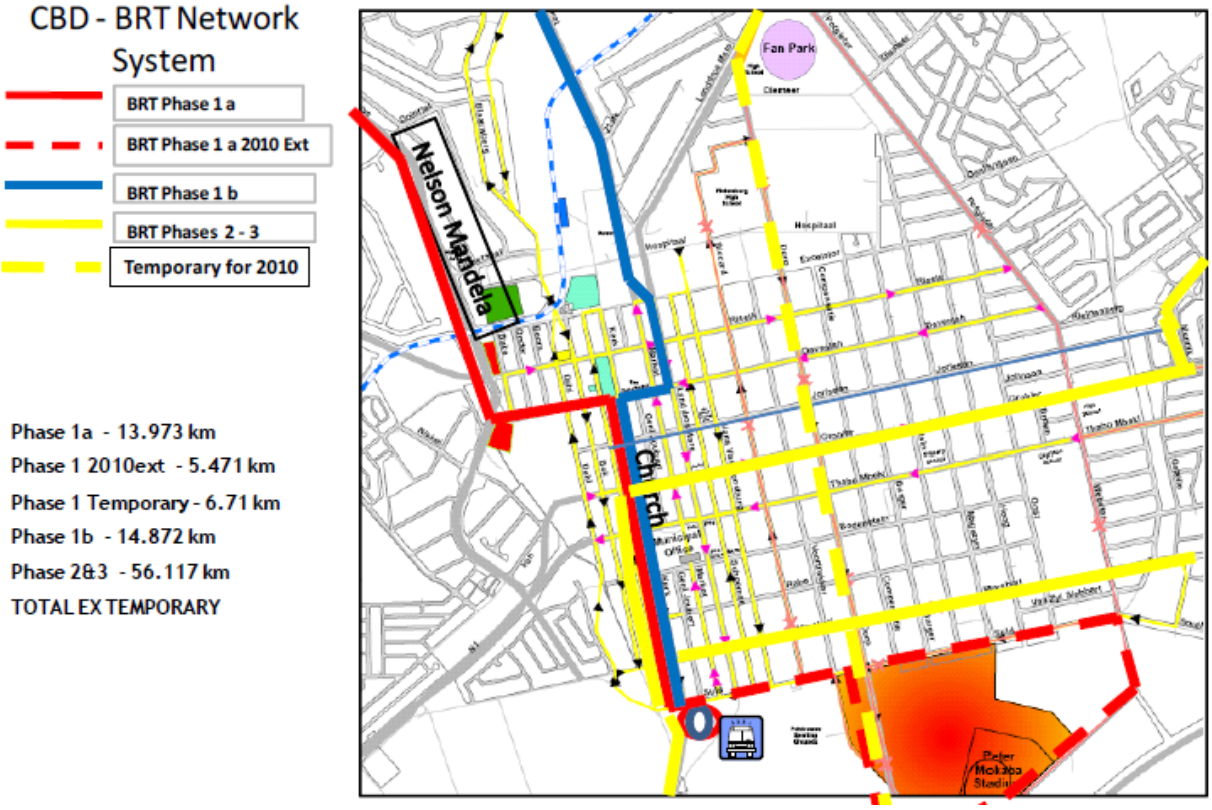



Figure 29: CBD BRT Network (Source: Mabilo *et al.* 2010:16)

The deployment of the ITS as part of IRPTN included the development of a control centre concept for operation of the buses. The table below illustrates the ITS concepts deployed as part of the Polokwane IRPTN: -

Table 4: Polokwane ITS Application

| | CCTV | Passenger Info Display (PID) | Destination display | Infotainment | Auto Vehicle Location (AVL) | Traffic Signal Priority (TSP) | Media Touch Terminal (MTT) | Auto Stop Announcement (ASA) | Panic button | PA system | IP phone in kiosk | Emergency intercom | Information button | GPRS | Wi-Fi | Fibre optic | Depot Data Manager (DDM) | AFC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trunk bus | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | ■ | ■ | | | |
| Trunk Station | ■ | ■ | | ■ | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | ■ | | ■ |
| Bus Depot | ■ | | | | | | | | | | | | | ■ | ■ | ■ | ■ | |
| BRT CC | ■ | | | | ■ | | | | | | | | | | ■ | ■ | | ■ |

(Source: ITS Engineers, 2014:3)

Therefore, the major ITS components used as part of the Polokwane IRPTN include the Bus Rapid Transit Control Centre (BRT CC); the Automated Public Transport

Management System – including a vehicle dispatch capability; Incident Management; Communications Network; Urban Traffic Control (for future development only; Public Transport Traveller Information; Safety and Security and Automated Fare Management (Source: ITS Engineers 2014:3).

In future ITS deployment, a part of the IRPTN will include a smart card and smart device integrated ticketing system; on board CCTV monitoring and verification system; point of sale and entry control devices; point of sale linked to the banking system; ticket information dissemination systems; automated access control / turnstiles at stations; on-board audio and video ticket and fare information dissemination and download capabilities at depots (ITS Engineers 2014:3). Such ITS deployment has played a significant role in traffic management and promotion of sustainable transportation of the Polokwane city.

One of the major lessons learned from the deployment of the ITS in the Polokwane IRPTN development was that all dissemination of information must be thoroughly tested in a pilot project prior to being formalised and rolled out. There should also be interim measures that need to be in place when implementing ITS, particularly in secondary cities such as Polokwane. In addition, the IRPTN projects require phasing in of terms of construction and costing or financial viability scenarios. Such lessons can also be learned from other secondary cities such as Rustenburg, in North West Province, which also implemented ITS as part of its BRT system.

### 3.4. LIMITATIONS OF ITS IMPLEMENTATION IN SECONDARY CITIES

The review of the precedent studies reveals an enormous work done on ITS implementation in primary cities of developed countries with some challenges in some Asian countries like India and China (Vanajakshi *et al.* (2010:50). There is also little work on implementation of ITS in secondary cities, particularly in developing countries. Therefore; the most success stories are evident in primate and secondary cities of developed countries. This provides difficulty in understanding and drawing conclusions on how secondary cities in developing countries are implementing ITS to aid transportation challenges and to draw lessons learnt in the implementation process of ITS in such cities. The limited availability of information and research studies on ITS in

secondary cities of developing countries to address transportation challenges leaves an assumption that secondary cities have not yet fully realised the importance of ITS implementation in order to address transportation challenges and the benefits that such systems have in promoting a sustainable development.

South Africa highly realised the implementation of ITS in 2010 when it hosted the International Federation of Association Football (FIFA) world cup. Each host city which include Johannesburg, Pretoria, Cape Town, Durban, Mbombela, Polokwane and Mangaung produced operational plans which comprised of strategies to minimise travel needs related to the event (ITS South Africa 2010:51). The majority of these strategies resulted in the deployment of ITS systems, particularly in cities which have been implementing BRT prior to the FIFA world cup, improved infrastructure, public transport, improved policing and security of transport facilities, train coaches upgrading, development of minibus regulations with at least 60% of the population responding to the use of public transportation as a sustainable mode of transport (ITS South Africa 2010:50). However, the ITS implementation in these host cities has not yet influenced secondary cities such as Pietermaritzburg, Richard`s bay, Emalahleni, Port Shepstone to name a few; to learn from them in developing cities that promote development of sustainable transportation systems.

Schtachaeva *et al*. (2016:249) state that the most common weaknesses that secondary cities are faced with and often hinder them from promoting sustainable developments are mainly due to the: -

a) remoteness from the capital and the major agglomerations;
b) aging of the population;
c) population decline;
d) spreading of alcoholism;
e) low living standard of the population;
f) low rates of urban economy growth;
g) unemployment among young people; and
h) lack of the enterprises of modern industry.

Port Shepstone is characterised by some of the above weaknesses that Schtachaeva *et al.* (2016:249) has detailed which include aging population that has led to the town being labelled a “retirement city” and lack of the enterprises of the modern industry. Even though the population is aging, there is still an increase in terms of the overall population size of the municipality. Adding to the weaknesses stated herein that most secondary cities face. Schutz (n.d:1) also highlight four (4) issues that almost all secondary cities share in promoting and meeting transport planning needs include: -

a) lack of resources to meet planning requirements;
b) education for staff and stakeholders;
c) communications and information overload; and
d) technology, both in-house and applications.

Schutz (n.d:1) state that most secondary cities often lack resources to undertake expensive travel surveys; recruit and retain specialised technical staff that will manage ITS systems. Primary cities often use sources of data such as data loops in traffic detectors which may not be equivalent in secondary cities where one or two permanent traffic recordings devices may serve the entire urban city (Schutz n.d:1). Even though secondary cities are known to be good in retaining employees due to the kind of lifestyles they often offer. It is still a major challenge for such cities to retain specialised technical staff that will understand the deployment of ITS that will meet the planning requirements. Therefore, implementation of ITS in secondary cities often include developing innovative methodologies, scaling efforts to the available resources and prioritising (Schutz n.d:2). One of the major challenges that such employees often face include the lack of educating and managing stakeholders; developing innovative approaches that will stimulate innovative business concepts and start-ups that will improve the attractive of the city for investors (Jonkers and Gorris 2015:21).

The issue of communication and technology is very big in secondary cities. Most people may not have access to a computer or internet. As such, using internet to communicate information to the public is attractive and can eliminate most transport problems that the city face. However, the challenge in this regard is keeping the information updated and responding to the public on-time. This may result in a massive failure if the technology

used which may include software or hardware is outdated resulting in the public asking too many questions and the time taken to respond to each enquiry being prolonged (Schutz n.d:2).

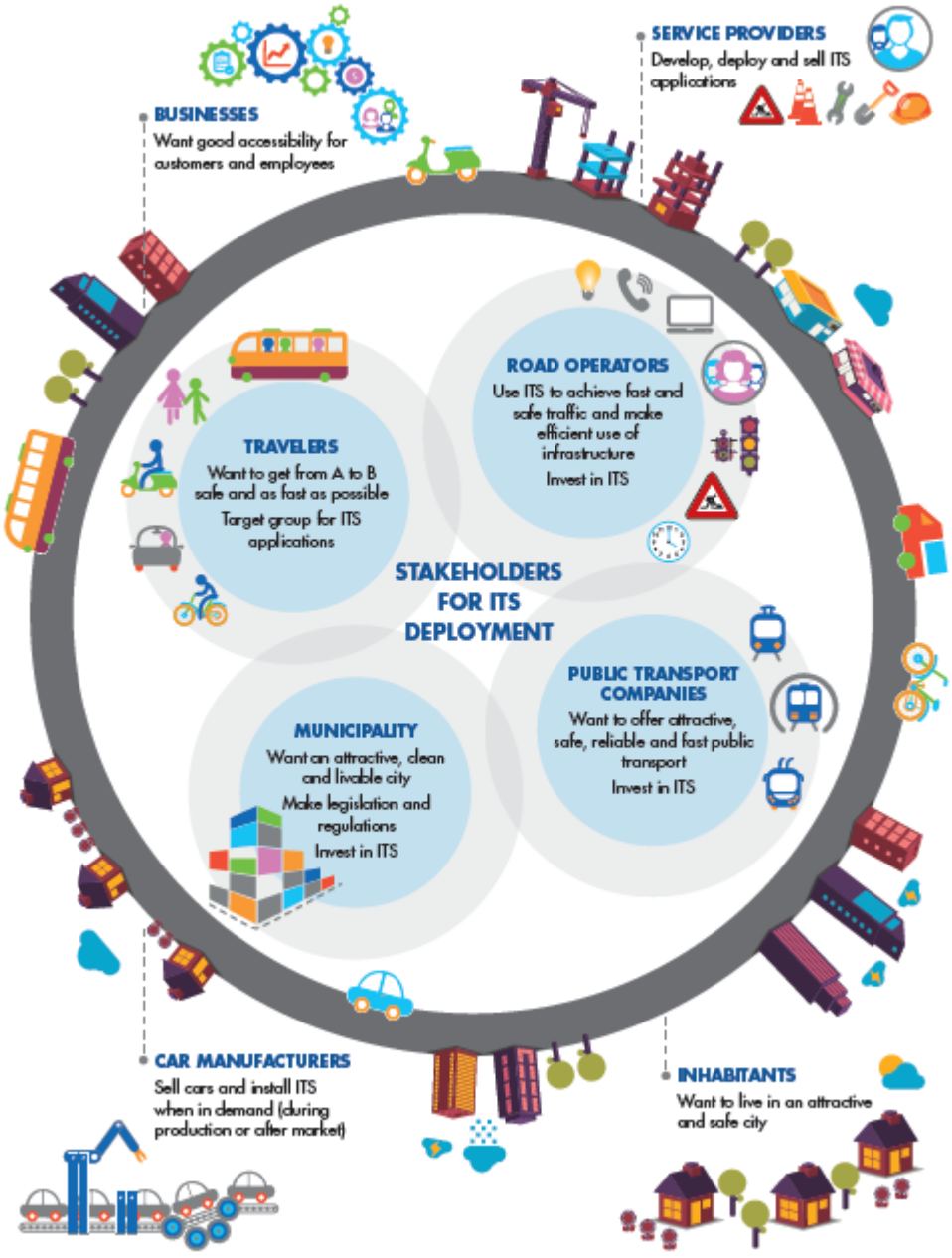



Figure 30: Info-graphic with stakeholders in a city (Source: Jonkers and Gorris 2015:22)

Therefore, secondary cities need to ensure that they make good decisions in deploying ITS technologies thus consider the viability and compatibility of such technologies over-time due to the rapid changes of the communications technology. The implementation of

ITS in secondary cities compared to primary cities is not one of the scale, rather it is more about understanding the transport planning needs of the city and identifying priority areas and focusing on them to the exclusion of other applications (Schutz n.d:4). Such prioritisation will also require a good business case that will win external investors and political buy-in (Jonkers and Gorris 2015:22).

## 3.5. CONCLUSION

Whilst this chapter thoroughly analysed both the successful and unsuccessful international and local scenarios, only a few were planned and deployed, with consideration given to having an impact on a local scale rather than on a regional scale. This always results in opportunities being missed to integrate, facilitate, and coordinate the sharing and optimisation of resources, with information and technology challenges being faced regarding sustainable operations as well as maintenance and funding thereof (Gauteng Department of Roads and Transport 2013:23).

The deployment of ITS, particularly in secondary cities, requires understanding of state of readiness from deployment through infrastructure development, funding and also planning not only at local level but also at a regional level for better results and impact. This requires a strong interrelationship between the local and the district municipalities, with the provincial government being the facilitator to ensure that the vision is also realised at a provincial and national level.

It is important that secondary cities learn from each other, particularly in implementing sustainable transport systems which often require deployment of ITS as part of the system. This requires a holistic and realistic implementation strategy with correct and good institutionalisation, public acceptance, funding and political support to drive it.

# CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY OF THE STUDY

## 4.0. INTRODUCTION

Any good research study requires a sound research design and methodology. This includes adopting various data collection methods and tools which assist the researcher to collect relevant and valid data in order to draw accurate and converging conclusions at the end of the research study. The use of a case study as a research methodology to gather and analyse data is one of the research design methodologies which can be used. As a result, this research study uses the case of Port Shepstone to understand the possibilities of the use of Intelligent Transport Systems to address transportation challenges of the city through the use of a ***"qualitative approach or technique".*** Various data collection methods and tools which include semi-structured interviews with open- and closed-ended questions, observations and a literature review of technical publications such as books, journals, and Internet sources, amongst others, are used in this research study.

Data sampling through purposive and snowballing techniques are explored in analysing the data collected from the data collection undertaken. The information collected is analysed through the use of a matrix system or tool for analysing ITS functional areas investigated in the research study. The use of triangulation and coding of research data analysis is maximised throughout the research study. This is done in order to ensure that all of the ethical considerations related to research are met without negatively implicating the identified participants. Ethical considerations include confidentiality, anonymity, autonomy and obtaining written consent from all participants to participate in the research study. Therefore, participation in the research was voluntary and no monetary or any other type of remuneration for participation in the research study was offered. Participants were further not expected to carry any costs towards the study. All information provided during the interviews was considered to be completely confidential and no identity or any personal information is shared in the research study.

With this in mind, this chapter provides a clear outline of how data was collected from participants and how the research methodology and tools were used to gather and analyse accurate and valid data on establishing the possibilities of using ITS to address the transportation challenges of the secondary city of Port Shepstone.

## 4.1. RESEARCH DESIGN AND METHODOLOGY

### 4.1.1. QUALITATIVE APPROACH

Kothari (2004:31) states that research design is the conceptual structure within which research is to be conducted, thus consisting of a blueprint for the collection, measurement and analysis of data. The design of the research often includes an outline of what the researcher will be doing in the research study and includes formulation of a research hypothesis and its operational implications and final data analysis.

Kothari (2004:31) defines research design as:

> "the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure."

Research design further provides an overall strategy in which a researcher chooses to integrate various components of a study in a very coherent and logical manner in order to ensure that the research objective is fully achieved. As such, the primacy of this research study is to discover the possibilities of the establishment of ITS in the secondary city of Port Shepstone. A ***qualitative approach*** is adopted in this research study as it seeks to focus on the social experiences that contribute to the traffic challenges of the Port Shepstone town and how these can be addressed through the use and maximisation of technology through Intelligent Transport Systems (ITS). Therefore, the research study is an exploratory and descriptive type of research which seeks to answer the "what and how" questions with a reasoning strategy used through an inductive approach.

### 4.1.1. THE USE OF A CASE STUDY IN RESEARCH DESIGN

According to Zainal (2007:1), case studies remain the most debated methods or approaches of data collection as they are widely recognised in most social science

studies, particularly when attempting to reveal in-depth explanations of social behaviour within a specific environment. In addition, Zanial (2007:1) defines a case study as a:

> "method which enables a researcher to closely examine the data within a specific context thus selecting a small geographical area or very limited number of individuals as the subjects of study".

While Creswell (2003:15) states that researchers often use case studies to explore an in-depth programme, event, activity, process, or one or more individuals, the case(s) are bound by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time. This means that a case study can play a significant role in providing a broad yet unique exploration and investigation of a specific real-life phenomenon through detailed contextual analysis of a limited number of events, conditions and relationships (Zainal 2007:1). A case study is further known to be the most practical technique used towards enquiring about contemporary phenomena within real-life contexts; particularly when the boundaries between phenomena and context are not clearly evident; and in which multiple sources of evidence are used (Zainal 2007:2). Therefore, it is a unique technique of viewing and investigating any natural phenomenon which may exist within a certain set of data. The uniqueness of a case study refers to the small geographical area or number of subjects of interests which are investigated in detail thus observing data at a micro level rather than at a macro level.

### 4.1.2. THE USE OF PORT SHEPSTONE AS A CASE STUDY

The Port Shepstone town was selected as a case study for an in-depth analysis of the transportation challenges of the town that impact on the economic growth of the town and surrounding settlement, as well as how these challenges can be addressed through the use of ITS. The main challenges facing the secondary city of Port Shepstone include the limited road infrastructural development being initiated to support the current economic investments; the high level of traffic congestion during peak hours of each day and seasonally, especially during school holidays and the festive season; linear distribution of traffic from the Port Shepstone town down to the coastal tourists' towns of the municipality

which include Shelly Beach, Uvongo and Margate towns; limited diversified public transportation in place; poor road and transport infrastructure; limited law enforcement and ITS systems in place and lack of both funding and institutional arrangements to foster sustainable transportation in the municipality; all of these in view of the increase in both public and private sector investment opportunities coming into the area.

As a result, the researcher's choice of using Port Shepstone as a case study presents the opportunity to reveal the existing possibilities of using ITS to address the transportation challenges of the Port Shepstone town. It further provides the opportunity to explore some of the possibilities presented by technology towards sustainable transport planning; to reveal the understanding and explore the challenges that most secondary cities such as Port Shepstone are facing in addressing transportation challenges; and to understand the significant role that ITS can play in addressing transport challenges and viewing similar cases of ITS in secondary cities across the world and in South Africa in order to draw instructive insights from such cases.

### 4.1.3. ADVANTAGE AND DISADVANTAGES OF A CASE STUDY

Over and above the use of Port Shepstone as a case study, it is acknowledged that case studies have their own advantages and disadvantages which may compromise the outcome of a research study. Such implications are observed throughout the research study in order to ensure that results are not compromised in any way and that the research objective is fully met.

It is acknowledged that the outcomes of a case study cannot be generalised, but they can be used to inform similar cases of ITS in secondary cities across the world (Zainal 2007:3). The advantages of using a case study are that it often enables the researcher to observe data at a micro-level; it provides detailed and systematic ways of observing events, gathering and analysing data and providing informed results over a long period of time (Zainal 2007:3). This often provides an opportunity to explore and describe collected information in real-life environment; and helps to explain the complexities associated with the investigated real-life issues which may not be captured through experimental and/or survey research (Zainal 2007:3).

The disadvantages of using a case study are that it disallows generalisation of findings and outcomes; it has a lack of rigidity. This means that in most cases, researchers seem to allow prejudiced views to influence the direction of findings and conclusions with regard to the interests of subjects being investigated (Zainal 2007:5). Case studies are viewed as normally too long and difficult to understand and analyse, particularly in attempting to find the core problems that relate to the specific area of research (Zainal 2007:5). They are also difficult to document as they often require massive amounts of data to be collected over a lengthy period of time, which often comes with the danger of not properly managing and systematically organising data (Zainal 2007:5).

## 4.2. RESEARCH PHILOSOPHIES

Research studies adopt different research methodologies that often need to be fully understood prior to the conducting of any research in order to fully address the research problem. It is important that the research design be fully detailed and understood as an overall strategy to be adopted, that will integrate various components of the research study in a logical and coherent manner in order to ensure that both the research objective and problem are fully met. Therefore, understanding the research methodology and design is important.

Kothari (2004:16) states that a quantitative approach is based on the measurements of quantity or amount. This implies that it relates to measurable variables expressed in terms of quantity. The qualitative approach, on the other hand, is based on the subjective assessment of attitudes, opinions and behaviour. Mason (2002:1) states that the qualitative approach to research is very exciting, important and yields high rewards as it engages the researcher with other things that matter and in ways that matter. Qualitative research further allows the researcher to explore various aspects or dimensions of the social world including the texture and weave of everyday life, the understandings, experiences and imaginings of research participants, the ways that social processes, institutions, discourses or relationships work, and the significance of the meanings that they generate (Mason 2002:1). This can be achieved through the use of qualitative

research which can directly analyse, explain and compel arguments on how things work in particular contexts (Mason 2002:1).

With this in mind, this research predominantly takes a *qualitative approach* as it is founded on the principle of constructive composition of non-measurable research data. As such, the qualitative data will contribute to obtaining and analysing non-measurable data which is based mostly on comprehensive understanding of subjective perspectives or personal opinions. Therefore, the research is an exploratory and descriptive type of research which seeks to answer the *"what" and "how"* questions. Therefore, this research study impresses upon inductive thinking and a reasoning approach that promotes the development of logical habits of thinking.

### 4.3. DATA COLLECTION METHODS AND TOOLS

Kothari (2004:17) states that in dealing with real life problems, it is often found that data at hand might be insufficient and therefore it is important to collect and gather data that is appropriate. There are various ways in which appropriate data can be collected and such ways differ considerably in the context of money or costs, time and other resources at the disposal of the researcher. There are two types of data collection, and these are primary and secondary data collection.

Primary data refers to the original data collected by the researcher through a variety of methods such as interviews, surveys, etc. The collection of primary data in this study was obtained through the conducting of *semi-structured Interviews* which allowed the researcher to use a set of combined open- and closed-ended questions. Many of the questions administered were open-ended and the purpose of this was to allow for a free flowing conversation on any ITS implementation matters that could not have otherwise been stimulated through closed-ended questions and structured interviews.

The semi-structured interviews were designed to answer the research question thus taking into account the broader objective of the research study. As such, the main population interviewed were stakeholders from Ray Nkonyeni Municipality (i.e. Town

Planners, Traffic Officers, Public Transport users and owners, etc.); civil society and intelligent transport systems specialists (i.e. Transport Engineers). The interviews with the identified participants took place in a mutually agreed upon location and conversations were recorded and transcribed for analysis. Shortly after the interviews had been completed, copies of both the audio and the manual transcripts were sent to participants to give them the opportunity to confirm the accuracy of the conversations and to add or clarify any points that they wished.

Secondary data was collected through an extensive *literature review* which made use of technical publications such as books and journals, official publications of the central government, state governments, local bodies, private data services and computer data bases. Precedent studies, i.e. international and local precedents, were also utilised as part of the secondary sources for this study. This allowed the researcher to understand and unpack theories of ITS and possibilities that exist for the use of ITS in the secondary city of Port Shepstone to address the transportation challenges. The aim of the researcher in using multiple data sources was to obtain converging data that would support particular ideas, behaviour, impressions, findings and conclusions that would fully meet the research question and objective.

### 4.4. SAMPLING DESIGN

Sampling designs and/or techniques differ depending on the aim and objective of the research, thus resulting in outputs which are dependent on the type of research undertaken. This research makes use of *purposive and snowball sampling techniques.*

Pandey and Pandey (2015:55) define the purposive sampling technique as: -

> "a technique selected by some arbitrary method because it is known to be representative of the total population, or it is known that it will produce well matched groups and the idea is to pick out the sample in relation to criterion which are considered important for the particular study".

Purposive sampling is also referred to as *non-probability sampling,* and it is not dependent on the basis of any estimation of probability that each item in the population has been included in the sample (Kothari 2004:59). This method is appropriate when the study places special emphasis upon the control of certain specific variables (Pandey and Pandey 2015:55). The implication of this is that the researcher uses his/her own judgement when choosing members of the population to participate in the research. Therefore, the researcher believes that he/she has the ability to select a representative sample by using sound judgement, which will result in saving of costs and time (Pandey and Pandey 2015:55). In support of the purposive sampling, the snowballing technique is also used to access additional participants that the researcher envisages to access. Pandey and Pandey (2015:55) further define the snowballing technique as: -

> "a technique used to describe a sampling procedure in which the sample goes on becoming bigger and bigger as the observation or study proceeds".

With this in mind, the research being predominantly qualitative and adopting the purposive and snowballing sampling designs, five (5) participants were chosen on the basis of their involvement in the transportation sector and having transportation knowledge of the secondary city of Port Shepstone. In addition, the snowball sampling technique was used to access additional participants that the researcher envisaged accessing, in order to fully achieve the objective of the research. However, it should be noted that the participants drawn using the purposive and snowballing techniques were not vulnerable individuals. For instance, those between the ages of 0 and 17 years; rather they were individuals of the age of 18 years and older. The advantage of using both the purposive and snowballing techniques is that this often results in the number of participants increasing as the researcher chooses. In the use of this type of research, the sampling design is always supreme in order to fully achieve the research objective.

Based on the sampling techniques chosen and ITS being a very broad phenomenon with different and complicated aspects, only a selected number of ITS functional areas were

explored to address transportation challenges of the Port Shepstone town. Such functional areas included:

a) advanced traveller information systems (ATIS);
b) advanced transportation management system (ATMS);
c) advanced public transport system (APTS);
d) enabled transportation pricing systems; and
e) data acquisition and management.

It was envisaged that results on the possibility of the use of ITS methods investigated would be based on the data collection and sampling techniques of this research which would then lead to findings, results and conclusions.

### 4.5. DATA ANALYSIS

The objective of data analysis is to obtain an understanding of the research outcomes by summarising data with the intent of extracting useful information and developing conclusions and recommendations.

Since in this research primary data was obtained through the use of semi-structured interviews. The research study made use of *triangulation and coding* as methods of data analysis. Mason (2002:188) defines triangulation as “the use of a combination of methods to explore one set of research questions”. In other words, it is an analytical method or approach which can be used by the researcher to approach his/her research question and objective from different angles and to explore their intellectual puzzle in a rounded and multi-faceted way (Mason 2002:190).

In support of the triangulation method adopted, the research further used *coding,* which Mason (2002:150) refers to as a cross-sectional indexing of data which involves devising a consistent system for indexing of datasets according to a certain or rather common principles and measures. This means that the researcher applies a uniform set of indexing categories systematically and consistently to the data collected (Mason 2002:151). The triangulation and coding data analysis tools in this research were achieved through cross-checking and cross-referencing multiple data sources and

collections. This was done to establish the extent to which all evidence collected converged.

Therefore, analysis of data in this research was done qualitatively, in which comparisons of responses generated from the open-ended and close-ended interview questions are fully analysed to draw conclusions. Such analysis takes into account the theories as well as international and local precedents informing the establishment of ITS in the secondary city of Port Shepstone. The data was further analysed through a thematic format using the *matrix system* or tool of the ITS functional areas investigated. In addition, data drawn from interviews conducted was interpreted, linking the findings with the literature review and precedent studies in order to reveal the value of the study and reinforce the current thinking of ITS on the implementation of ITS in secondary cities.

## 4.6. RESEARCH ETHICAL CONSIDERATIONS

Kamat (2006:21) states that conducting research that focuses particularly on social issues and experiences is often problematic. This is due to various factors such as accessibility, cost and timing, which often impose problems on the research conducted. As a result, when conducting research which will involve the participation of people, ethical considerations should be taken into account throughout the research.

With this in mind, the conduction of this research adheres to the Durban University of Technology Research and Ethics Guidelines. The research has considered all ethical issues pertaining to human research which include emotional safety, confidentiality and informed consent. In addition, the research has taken into account the ethical requirement that matters of confidentiality and anonymity in regard to which data or information is provided by the participants must be secured. The identity of “ALL” participants is not disclosed and is protected through the coding process used to hide identity of the participants and the findings also do not also reveal any participant’s identity (i.e. names, date of birth, sex or age).

Verbal and written consent was obtained prior to the conducting of the interviews. All participants were informed about the purpose of the research and its nature, allowing them to make an informed decision on whether or not to participate in the research.

Participants were also informed of their right to withdraw from participating in the research study at any time if they so wished. In addition, permission to conduct interviews was only obtained from the identified participants who were individuals over the age of 18 years, and not from any vulnerable individuals between the ages of 0 and 17 years.

## 4.7. LIMITATIONS OF THE STUDY

Qualitative research comes with various limitations, particularly in terms of data collection and analysis, as it mostly depends on literature and information obtained from informants through the interviews. As such, this may lead to results being crippled by what the respondents are likely to disclose, thus leaving the researcher in confusion and having to make assumptions on some of the aspects being investigated. The research data collection and analysis was limited to only five (5) ITS functional areas, and their possibility of establishment in the secondary city of Port Shepstone was investigated. The reason for limiting this study to only five functional areas of ITS was because ITS is very broad and it makes sense for the researcher to limit the research investigation in order to focus only on the identified functional areas in order to ensure that the research objective could be fully met.

## 4.8. CONCLUSION

This chapter presents the methodology for this research study. The data collection and analysis techniques adopted are further revealed in the subsequent chapters, with recommendations and conclusions made at the end of this study. Therefore, the chapter provides a clear outline on how data was collected from participants and how the research methodology and tools were used to gather and analyse data for establishment of ITS in Port Shepstone.

# CHAPTER 5: ANALYSIS OF FINDINGS AND RESULTS

## 5.0. INTRODUCTION

This chapter presents an analysis of results and findings taking into account both secondary and primary data. The analysis of the secondary data mainly focuses on revealing findings on the current population and projected population growth over the next 40 years. The findings presented also include development aspects influencing travel patterns which include spatial growth patterns, transportation and local economic structures of the town. Findings on secondary data are further discussed through cross-referencing literature review and precedent studies undertaken in previous chapters of the research study.

In addition, the chapter also provides an analysis of the feasibility of the establishment of ITS in Port Shepstone using both the open- and closed-ended responses received from the semi-structured interviews conducted, based on the five (5) ITS functional areas. The analysis is undertaken in order to draw thematic patterns which provide an understanding of the assumptions and underlying ideas provided by the respondents and to ensure that the research objective and question are fully answered. While the investigated functional areas represent a significant portion of the ITS for this research study, there might be some ITS functional areas which might be beyond the scope of this research study and might require further investigation in the future. The feasibility of implementation of some of the functional areas investigated will be detailed as part of the recommendations at the end of the research paper.

The study aimed at having a sample size of approximately four (4) participants. However, ten (10) participants were interviewed and the data collected from the 10 interviews was transcribed and analysed accordingly under this section *(responses annexed accordingly).* The transcribed interviews were analysed through the use of a thematic analysis matrix tool in which common discourses were identified, focusing specifically on the ways in which the participants constructed and responded to the discourses under investigation. The main participants interviewed are listed in the table below as follows: -

Table 5: List of Participants

| No. of Participant | Description of Participant | Date | Time | Venue |
|---|---|---|---|---|
| **Participant 1** | Town Planner | 19 June 2018 | 16h00 | Uvongo |
| **Participant 2** | Law Enforcement Officer | 25 July 2018 | 08h00 | Port Shepstone |
| **Participant 3** | Law Enforcement Officer | 31 July 2018 | 08h00 | Port Shepstone |
| **Participant 4** | Transport Engineer (Specialist) | 17 August 2018 | 10h00 | Durban |
| **Participant 5** | Town Planner | 14 June 2019 | 10h00 | Port Shepstone |
| **Participant 6** | Public Transport User | 08 July 2019 | 13h00 | Port Shepstone |
| **Participant 7** | Public Transport User | | 13h45 | Port Shepstone |
| **Participant 8** | Public Transport User | | 15h30 | Port Shepstone |
| **Participant 9** | Bus Operator | 15 July 2019 | 11h00 | Port Shepstone |
| **Participant 10** | Taxi Operator | 1 August 2019 | 10h00 | Port Shepstone |

There were number of challenges that were encountered in the collection of data for both primary and secondary data. In terms of primary data, some participants were unavailable or rather they will postpone the agreed meeting time for the interviews, particularly the taxi operators and transport specialists.

Secondly, identifying the person responsible for transport in the Municipality was challenging as the Municipality does not have dedicated transport planners. It was found that the function of transport planning is delegated to the traffic department or unit. Hence, respondents (especially traffic officers) were not sure if they were the correct person/s to participate in the study or should it be someone else. In addition, some of the public transport users interviewed did not agree to answering the open-ended questions posed to them. As such, this made it difficult for the researcher to draw conclusions on their thoughts and ideas with regards to the research study objectives and question.

This also resulted in the data collection period being prolonged or rather taking long to complete. In terms of the secondary data collection, there seemed to be limited available data on the local information; particularly on transportation systems of the Port Shepstone town; day-time population; to name a few. Therefore, the implementation of ITS in Port Shepstone will require more secondary data to be generated in order to fully understand the transportation challenges of the town and to adequately address them.

## 5.1. THE PORT SHEPSTONE CASE STUDY

The town of Port Shepstone was founded in the late 19th century, when marble was discovered nearby. It was named after Sir Theophilus Shepstone (Du Bois 2016:104). A group of Norwegian settlers colonised the area in 1882 and played a significant role in the development of the town. The settlers developed a harbour which today still has a lighthouse that remains as one of the historical and heritage landmarks at the mouth of the uMzimkhulu River in Port Shepstone. The harbour became Port Shepstone's economic lifeline as the economic growth of the town and the South Coast citizens depended mainly on the port (Du Bois 2016:108). Du Bois (2016:108) states that one of the best transport innovations in the town was the uMzimkhulu River shipping, which formed a major part of the transport system of the town. However, this did not last long as it did not really address the transport challenges in terms of connectivity of the town to its surrounding towns such as Durban, as there was no rail transport system supporting the river shipping transport activities.

Figure 31: Port Shepstone lighthouse built in 1887 (Source: http://www.rnm.gov.za/Pages/default.aspx, 2017)

Today Port Shepstone is only serviced by road infrastructure or transport, linking the town with other regional centres which include amongst others Durban, Kokstad and Pietermaritzburg. The main roads linking Port Shepstone with other regional towns in the province include the N2, the R61, the R620 and the R102. It is on these roads that the town is today experiencing transportation challenges in terms of traffic congestion, deterioration of road infrastructure, parking issues, and so forth.

Since the town of Port Shepstone was developed in 1867 after the discovery of marble, it has grown and is still growing significantly into a major economic hub in the South Coast region. The region supports approximately 753 336 people (as per 2016 Community Surveys) spread along the length and breadth of the Ugu District Municipality covering an area of approximately 4 908km$^2$. The region is made up of a coastal strip of urban settlements, a vast rural hinterland and commercial farmlands to the west (Isibuko Se-Afrika Development Planners 2016:9).

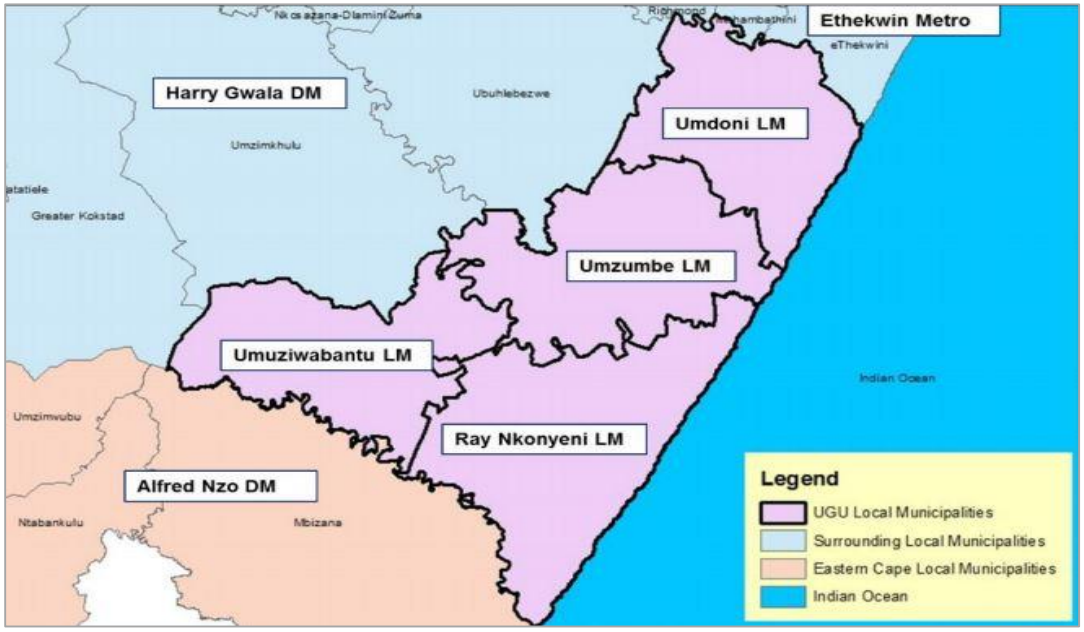



Figure 32: Ugu District Local Municipalities (Source: Ugu District IDP 2017-2021:21)

Port Shepstone is identified as a provincial secondary node in the KwaZulu-Natal Provincial Growth and Development Strategy (2016). The strategy further identifies the town as one of the urban centres with good existing economic development and potential growth and services for the regional economy. It lies on the coastal corridor of the Ugu region with relatively well developed hard and bulk infrastructure, light industry, commercial, agriculture, tourism and residential activities adding to the economic development of the Ugu district. However, there has been a lack of planning in terms of transport. This has left the municipality facing major transportation challenges in the present day. It is only through transport planning platforms, which may include policy development, infrastructure investment and development, that these transport challenges of the town might be alleviated.

## 5.2. ANALYSIS OF RESULTS AND FINDINGS

### 5.2.1. POPULATION PROJECTIONS

Literature reveals that by 2050, the majority of the cities in Africa will be urbanised with a population of approximately 1 billion. Rapid urbanisation will not only be visible in African countries but also across the world, and it is unlikely to slow down. Therefore, inefficient planning by cities could result in significant impacts on the quality of lives of residents, thus resulting in increased inequality, displacement of poverty and creation of state of dependency. Since Statistics South Africa conducted its last Statistical Survey in 2011, Community Surveys were conducted in 2016. However, it should be noted that the surveys were mainly conducted at a municipal level and were not ward-based as the 2011 statistics were. The population of Port Shepstone is analysed using both the 2011 statistics and the 2016 community surveys.

The population of Ray Nkonyeni Local Municipality is spread unevenly across 36 electoral wards with the town of Port Shepstone located in Ward 18 of the municipality. The population is tabulated below as follows: -

Figure 33: Population of Ray Nkonyeni vs Port Shepstone

| Area | Type of Enumeration | Population | Growth Rate (%) | Household Size |
|---|---|---|---|---|
| Ray Nkonyeni | 2011 Statistics | 256 135 | 1.6 | 3.4 |
| | 2016 Community Surveys | 348 555 | 1.6 | 3.4 |
| Port Shepstone | 2011 Statistics | 8 004 | 1.6 | 3.4 |
| | 2016 Community Surveys | 8 945 | 1.6 | 3.4 |

(Source: Statistic SA, 2011 and Community Surveys, 2016)

The table above illustrates that the town has an average household size and confirms the urban character of the area. Therefore, the population of the town makes up

approximately 3% of the total municipal population. This population size is anticipated to increase due to social and economic pulling factors of the town and the Municipality as a whole.

The figure below depicts the Port Shepstone town population as per the 2011 statistics.

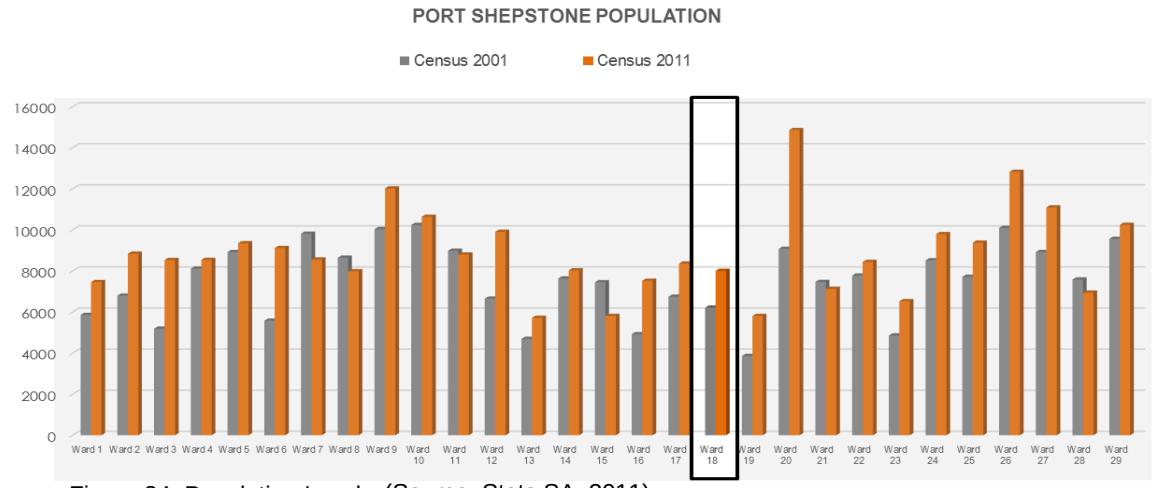


Figure 34: Population Levels (Source: Stats SA, 2011)

The population projections were determined using the Malthusian Growth Model which was used to determine the number of individuals in a population over time (Zill and Dewar 2010:313). The formula is expressed as follows:[5]

$$P = P_o \times \frac{e^{rt}}{100}$$

**P** – total population over time

**$P_o$** – starting population in the current year

**r** – % rate of growth

**t** – time in years

**e** – Euler number which is an important number in mathematical logarithms and equals 1 (Zill and Dewar 2010:313).

[5] Malthusian Growth Model was developed by Thomas Malthus in the late 18th century. The model was seen as one of the realistic models to predict exponential population growth in countries linked to availability of resources (Source: Zill and Dewar 2010:313).

For example, Port Shepstone has a total population of approximately 8 004 as the base population for 2011 with a household size of approximately 3.4 at a growth rate of 1.6%. This in the year 2012 will result in the following growth in population:

$$\mathbf{P = P_o \times e^{rt}}$$

P = 8 004 x (1+1.6/100) (2012-2011)

= 8 004 x 1,016

= 8 132 population by year 2012

The total population over time is then divided by the average household size to determine the household projection, i.e. 8 132 / 3.4 household size equals 2 392 households by 2012.

Table 6: Port Shepstone 40 Years Population Projections

| Projection variables | Projected population | Future population | Future households |
|---|---|---|---|
| **Base year: 2011**<br>**Base population: 8 004**<br>**Growth rate (%): 1.6**<br>**Average household size (2016): 3.4** | 2012 | 8 132 | 2 392 |
| | **2017** | **8 804** | **2 589** |
| | 2022 | 9 531 | 2 803 |
| | 2027 | 10 318 | 3 035 |
| | 2032 | 11 171 | 3 285 |
| | 2037 | 12 093 | 3 557 |
| | 2042 | 13 092 | 3 851 |
| | 2047 | 14 174 | 4 169 |
| | **2052** | **15 344** | **4 513** |

From the table above, it is clear that the population of Port Shepstone in 2017 was approximately 8 804 with approximately 2 589 households, while in 2052 the population is projected to be approximately 15 344 with approximately 4 513 households.

This indicates that the population growth will need to be accommodated and planned for through infrastructure development; it must also be ensured that economic investment growth is encouraged. Furthermore, the municipality will require massive investment in the development of road infrastructure and other sustainable transportation solutions in order to support the expected growth population. It is important that in planning for the future, technological innovation in secondary cities like Port Shepstone needs be at the

top of the priority list for implementation to promote efficient and sustainable service delivery which will respond to the needs of the growing population. This also means that the municipality needs to start putting integrated basic services in place and strengthening intergovernmental relations (IGR) in order to promote implementation of smart solutions that will respond to the growing population needs.

### 5.2.2. SPATIAL AND LAND USE STRUCTURE ANALYSIS

#### 5.2.2.1. RAY NKONYENI INTEGRATED DEVELOPMENT PLAN 2017-2021

The Ray Nkonyeni Integrated Development Plan (2017:1) (IDP) describes Port Shepstone as a major economic hub and is an administrative seat for the Municipality. The IDP further describes the Municipality as one of the most fast growing municipalities in the KwaZulu-Natal Province with a number of catalytic economic projects taking place which have been mainly the source of employment for most of the municipal population. The Ray Nkonyeni Integrated Development Plan (2017:47) details the municipality`s vision as follows: -

> *"By 2036 Ray Nkonyeni Municipality will be a prime tourist-friendly; economically diversified and* ***smart Municipality*** *with equitable access to opportunities and services in a safe and healthy environment"*

The implication of the said vision means that the Municipality should start planning towards opening new opportunities for business through technology and such opportunities may include enhancing of the land-use structure through technology such as the maximization of Geographic Information Systems and deploying electronic systems for processing of land-use development applications; adopting Intelligent Transport Systems (ITS) solutions to enhance the transportation system of the municipality; promoting electronic governance (e.g. the use of electronic agendas for meetings; providing employees with electronic pay slips, to name a few). This should be done across the municipal space in order to have visible benefits to the communities of the Ray Nkonyeni Local Municipality.

The Port Shepstone town is seen to be quickly reviving its appearance as more establishments are being developed (Ray Nkonyeni Integrated Development Plan

2017:1). The developments that are currently booming in the Port Shepstone town include but not limited to the following catalytic projects: -

Table 7: Catalytic Projects

| Project Name | Initiator | Project Description | Project Value |
|---|---|---|---|
| **Justice Park** | Ray Nkonyeni LM | Development comprising of a high court and more magistrate courts and office block to accommodate the Department of Justice needs | R360 million |
| **Intermodal Public Transport Facility** | Ray Nkonyeni LM /KZN DoT | Port Shepstone. To be developed at the current Port Shepstone taxi rank. This project will be a public transport ranking, facility with high order commercial mix. The facility in essence will be a bus and taxi rank and a mall. | Over R2 billion. |
| **Port Shepstone Regional Technology Hub** | Ray Nkonyeni LM /KZN Treasury | The main attributes of the Technology hub include, specialised business park with tenants focused on technology and scientific research, | R120 million |

| | | | |
|---|---|---|---|
| | | closed alignment to tertiary institutions and their academic staff and partly linked to a wider research system. | |
| **Port Shepstone Library** | Ray Nkonyeni LM/ Department of Arts, Culture, Sports and Recreation | The main attributes of the Port Shepstone Library include provision information ranging from analog to digital, including a wide selection of books (hardcopy and electronic books), computers for internet access, cyber café and a gaming zone among others. | R60 million |
| **Port Shepstone Maritime Museum** | Ray Nkonyeni LM/ Department of Arts, Culture, Sports and Recreation | This museum features state of the art amphitheatre, accommodating 60-50 people, exhibition area, achieves storeroom, boardroom with electronic conference facilities, to name a few. | Over R17 million |

| | | | |
|---|---|---|---|
| **LOT 19 &20 Marburg, Port Shepstone Light Industrial Development** | Ray Nkonyeni LM | Strategic land identified for development of light industrial developments that will support the economic development of the Municipality. | Municipality still sourcing funding |
| **Parking block in Dick King's Parking** | Ray Nkonyeni LM | Land identified by the municipality for development of a multi-storey paid parking to generate revenue. | Municipality still sourcing funding. |
| **Port Shepstone Beach redevelopment** | Ray Nkonyeni LM | The redevelopment of the Port Shepstone Beachfront to include world water fun park, hotels, beachfront promenade, and other mixed use economic developments. | R50 million. |

(Source: Ray Nkonyeni Integrated Development Plan 2017:13)

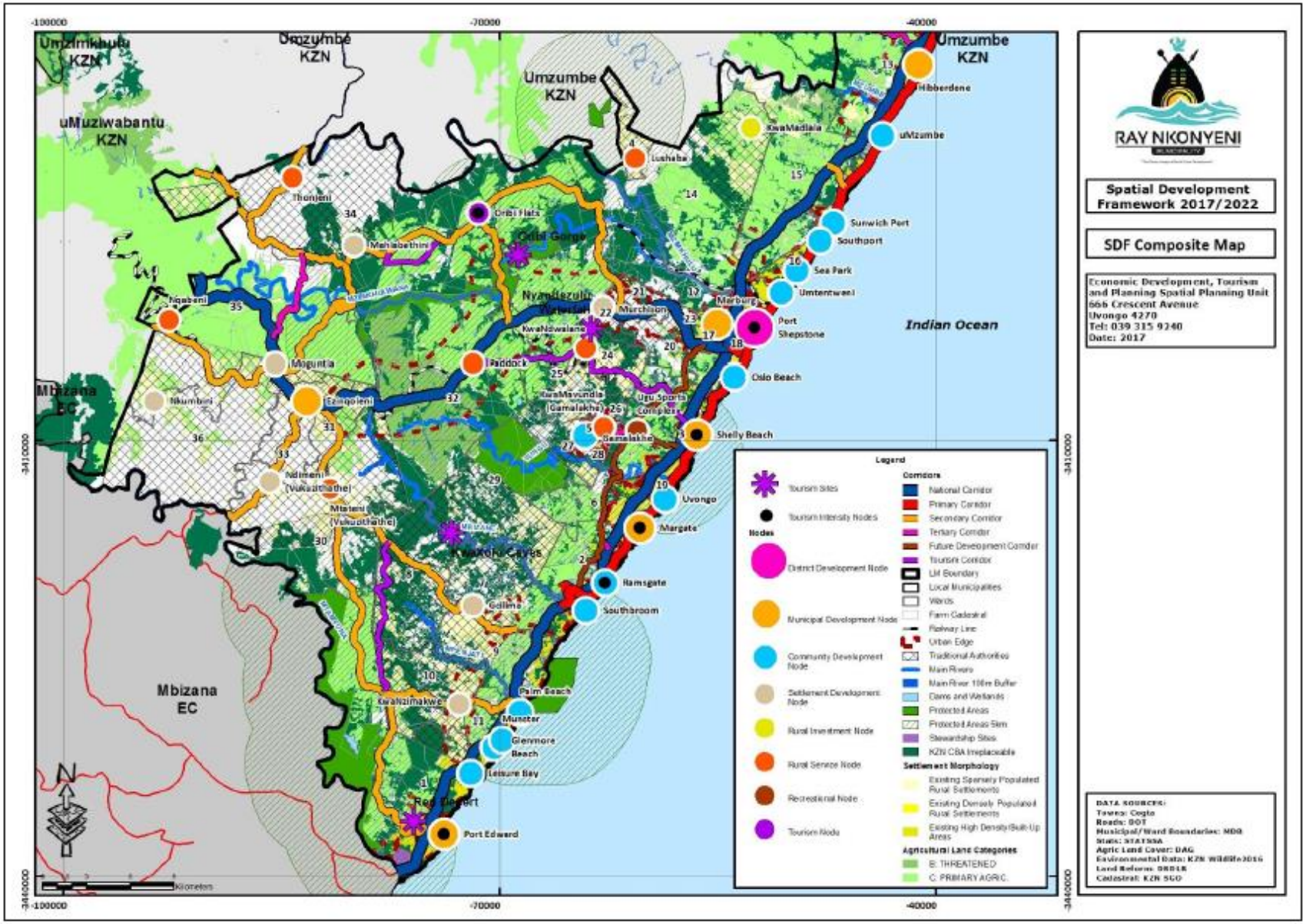
These projects are further spatially depicted in the Ray Nkonyeni Spatial Development Framework 2017-2021 and are seen to be having greater potential of moving the municipality towards achieving its set vision and for the Municipality to become one of the highest contributing Municipalities towards the Gross Domestic Product (GDP) in the Province.

### 5.2.2.2 SPATIAL DEVELOPMENT FRAMEWORK 2017-2021

The Ray Nkonyeni Local Municipality Spatial Development Framework 2017-2021 describes Port Shepstone as a *" District Development Node"* [6] as it is seen as an economic node servicing the entire local Municipality and the Ugu Region. The town is located along the N2 corridor (national corridor) running in a north-south direction and in a westerly direction dissecting parts of the town. The N2 is regarded as a generator for growth, particularly between Port Shepstone and Harding thus providing a linkage to public transport and accessibility to the surrounding communities at the interceptor points with other movement corridors (Ray Nkonyeni Local Municipality Spatial Development Framework 2017:27). A range of economic development opportunities are envisaged along these development corridors. The town is developed around the harbour area, also with the development of a railway line to Durban which forms one of the existing transportation system of the Municipality which its use of however not maximised in terms of being an option to promote sustainable transportation of the Municipality as it is only used for cargo and not necessarily for passenger (Ray Nkonyeni Local Municipality Spatial Development Framework 2017:28).

However, the Municipality is rich with a number of land parcels measuring approximately 19 hectares (ha) located along the coastal line of the Municipality i.e. Port Shepstone, Shelly Beach, Margate coastline to name a few (Isibuko Se Afrika Development Planners 2016:25). There are also a number of government facilities in the Port Shepstone CBD owned by provincial government.

[6] "District Development Node" means an economic node that served the entire Ugu District (Ray Nkonyeni Spatial Development Framework 2017:28).


RAY NKONYENI
Spatial Development Framework 2017/2022
SDF Composite Map
Economic Development, Tourism and Planning Spatial Planning Unit
66b Crescent Avenue
Uvongo 4270
Tel: 039 315 9240
Date: 2017
Indian Ocean
Umzimkhulu KZN
Umzumbe KZN
uMuziwabantu KZN
Mbizana EC
Hibberdene
uMzumbe
Sunwich Port
Southport
Sea Park
Umtentweni
Port Shepstone
Oslo Beach
Shelly Beach
Uvongo
Margate
Ramsgate
Southbroom
Palm Beach
Munster
Glenmore Beach
Leisure Bay
Port Edward
Thonjeni
Mahlabathini
Orbit Flats
Qibil Gorge
Nyandezulu
Merchiston
Merburg
KwaNdwalana
Paddock
Mqonta
Nkumbini
Ezingoleni
KwaMavundla (Gamalakhe)
Ugu Sports Complex
Gamalakhe
Ndimeni (Vukuzithathe)
Mbiteni (Vukuzithathe)
Gollima
KwaNzimakwe
Lusheba
KwaMadlala
Legend
Tourism Sites
Tourism Intensity Nodes
Nodes
District Development Node
Municipal Development Node
Community Development Node
Settlement Development Node
Rural Investment Node
Rural Service Node
Recreational Node
Tourism Node
Corridors
National Corridor
Primary Corridor
Secondary Corridor
Tertiary Corridor
Future Development Corridor
Tourism Corridor
LM Boundary
Local Municipalities
Wards
Farm Cadastral
Railway Line
Urban Edge
Traditional Authorities
Main Rivers
Main River 100m Buffer
Dams and Wetlands
Protected Areas
Protected Areas Sim
Stewardship Sites
KZN CBA Irreplaceable
Settlement Morphology
Existing Sparsely Populated Rural Settlements
Existing Densely Populated Rural Settlements
Existing High Density Built-Up Areas
Agricultural Land Categories
B: THREATENED
C: PRIMARY AGRIC
DATA SOURCES:
Towns: Cogta
Roads: DOT
Municipal/Ward Boundaries: MDB
Stats: STATSSA
Agric Land Cover: DAG
Environmental Data: KZN Wildlife 2016
Land Reform: DRDLR
Cadastral: KZN SGO
Kilometers
N
-100000
-70000
-40000
-3410000
-3440000

Port Shepstone is characterised by relatively flat land with some areas being fairly steep but developable. The Port Shepstone Central Business District (CBD) is placed in a gridiron pattern and characterised by commercial, retail, service industry and government administration activities with limited public sector investment in terms of infrastructure and social facilities upgrades. The town has a land use that measures approximately *219,19ha,* consisting of the following: -

Table 8: Broad Port Shepstone Land Uses

| Broad Land Use | Estimated Sum of area (ha) | % in study area |
|---|---|---|
| Environmental and Open-space | 48.43 | 22.1 |
| Residential | 20.35 | 9.3 |
| Utilities and Transport | 66.03 | 30.1 |
| Commercial, Office Space & Retail | 56.86 | 25.9 |
| Civic & Social Land Use | 27.52 | 12.6 |
| **Total** | **219.19** | **100** |

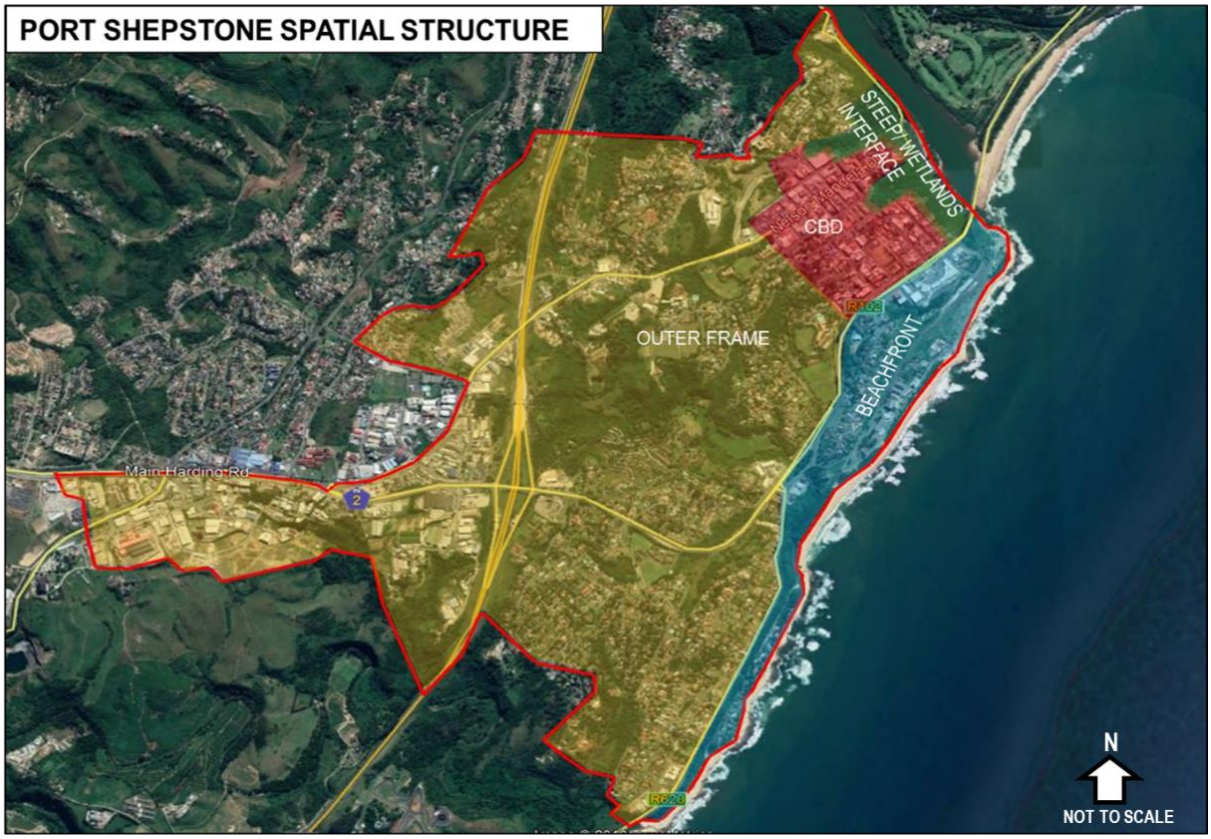



Figure 35: Port Shepstone Spatial Structure (Source: Diagram by Researcher 2018)

The Port Shepstone beachfront area forms a greater portion of the outer frame of the town and it is characterised by a railway line that spatially separates the outer frame and the CBD from the beachfront area. The outer frame is strongly characterised by low to medium density residential developments which are supported by the economic activities in the CBD and light industrial developments along the N2 towards the Marburg area.

The Ray Nkonyeni Spatial Development Framework (2017:54) calls for a future development direction of the Municipality which focuses on *a* "compact polycentric city model" which concentrates development growth in a compact urban core, around transformation areas and key urban transit oriented development nodes. Presently, the Ray Nkonyeni Municipality presents an opposite of the compact polycentric city model due to people living far from work opportunities (Ray Nkonyeni Spatial Development

Framework (2017:54). “The Port Shepstone core does not perform as the strong, structuring center it should be. High density residential areas (the ‘rural settlements’) are separated from urban economic centers and movement structures of the area” (Ray Nkonyeni Spatial Development Framework 2017:54). This pattern of development results in high social, economic and environmental costs.

With this in mind, the Municipality proposes a shift to a more efficient and inclusive urban logic of compact pol-centricity with a focus on Port Shepstone town since it is the inner or core node of the Ray Nkonyeni Local Municipality, surrounded by mixed use nodes of various densities connected by effective public transport and more logical and efficient density gradient radiating outwards from the cores (Ray Nkonyeni Spatial Development Framework 2017:55). This nodal strategy is presented in the figure below: -


Figure 36: Proposed Ray Nkonyeni Future Development Growth
(Source: Ray Nkonyeni Spatial Development Framework 2017:55)

It is envisaged that the compact-polycentric model will bring employment to residential areas and housing opportunities to employment centers rather than merely transporting people from the two (Ray Nkonyeni Spatial Development Framework 2017:56). This

model will further create complete development nodes where people can live, work and play whilst connected to an efficient public transportation system.

### 5.2.3. TRANSPORTATION STRUCTURE ANALYSIS

The current transportation structure of Port Shepstone plays a major role in the functionality of the town. The town is highly accessible on both national and regional scale and is well integrated into its surrounding settlements. It is characterised by major road networks which play a major role in terms of moving people and goods daily. The town is located along the N2 road which provides primary north-south linkages from Durban to the Eastern Cape province. The N2 links Port Shepstone with Kokstad in an east-west linkage and is regarded as a generator for growth especially between Port Shepstone and the town of Harding in uMuziwabantu Local Municipality. The N2 further plays a significant role in linking Port Shepstone with Scottsburg in Umdoni Local Municipality and King Shaka International Airport in eThekwini Municipality. Parallel to the N2 corridor is the R61 road which is a provincial road that also links the town with intermediate

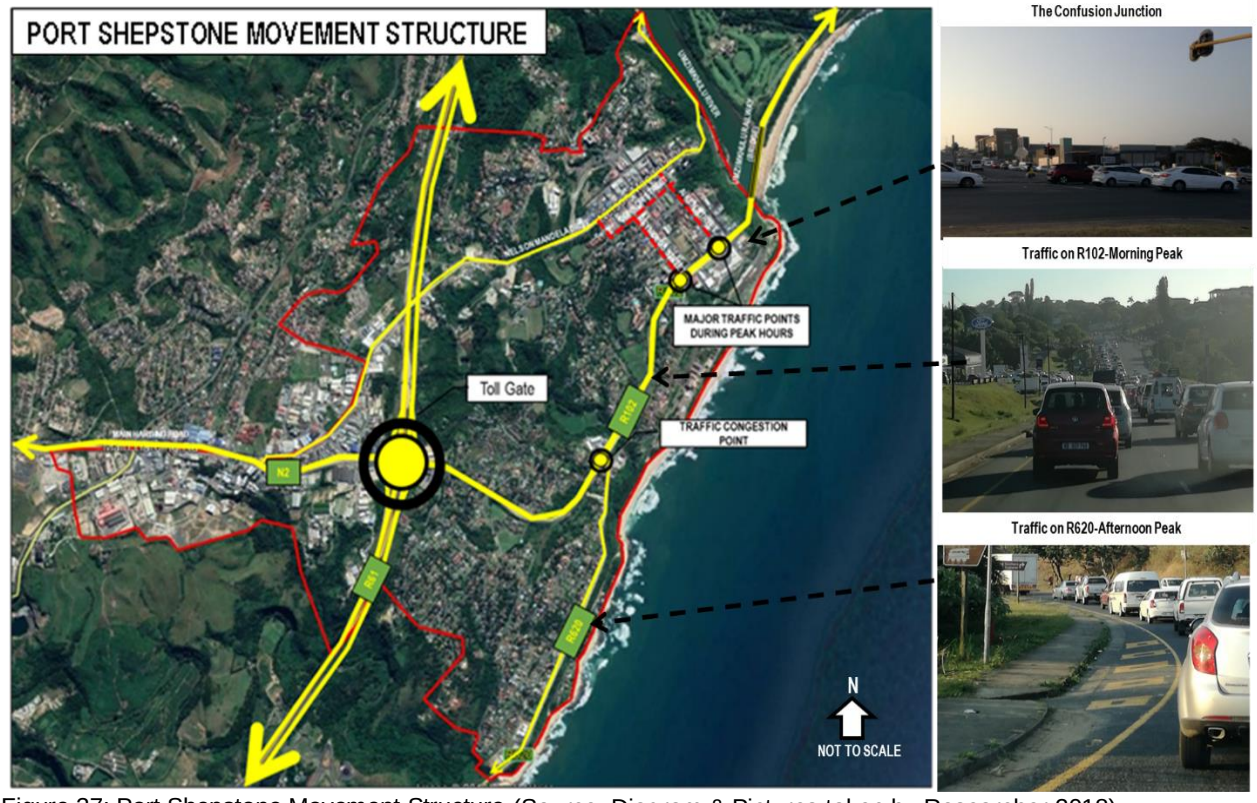


Figure 37: Port Shepstone Movement Structure (Source: Diagram & Pictures taken by Researcher 2018)

settlements of the municipality, particularly rural settlements such KwaXolo, Mavundla and KwaNzimakwe rural areas.

Port Shepstone further supported by the regional roads which carry most of the town's transportation challenges. These roads include the R102, providing a secondary north-south linkage from Hibberdene to the Marburg area, forming the outer frame of the town of Port Shepstone.The R102 crosses over the uMzimkhulu River, providing direct access to the Port Shepstone CBD from Durban in a north-east direction along the coastline. Entering the CBD from the north-south direction is the first major intersection, better known as "confusion junction", characterised by three-phased traffic lights directing traffic into the CBD through Aikens Street and into Oribi Plaza to the west. At this point, the R102 is characterised by lack of pedestrian cross-ways and a double carriageway with a broad centreline. Connecting to the R102 is the R620 better known as Marine Drive. The R620 connects Port Shepstone with the coastal towns of the municipality which include such towns as Oslo Beach, Shelly Beach, Uvongo and Margate. Both the R102 and R620 are regarded as distributor roads carrying most of the traffic in and out of Port Shepstone daily.

Along the R102, there are three (3) major traffic congestion points which become congested during peak hours. In the morning peak hour, congestion is experienced on the R602 and the R102 intersections collecting traffic from coastal towns such as Shelly Beach, Marburg, Margate and Uvongo. The afternoon traffic congestion is experienced at the "confusion junction" connecting the R102 and Aiken Street and also Reynolds Street connecting to R102. The traffic converging on these intersections is distributed on the R102 in both north and south directions. The toll-gate road, i.e. the R61 connecting to the R102 in the southern direction, experiences major traffic congestion during the morning peak hour.

Figure 38: Most Congested CBD Roads During Peak Hours (Source: Isibuko se Afrika Development Planners 2016:33)

The Port Shepstone CBD is characterised by various roads that connect the CBD to the entire town of Port Shepstone. The main streets from the CBD connected to the R102 which distributes traffic in and out of the CBD are Bazeley, Aiken, Connor, Nelson Mandela and Dennis Shepstone Street. These roads are mostly congested during peak hours and also have limited parking spaces. The CBD roads also deal with transportation challenges such as poor traffic signalling, lack of pedestrian crossings, a poor parking system and poor traffic movement and circulation.

#### *5.2.3.1. Parking system*

One of the major contributing factors to the transportation challenges of the Port Shepstone area is parking, particularly in the CBD. Parking should be the foundation of any major development, particularly in CBD of any town across the country. However, parking seems to be one of the major nightmares for the town of Port Shepstone.

Litman (2016:2) states that parking facilities are one of the major costs to society and this is the most common issue that most urban designers, operators, planners and other officials in government face. Parking is mostly defined in terms of supply i.e. too few spaces are available and somebody is always expected to build more. Parking is also measured or defined in terms of management, i.e. facilities used inefficiently and also not well managed. Litman (2016:2) states that it is often better to manage parking rather than to supply more.

Figure 39: Parking Facilities in Port Shepstone CBD (Source: Isibuko se Afrika Development Planners 2016:35)

Therefore, the municipality has not yet explored the new paradigm shift towards maximising management of parking spaces and ensuring that parking is used efficiently. The benefits of managing parking rather than merely supplying it, is that it often results in increased revenue for government and ensuring that any spill-over problems with parking are adequately addressed in the development stage of any building (Litman 2016:7). Therefore, the sharing of parking facilities between different destinations is emphasised,

with concomitant advocacy of charging of facility costs directly to users, as well as providing of rewards to people who reduce their frequency of parking.

Currently, the municipality does not have any integrated parking plan. However, the Isibuko Se-Afrika Development Planners (2016:16) suggests that the new paradigm shift regarding parking be implemented in the municipality, and that this should focus on the management of parking rather than simply on supply of parking. Some of the parking management solutions proposed include: -

- management of the existing on-street parking facilities to improve parking availability;
- improvement of the existing municipal parking areas at the top end of Reynolds and Wooley streets as it is anticipated to yield a bigger parking area;
- identification of a property, particularly in one of the mid-blocks within the CBD (e.g. between Reynolds, Colley, Dennis Shepstone and George Streets), which the municipality can acquire for the development of a parking garage or parkade;

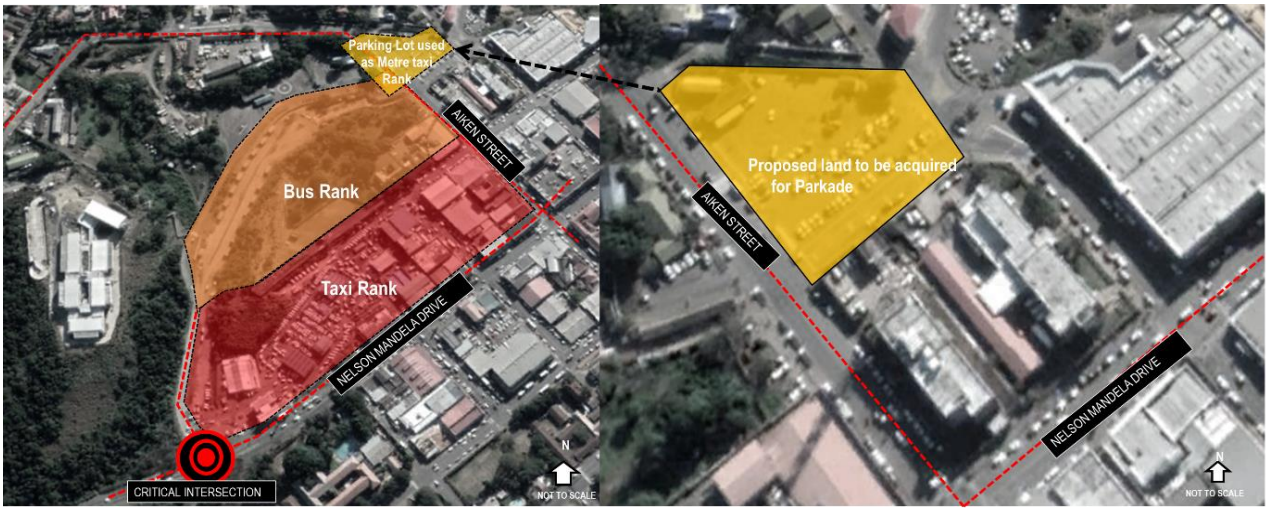



Figure 40: Proposed Parking Lot (Source: Sketch by Researcher, 2019)

- addressing of parking meter problems with the parking meter system. Bazley and Robinson Streets must also be provided with parking meters, since currently, there are no parking meters and people use the on-street parking for the entire day; and
- ensuring compliance to parking restrictions and time limits will also improve the parking situation.

The majority of these solutions have not yet been implemented on the ground. As in any other local municipality; funding is a major issue, resulting in the parking problem not being a major priority for immediate implementation. However, long term solutions in terms of strategies in the Ray Nkonyeni Integrated Development Plan Review (2017) identify the provision of a parkade in the CBD as the most likely solution for the town and it is assumed that this will alleviate most parking issues in the town of Port Shepstone. Again this confirms the lack of paradigm shift from supply to management of parking, with no enforcement measures being mentioned.

#### *3.5.2.1. Public Transport*

Most secondary cities in South Africa do not plan for public transport even with the projected levels of population growth over the next 40 years. This will cause unnecessary pressure on infrastructural development as the number of people using private transportation will increase, resulting in roads being continually congested and damaged. Port Shepstone is no different, with only a limited public transportation system available. Furthermore, the reliance on private transportation will result not only in congestion issues but also in lack of road safety for the Port Shepstone residents and the municipality at large.

The main transport and utility uses in Port Shepstone include tarred roads, a taxi rank, a railway line running parallel to the R620 and R102 routes and the harbour located in the north-eastern section of the town. During an interview held with the taxi operators in Port Shepstone. It was revealed that the main areas that are serviced by the Port Shepstone taxi rank include: -

Table 9: Serviced Areas

| Rank | Main Area Serviced | Type of Settlement |
|---|---|---|
| **Port Shepstone** | All Coastal Towns (Margate, Shelly Beach, Uvongo, Ramsgate, Emtentweni, Sea Park, Hibberdene, Port Edward) | Urban |

| | | |
|---|---|---|
| **Port Shepstone** | Gamalakhe | Township |
| **Port Shepstone** | Murchison/ Bhobhoyi, Nyadezulu, Gcilima, KwaMdlala, KwaLushaba, Nzimakwe. | Rural Areas |

The taxi rank plays a significant role as a transport interchange for the rest of the municipality as it caters for commuters for both short and long distances. The long distance taxis include mainly inter-provincial taxis to Durban, Pietermaritzburg and Richard's Bay.


Figure 41: Port Shepstone Public Transport Precinct
(Source: Sketch by Researcher, 2019 & Images by South Coast Herald, 2018)

This is supported by the bus-rank, which is located adjacent to the taxi rank and which caters mainly for local commuters, particularly those residing in the rural settlements. However, it should be noted that the bus system is generally not highly utilised compared to the taxi rank, particularly for areas such as Gamalakhe; Madlala, Gcilima as they are located within a radius of approximately 20km from Port Shepstone town. Therefore, the

importance and use of buses as a sustainable use transportation should be encouraged. Both the Port Shepstone taxi and bus rank do not have any Intelligent Transport System supporting the smooth operation of the facilities or the transport system as a whole.

The harbour plays a significant role as the most iconic, historical and heritage feature, thus bringing tourism significance to the rest of the town. Over and above the ocean that is the eastern side, the town is also characterised by a linear natural network of open spaces along the uMzimkhulu River as well as the beachfront, interrupted by a dilapidated railway infrastructure which is underutilised and which requires upgrading. It is therefore important that in achieving sustainable transportation in the municipal area, all transport infrastructure should be revitalised to accommodate the growing population of the town and the municipality in general, thus ensuring that transport planning is suitably aligned to land use and spatial planning.

### 5.2.4. LOCAL ECONOMIC STRUCTURE

The economic structure of most cities across the globe is centred on transport and logistics activities of the transport facilities such as ports (i.e. air and water) for domestic and export-orientated manufacturing and tourism, and rail and road infrastructure for the transportation of goods and services from one region to the other. The performance of the local economy of most towns is closely linked to trends in the global and national economies. Such performance requires an understanding of the prospects that shape the economic growth of the town and the municipality as a whole, thus focusing on the gross domestic product (GDP) growth, employment, and fixed investments, to name but a few. These aspects of the economy also require an understanding of the municipal contribution to the South African economy.

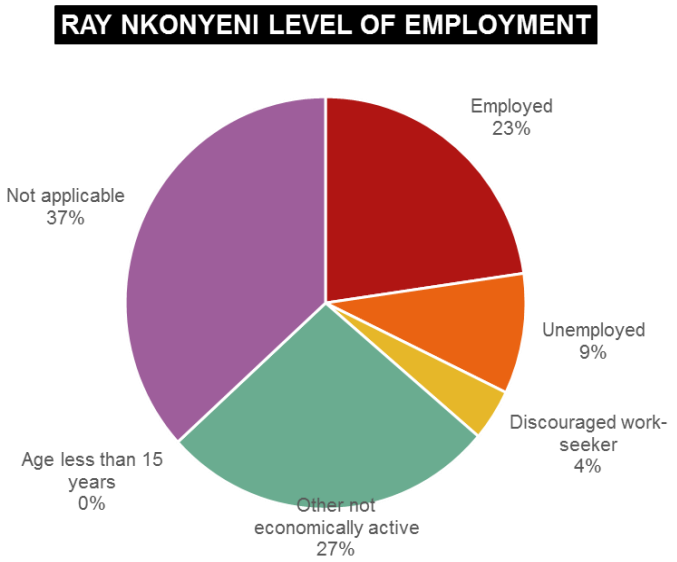



Figure 42: Levels of Employment (Source: Community Surveys, 2016)

It is reported that Port Shepstone increased its contribution to the KZN Provincial GDP by 2.94% in quarter 1 of 2008 to as high as 3.25% in the fourth quarter of 2008 (Isibuko Se-Afrika Development Planners 2016:11). It should be noted that the Municipality`s GDP was estimated to be R13 billion in 2016 accounting at least 61% of the Ugu Region GDP at R21.4 billion followed by Umzumbe Municipality (20%), Umdoni Municipality (13%) and Umziwanbantu Municipality (6%) (Ray Nkonyeni Local Economic Development Strategy 2018:36). The majority of the municipal GDP comes from Port Shepstone town due to the establishment of light-industrial and commercial activities that the town hosts.

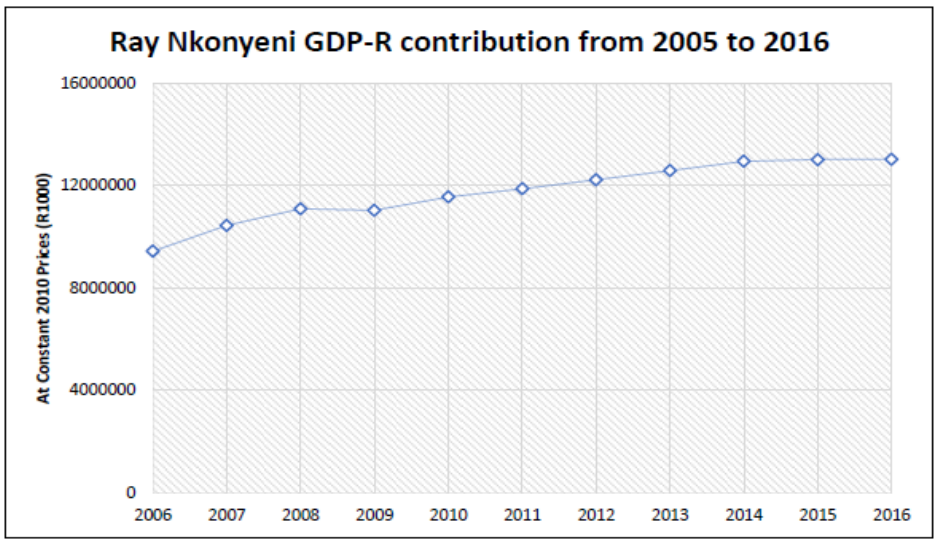



Figure 43: Ray Nkonyeni GDP 2005 to 2016 (Ray Nkonyeni Local Economic Development Strategy 2018:36)

The town is characterised by a variety of economic sectors, from informal to formal sectors, enabling the South Coast economy to be more resilient and less exposed to global economic trends and thus sustaining its GDP even in the most difficult times.

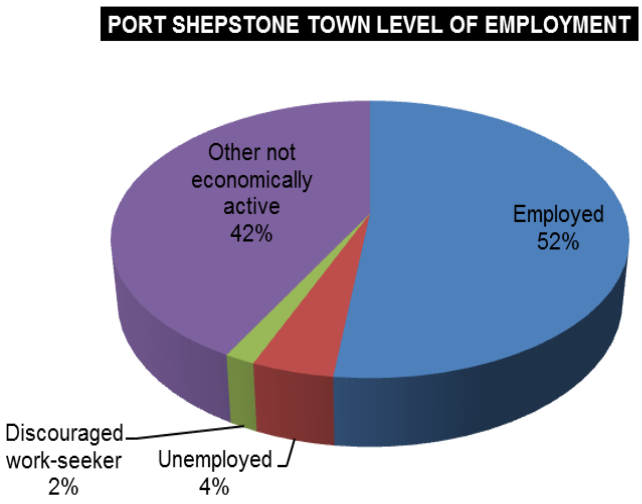



Figure 44: Port Shepstone Level of Employment (Source: Stats SA, 2011)

Statistics South Africa, 2011 as per Figure 44 above reveals that approximately 52% of the people residing in Port Shepstone are employed with approximately 42% not being economically active and approximately 4% unemployed. The Community Surveys (2016) as per Figure 42 illustrate that approximately 23% of the municipal population is employed, with approximately 27% not economically active and approximately 9% being unemployed.

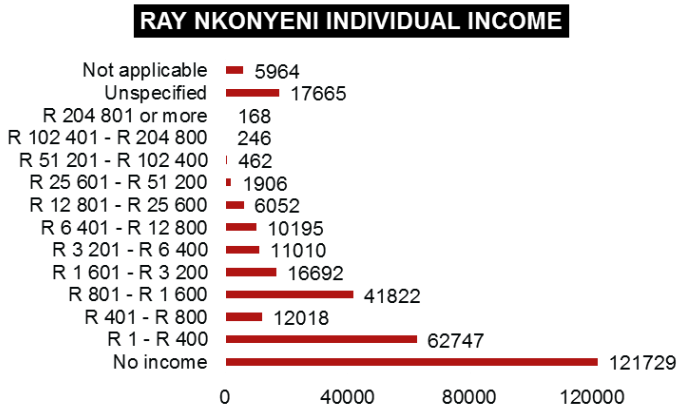



Figure 45: Ray Nkonyeni individual income levels (Source: Community Surveys, 2016)

In addition, the Community Surveys (2016) as per Figure 45 record that the individual income of Ray Nkonyeni Municipality amounts to approximately 34% of the population having no income i.e. 121 729 people with only 4.8% earning a minimum wage of R3 200 per month. Neither the 27% of the municipal population nor the 42% of Port Shepstone town are economically active, illustrating that even though the town and the municipality as a whole might be able to sustain themselves through economically difficult times, there is still a major gap between the employed and the unemployed people – or rather the people not contributing to either the provincial or the local GDP. Therefore, the current trend of economic activity of Port Shepstone has become significant for the economic growth of the entire municipality and the province as a whole.

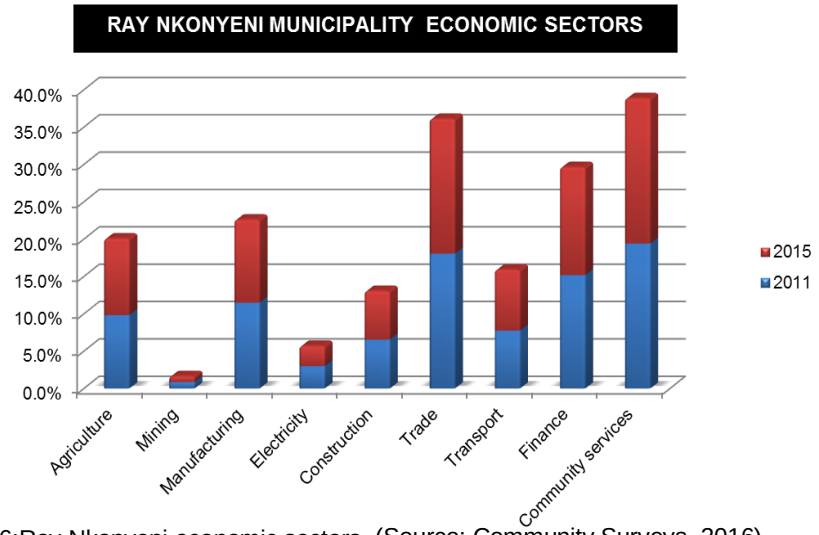



Figure 46:Ray Nkonyeni economic sectors (Source: Community Surveys, 2016)

Port Shepstone supports both the formal and informal economy. The informal economy is however one of the major contributors to the economic growth of the municipality and the province as a whole. There are still economic activities which require strengthening, such as the location of district and sub-district offices of various government departments; location of facilities and services for an effective administration; industrial development, focusing mainly on the processing of raw materials produced within the sub-region; and location of public facilities serving the whole sub-region and beyond such as district hospital, sports facilities and transportation facilities (Isibuko Se-Afrika Development

Planners 2016:12). From the economic sectors depicted on the graph above, it is also evident that construction (12%) and transport (15%) seem to be lagging behind and these sectors also require strengthening in terms of their contribution on the GDP.

The performance of the local economy of the town is closely linked to the major informal sector that dominates the town, located mainly around the public transport precinct. This sector faces major development challenges, particularly in terms of informal trading infrastructure. Only a few of the major retail and wholesale stores are located in close proximity to the public transport precinct. Accessibility to the informal economy is mainly through pedestrianised movement connecting the taxi rank and the bus depot. However, the people are mainly drawn to the informal economy rather than the formal sector. This might be due to the level of affordability for consumers that the informal sector offers and the income levels of the majority of the Ray Nkonyeni citizens.

### 5.2.5. POSSIBLE ITS FUNCTIONAL AREAS TO BE ESTABLISHED IN PORT SHEPSTONE

The findings of the secondary data (literature review and precedent studies) provided a base for the analysis of data collected from the interviews. Analysis of closed-ended questions of the interviews conducted focused on the five (5) ITS functional areas under investigation, while the open-ended questions asked in order to understand and establish suitable ITS functional areas which could be established in Port Shepstone were analysed through the thematic analysis matrix tool. The interviews were also conducted in the hope of revealing the state of readiness for implementation of ITS in Port Shepstone. The findings obtained through the analysis are summarised below as follows:

#### *a) ATIS – Advanced Traveller Information Systems*

It is understood in terms of the ATIS functional area that the majority of participants agree with the use of technical application solutions such as smart phones, digital road signs warnings, navigator boards, computers displays, radio announcements, television, and emails, to mention but a few. Therefore, real-time travel information seems to be crucial when travelling. This might be feasible as at least 87% of the municipality population have access to cell phone with at least 17.4% having access to in internet through a cell phone (Stats SA, 2011). This means that, of the 84%, only 17.4% have access to

smartphone (Stats SA, 2011). This might also mean that the 17.4% is from the coastal towns such as Port Shepstone, Margate, Shelly Beach, to name a few as the municipality is largely rural.

Social media is also seen as a great platform for notification of transportation challenges of the town prior to travelling. However, there is still some uncertainty in terms of the benefits and the results that this system will yield during implementation, as well as in terms of how many people will be willing to use it. It is understood that prior to implementation of the system, the municipality will need to investigate the benefits of developing such a system and to gauge the level of certainty that the public will use it. The cost of developing the system was one of the major concerns raised as it has previously been mentioned that most municipalities may have difficulty in obtaining the funding to implement such strategies.

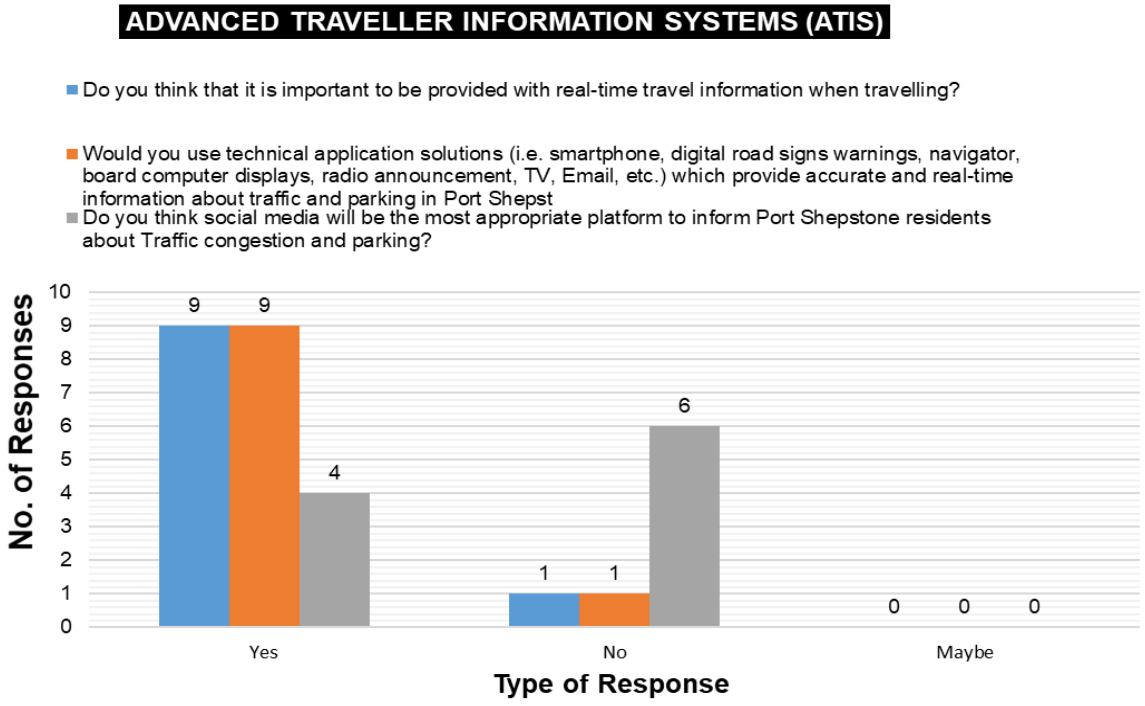



Figure 47: Advanced Traveller Information Systems Responses

### *b) ATMS – Advanced Transportation Management System*

From the responses received. It is understood that re-scrutinising of traffic lights may not necessarily result in the traffic congestion being reduced during peak hours. However, introduction of other integrated technical applications might yield better results and benefits towards the reduction of traffic congestion in the city. In addition, this should also be linked to proper dissemination of information to users to plan their trips daily without negatively impacting the traffic system i.e. ATIS.

It is further understood that the re-scrutinising of traffic lights also require the upgrading of the road network, taking into account the time spent on the road during peak hours. Therefore, it is believed that the municipality should prioritise the upgrading of road networks and should integrate ITS as part of the road network for traffic management.

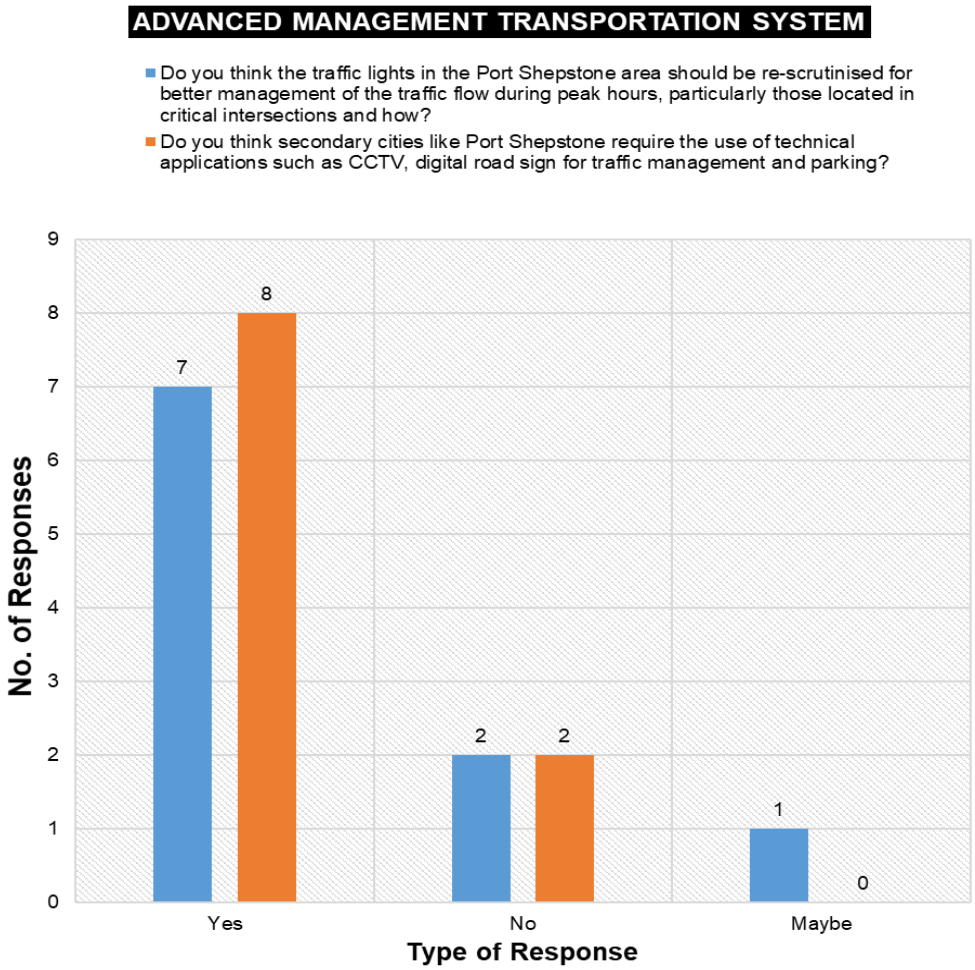



Figure 48: Advanced Management Transport System Responses

### *c) APTS – Advanced Public Transport System*

This seems to be one of the ITS functional areas which is fully supported and is believed to have the potential to relieve the municipality in dealing with transportation challenges; its benefits and impact are visible on at a greater scale. From the responses received, it is understood that the municipality needs to invest in the development of a bus rapid transport system which should not only be centred on the town of Port Shepstone but on the municipality as a whole. It is believed that such a system will eliminate most transportation challenges which may include traffic congestion during peak hours and reduction of $CO_{2,}$ thus improving operations efficiency and the safety of people on the road.

One of the most encouraging findings is that the municipality is currently converting the existing Port Shepstone taxi rank into an integrated intermodal facility which will include a bus rank (for long and short distance buses), a taxi rank and metred taxis as part of the urban renewal programme, and will also include a shopping mall for retail and commercial purposes. Provision will also be made for informal traders and kiosks outside the facility and employment opportunities to increase the local economy of the municipality. It is envisaged that the proposed facility will generate major traffic into the Port Shepstone CBD. As such, the traffic flow around the proposed intermodal facility is put forward as depicted on Figure 49.


Figure 49: Proposed Traffic Flow (Source: Isibuko Se Afrika Development Planners 2016:98)

However, the effectiveness of the planned public transport system is questioned as findings did not reveal to what extent the inter-modal facility will incorporate ITS to manage transportation challenges which may emerge from the operation of the facility, taking into account its large scale. It is furthermore unclear whether the public transport system that has been initiated will put in place ITS such as automatic vehicle locations (AVL) which enable the detection of transit vehicles such as a buses to make it simple for operational managers and public transport users to determine and view real-time travel status. Electronic fare payment systems for public transport users, which may include the use of smart cards applicable for different modes of transport, etc., are also one of the ITS big questions which still requires answers. It is believed that if the municipality prioritises implementation of the APTMS, this will alleviate most transportation challenges not only of Port Shepstone but also of the municipality as a whole.

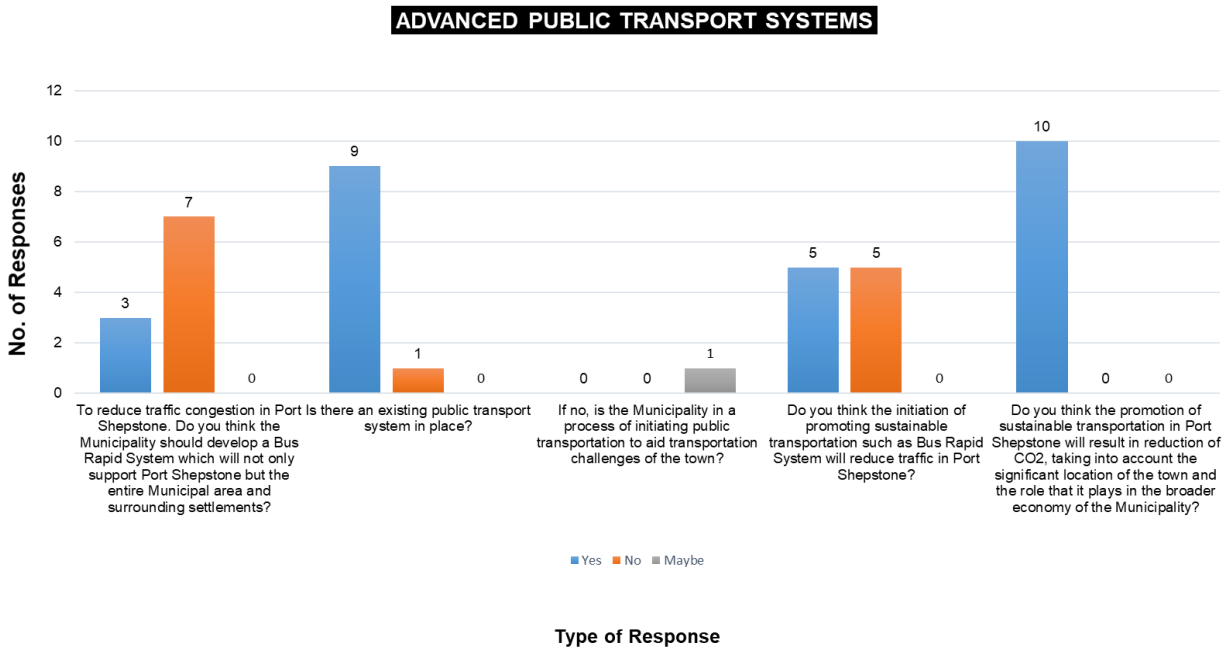



Figure 50: Advanced Public Transport Systems Responses

### *d) ETPS – Enabled Transportation Pricing Systems*

It is understood that the ETPS is one of the ITS functional areas which plays a significant role as a transportation funding strategy for most developed and developing countries in the world. However, for Port Shepstone, it seems to not be a great priority for implementation as it is believed that such systems often work better in primate cities and not secondary cities like Port Shepstone. One of the greatest concerns revealed is that initiating such a system will often result in public rejection and political opposition, particularly if awareness campaigns and advocacy are not carried out prior to implementation. It is understood that such systems can be initiated mainly to solve parking problems of the town and not specifically congestion. However, this can only be effective up to a certain point, taking into account the lack of enforcement that is currently in place. It is believed that the municipality still needs to address transportation challenges extensively through enforcement, particularly in terms of the parking system. This can be achieved through putting in place traffic and parking bylaws which should be enforced efficiently.

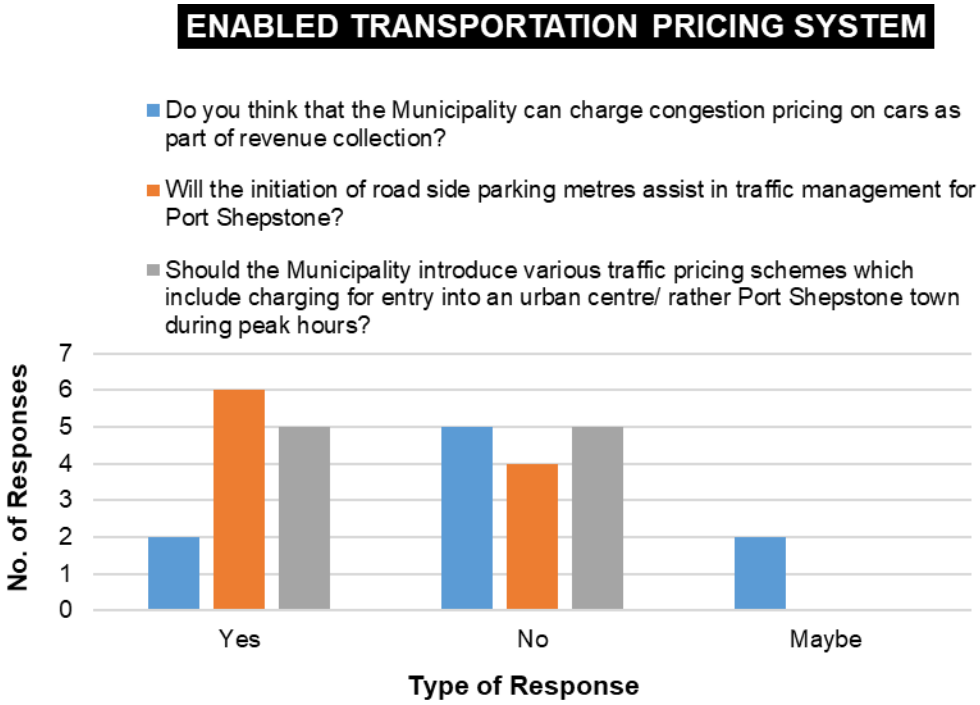



Figure 51: Enabled Transportation Pricing System Responses

### *e) DAM – Data acquisition and management*

It is understood that data acquisition and management can be a real nightmare for secondary cities due to lack of resources and funding. However, putting in place measures on how data should be acquired and managed can make life easier, particularly in terms of accessibility and efficiency. The type of resources or technology that one uses often plays a significant role in assisting transport users to escape the nightmares of facing traffic, dealing with unforeseen road accidents, and so forth.

One of the findings is that for Port Shepstone, the DAM ITS functional area is of great importance, particularly in the use of traffic management tools such as CCTV cameras and the development of a data management centre equipped with the latest technology to alleviate transportation challenges of the town. Currently, the municipality has a data management centre which is not in a good condition and which uses old technology. This does not help in terms of managing the transportation problems of the town of Port Shepstone or the municipality as a whole. It is believed that the municipality needs to

prioritise investment in the latest data acquisition and management technology for alleviation of transportation challenges. It is further understood that a maintenance strategy should be in place to ensure that such technology is managed and maintained continually.

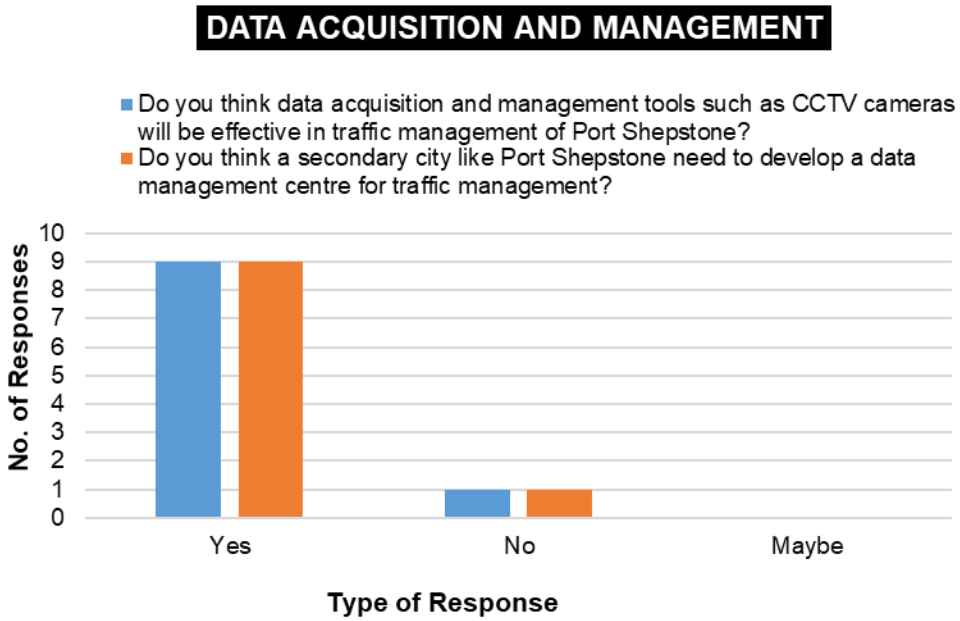


Figure 52: Data Acquisition and Management System Responses

### 5.2.6. DISCUSSION OF FINDINGS

#### 5.2.6.1. OPEN-ENDED QUESTIONS

The following discussions of findings are drawn from open-ended questions that were done in order for the participants to provide ideas on the establishment of ITS in Port Shepstone. A thematic analysis was used to identify themes and ideas that the respondents provided and for the researcher to draw conclusions and converging ideas towards the area of investigation. It should be noted that usually a thematic analysis attempts to identify common words used by respondents in order to establish findings. However, in this case, the respondents used themes and not necessarily words which were analysed accordingly and the findings in this regard are summarised as follows: -

1. **New transportation services to help meet transportation needs**

It is understood that the majority of the respondents would prefer to use an improved public transportation system. It is believed that public transport provides people with a sense of safety, efficiency and affordability. It is further understood that having a municipal bus rapid system which services the entire municipality will benefit most people, particularly those staying on the outskirts of the urban areas. However, while the majority of the respondents advocated for the development of a BRT system in Port Shepstone, the underlying question is whether the establishment of a BRT will work, considering the dispersed settlements or rural areas located at least 30km and more inland, and characterised by poor to no road infrastructure. This might require extensive investment to implement. Furthermore, household density and income play significant roles in terms of ensuring that such a transportation system is sustainable and bringing about real benefits which are visible. Accordingly, literature reveals that public transport services in South Africa have been hugely designed to serve the perceived need to assemble labour from distant areas and satellite low-income areas to centralised workplaces. It is understood that before implementing such as system, much thought should be given to population density, income and location of the potential users of such a system. Spatial and land use structure is directly linked to the behaviour of people and the mode of transport that people desire to use in order to meet their daily travel needs. It is the researcher`s assumption that the integration of ITS as part of BRT for a small town as Port Shepstone might not result in any visible benefits which will bring operational efficiency and sustainability. As such, it is important that the municipality undertake extensive investigations on the benefits of BRT prior to implementation.

2. **Institutionalisation of ITS by local municipalities for the implementation of ITS**

It is understood that institutionalisation needs to start from regulating transportation in the city, and this requires prioritisation of transport plans which should form part of the Integrated Development Plan (IDP) and Spatial Development Framework (SDF) processes. It is further understood that if enforcement is not at the forefront of the transportation sector, not much can be achieved through the ITS solutions being

implemented, particularly in the public transportation sector. This is believed regardless of the political opposition that exists in most municipalities with Port Shepstone not being an exception. Municipalities should take charge of their projects and drive them through implementation, even though political opposition might seem to be one of the major barriers to change and development including that of implementation of transportation projects. We need to understand the role and the importance that such institutions bring into the development space of most municipalities and the impact that they have on investments and economic growth. Literature reveals that the process of changing any unsustainable development to a more sustainable development, which also includes that of the transportation sector, is beyond institutionalisation through policy development, and falls rather under the banner of acceptability to the public, which often drives political acceptance. Therefore, the lack of public involvement during the transitioning phase to a more sustainable system always requires people's support and buy-in, thus ensuring that there is no political contestation and public unrest.

### 3. Winning political support for implementation of ITS

It is believed that one of the major strategies is to use the bottom-up approach of development which advocates for inclusion of people through public awareness campaigns and other public participation platforms. It is understood that taking into account the ideas of the people on the ground will result in obtaining political support and thus yield positive results. It is understood that politicians always desire to serve the masses and this often require demonstration of the benefits of implementing projects like those of ITS. Therefore, such benefits should be advocated by the politicians as this will also work in their favour in terms of serving the masses.

### 4. Financial implications that most cities face in implementing ITS for sustainable transportation

Like politics, finance is a major barrier to change in development. The issue of finance is an important question to deal with, and the municipality must align itself in terms of any

unexpected financial implications that may come with the development of sustainable systems like ITS. Even though clear responses were not obtained in terms of the major financial implications which come with the implementation of ITS projects in cities like Port Shepstone, what is understood is that infrastructure maintenance is the major financial implication that secondary municipalities do not prepare themselves for. It is believed that secondary municipalities often put in place infrastructural development initiatives without giving any thought to the institutional arrangements and financial implications which come with such initiatives, particularly in terms of maintenance. Often they do not put in place post-project plan strategies to provide a roadmap on where and how such systems will be integrated into the existing systems and the maintenance thereof. Even though literature reveals that South Africa as a developing country has seen the light in terms of the implementation of ITS, there is still a gap in secondary municipalities in seeing the light in terms of the benefits that come with the implementation of ITS. It is assumed that this might be due to the secondary municipalities not realising that their role in the broader national economy is wider than just for local economic development. Therefore, they tend to under-invest or not invest at all in implementation of ITS projects. It is believed that both the public and the private sector in secondary municipalities need to demonstrate the role that finances play in the establishment of sustainable transportation solutions and the value that they add to the successful implementation of such initiatives as ITS.

## 5. Responsiveness of Port Shepstone to ITS transportation needs

One of the major findings drawn from both primary and secondary data is that awareness and public participation should always be supported by policy certainty and/ or regulations in place to drive the implementation. It is believed that if these strategies are put in place, major impact and benefits will be visible on the ground. It is further understood that institutional strategies such as technical committees in the municipalities which will mobilise the implementation of ITS should be established. This will ensure that benefits are visible on the ground and that the implementation is monitored throughout. It is understood that the degree of benefit of implementation of ITS is different in different places across the country and that only initiating small ITS solutions in the existing

infrastructure together with showing the benefits of starting small may result in major benefits.

### 6. Creating awareness for the use of ITS in aiding traffic challenges

It is understood that public awareness can be successfully achieved through the use of social media and public meetings in which people can be made aware of the benefits of establishing ITS as part of the solution to transportation challenges. It is believed that the public participation meetings need to include key role players which include ward councillors, public transport representatives, and schools which often use buses to transport children, to mention but a few. This is because such role players might be the first to understand the benefits of using such systems and this will make it easier for the municipality to roll out the system to other parts of the municipality and not just to Port Shepstone town. It is further understood that creating awareness should always be the first step to be taken when implementing ITS solutions in order to understand the implications that come with it and to be able to adequately address the individual expectations that come with the implementation of the system. This remains at the core of any change related to development in any community and/or society.

### 7. Policies and smart strategies to be put in place, particularly in the IDP and the SDF before adopting ITS in cities like Port Shepstone

Literature revealed that the establishment of sustainable transportation goes beyond the development of policies and resource constraints; rather it is more about public acceptance. But this does not mean that other barriers to change should be ignored. Visible gaps in policy development should be identified, and should be addressed accordingly taking into account the needs of the community at the time. It is believed that this can be achieved through the understanding of existing transportation challenges and aligning them to policy development and formulation. It is also understood from the responses received that policy development on ITS should emphasise the need for infrastructural development prior to implementation of ITS. It is however important to note that every city responds differently towards ITS solutions and transportation challenges that they face.

### 8. Other thoughts or suggestions on the implementation of ITS in Shepstone

It is understood that implementation of ITS in Port Shepstone should take into account people's behavioural culture, particularly in terms of understanding the sectors of employment that serve the majority of the town`s population and income levels as these often shape the type and/or mode of preferred transport solution. It is further understood that upgrading of infrastructure needs to be at the forefront of ITS solutions and should include re-synchronisation of traffic lights and changing the design of road infrastructure, for example. This confirms that it might take a while for people to accept the change to sustainable transport systems and this further emphasis that the government still has a lot to do in securing extensive public acceptability, political will and sufficiently extensive priority investment in order to become a reality. It further confirms that in South Africa, we are still more worried about having to fit in a system which benefits an individual more than it benefits the society; and having such a mentality will and is still continuing to damage most societies and the country as a whole.

### 5.2.6.2. SUMMARY OF FINDINGS

The concept of sustainable transportation is not easy to achieve, particularly in secondary cities, as it has various aspects attached to it which may create barriers when it comes to implementation. It is apparent that the barriers to achieving sustainable transportation in secondary cities is beyond the development of strategic policies and political support; rather they are more about public acceptance to the transitioning from unsustainable systems to more sustainable systems which, in the current era, often involves technology. It is understood that not involving people during implementation of the transition to sustainable transportation often results in community opposition and political contestations affecting decision-making processes. Therefore, strategic solutions need to be applied to respond to the specific transport needs faced at the time and that ITS might not be a solution for everyone to adopt; it should be applied selectively as it may be effective up to a certain point and thereafter anything more might be a waste.

Primary data reveals that in order to respond to the aforementioned transportation challenges of the town, adoption of ITS strategies might not be a solution due to the

current deterioration of transport infrastructure. This implies that the municipality needs to prioritise upgrading of transport infrastructure prior to incorporating any technological solutions in the transport system. One of the most favourable solutions that was revealed to be feasible for implementation is the development of a bus rapid system for the entire municipality in order to ensure that transportation challenges are not catered for only on a local scale, but rather on a regional scale. It is revealed that such a system should be supported by the implementation of the following four (4) ITS solutions: -

a) *Advanced Traveller Information System (ATIS),*
b) *Advanced Public Transportation System (APTS);*
c) *Data Acquisition and Management System (DAMS), and the*
d) *Enabled Transportation Pricing Systems (ETPS)*

In order to address the parking issues of the town. It is further revealed that such systems will need to be well institutionalised by ensuring physical enforcement and that public consultations are done to obtain political support. It is understood that the development of ITS in Port Shepstone should be implemented incrementally, thus ensuring that each phase undergoes public consultation which is fully conducted and achieved.

Therefore, at this point in time, development of ITS in Port Shepstone will require extensive prioritisation in terms of funding and political support, time and strategic thinking. If something is not done fairly quickly, the town will not be able to relieve primate cities from development pressures which come with the increase in population growth which in turn requires increase in development and economic growth.

## 5.3. CONCLUSION

The chapter provides clear conclusions on the ITS solutions to be implemented in Port Shepstone taking into account the analysis of both primary and secondary data. The next chapter will provide recommendations based on the synthesis of findings presented herein. It is clear that not all of the ITS functional areas investigated will be possible to implement due to a number of factors, which include development aspects such as the current spatial structure of the town and other social and economic aspects which often influence transport development and improvements. Therefore, strategies on ITS

implementation should clearly understand the impact that each development structure contributes to the transportation sector of the town and the benefits and barriers that come with enhancing the transportation sector through innovation and technology.

# CHAPTER 6: FINAL CONCLUSION AND RECOMMENDATIONS

## 6.0. INTRODUCTION

The aim of the study was to establish the possibilities of using intelligent transport systems (ITS) to address the transportation challenges of the secondary city of Port Shepstone. Some of the sub-objectives which needed to be addressed included: -

a) To critically identify possibilities of establishing ITS in Port Shepstone;
b) To establish the theories informing ITS;
c) To learn through comparison and/or cross-references from international and local precedents on ITS and secondary cities;
d) To provide recommendations on the use of ITS in Port Shepstone.

In order to have an efficient ITS in place for the town of Port Shepstone, it is important to look at all aspects of development. Therefore, the previous chapters looked into population dynamics as well as spatial and land use, transportation and local economic structures of the town, in order to link these development aspects to the ITS functional areas in question for establishment in the town of Port Shepstone.

With this in mind, the aim of this chapter is to reflect on the literature review, precedent studies and the analysis of primary and secondary data results and findings.

## 6.1. SUMMARY OF RESEARCH FINDINGS

This chapter summarises the empirical findings of the research study and aims at fully addressing the research question and objective. Such findings are summarised as follows:

1. The Ray Nkonyeni Local Municipality seems to have grown and is still continuing to grow at a rapid rate due the level of economic activity of the municipality. Using the 2016 Community Surveys, the expected growth for the municipality over the next 40 years, i.e., by 2052, will be over half a million i.e., 617 223, with approximately a hundred thousand (100 000) households. This has various implications for the town and the municipality as a whole, taking into account that it

is a secondary municipality that needs to reinvent relief solutions that will assist primate cities in accommodating the expected population growth of 2050.

2. The population of Port Shepstone in 2017 was approximately 8 132 with approximately 2 589 households, whilst in 2052 the population is projected to be approximately 15 344 with approximately 4 513 households.
3. The town presents a fragmented spatial structure characterised by relatively flat land with the CBD laid out in a gridiron pattern and supported by rural settlements located 30km to the west. The transportation structure of the town is only limited to a municipal bus system and mini-taxi`s that services the town and the surrounding rural settlements.
4. It is revealed that the town supports most of the economy of the municipality, with the formal sector contributing at least 3.1% to the KZN provincial GDP in 2015 (Isibuko Se-Afrika Development Planners 2016:11). The formal and informal economy is characterised by a number of development sectors which vary from transport, construction, manufacturing and community services to informal trading (Isibuko Se-Afrika Development Planners 2016:12).
5. Even though the town seems to be also contributing to the provincial GDP, there are still some sectors in the formal economy which require strengthening in terms of luring economic investment into the municipality; these include restructuring of the spatial location of social facilities and services for effective administration and industrial development focusing on processing of raw materials.
6. The town’s transport structure is no different from that of any secondary city in the country or in fact across the world. It is transversed by national and regional routes which include the N2, the R102, the R61 and the R620, which intersect and divide the town into two portions. These roads, particularly the R102 and the R620, experience major traffic congestion during morning and afternoon peak hours and also seasonally i.e. during holidays.
7. The transportation sector is characterised by one (1) public transport facility and system that is in place and only includes two modes of transport which include buses and taxis servicing the town and the adjoining settlements.

8. The transport sector is further characterised by a failing parking system which still uses the old parking paradigm or system that assumes that parking should be abundant and free at most destinations in the town with little or no management or enforcement system in place.
9. The enquiry on literature review revealed that the concept of sustainable development is not an easy one to achieve in secondary cities due to a number of barriers to development which mostly include funding issues, political opposition, public acceptance and technical failures which come with implementation. Therefore, it is highlighted that in establishing sustainable transportation solutions, such barriers need to be fully understood and tackled carefully prior to implementation thus ensuring that each solution is applied selectively to respond to a specific transport solution of that city or town.
10. The enquiry further revealed that prioritisation in implementation is important and should also be carried out carefully to respond to the needs of citizens.
11. The literature review enquiry is further supported by the enquiry about precedents, which revealed that developed countries often overcome the barriers to development simply because they understand them fully prior to implementation and have all the resources in place, i.e., both financial and physical resources, and they understand that implementation is beyond policy development – rather it is more on overcoming the barriers to sustainable development.
12. Of major importance to note in the study of the precedents is the development of ITS solutions in developing countries which mostly seek to provide benefits at a local level and not on a regional level, thus resulting in missed opportunities particularly in ensuring integration, coordinating the sharing and optimisation of resources, information and technology, funding opportunities, and facing challenges in terms of sustainable operations and maintenance.

Over and above the findings summarised above, the synthesis of data collected through interviews revealed that not all functional areas of ITS can be established in Port Shepstone due to a number of limitations which present themselves because of the current spatial formation and economic structure of the town which seems to make it

almost impossible for the town to transition from unsustainable systems to more sustainable systems. Empirical findings revealed upon investigation of the five (5) ITS functional areas for the town of Port Shepstone may be summarised as follows:

***a) The advanced traveller information systems***

- These systems seem to be one of the best options to adopt as a start towards implementation of ITS. They include the use of digital platforms such as smart phones, digital road signs warnings, navigator board computers display, radio announcements, television, emails, social media, and so forth.
- The use of such systems will need to be investigated as there is still some uncertainty in terms of the benefits that they will bring to Port Shepstone citizens. This needs to be done through public consultation prior to implementation.
- The cost implication is one of the major concerns to arise and strategies on how to deal with this will need to be considered.

***b) The advanced transportation management system***

- This system seems not to be as feasible, as it is believed that major investment is required for infrastructure upgrade prior to such an option being implemented.
- The ITS option is not entirely advocated by most and therefore further investigation will need to be undertaken on this ITS solution to understand its benefits if implemented in a small town like Port Shepstone.

***c) The advanced public transport system***

- This solution is advocated by the majority and is suggested to be the most feasible option for implementation.
- It is believed that the benefits of the system and its impact will be visible on a greater scale.
- It is further suggested that implementation of this system should not only be implemented on a local scale, but rather on a regional scale to benefit the entire municipality.
- It is revealed that household and income density plays a significant role in terms of ensuring that a system such as APTS is sustainable and bringing about real benefits

which are visible. Therefore, the greater compaction one has in terms of household density, spatial structure and income density often results in a more efficient and sustainable transportation system.

- One of the empirical findings is that the municipality is currently working on developing an integrated intermodal facility which will accommodate long and short distance buses, meter taxis and mini-buses/taxis. However, the extent to which ITS is to be incorporated as part of the facility still remains one of the unanswered questions.

***d) The enabled transportation pricing systems***

- These systems play a significant role as a transportation funding strategy.
- However, for secondary cities such as Port Shepstone they might not be feasible.
- Responses revealed that the system will work better for parking, and enforcement will need to be strengthened through policy development, regulation and physical policing, which may include car impounding, parking charges at peak hours and implementation of parking bylaws in order to ensure compliance.
- The greatest concern revealed in this regard is that it may result in public rejection and political opposition, particularly if awareness advocacy is not carried out prior to implementation; it may only work to a certain extent if not enforced properly.

***e) The data acquisition and management system***

- This system is also advocated for by the majority of the respondents.
- However, if there is lack of resources and financial constraints, this could be a nightmare to implement.
- Putting in place measures such as both hardware and software infrastructure for data acquisition and management is not easy and requires huge financial resources and personnel. Therefore, it might be difficult to administer such a system if such resources are not available.
- However, it is believed that if such a system were to be implemented, it would result in efficient service delivery.

## 6.2. RECOMMENDATIONS

Based on the findings summarised above, it is understood that the implementation of ITS in Port Shepstone comes with implications that need to be thoroughly considered. The following recommendations are therefore proposed:

1. The implications that come with the increase in population growth require that the municipality start accommodating and planning for the expected population growth through infrastructure development and ensure that economic investment growth is encouraged. This can be achieved through massive investment in the upgrading and maintenance of the transport infrastructure, and integrating technological systems into the upgraded infrastructure to support the expected population growth by 2050.
2. Technological innovation needs to be encouraged not only in Port Shepstone but also in the municipality as a whole, and this should be at the top of the priority list for implementation, in order to promote efficient and sustainable service delivery which will respond to the needs of the growing population.
3. The municipality needs to promote integrated basic services and the strengthening of intergovernmental relations (IGR) in order to promote implementation of smart solutions that will respond to the growing population needs.
4. Policy development, particularly in regard to spatial plans, needs to prioritise the restructuring of spatial and economic structures in order to respond to the needs of the population, ensuring that services, which include social, administration and economic services, are located along transport routes, i.e., to ensure that promotion of transit-orientated developments (TOD) is achieved.
5. Political and institutional structures should be in place, thus ensuring that public acceptance through awareness is fully achieved prior to implementation of any ITS solution.
6. Management of the transportation sector should be prioritised in order to achieve real and visible benefits from government, businesses, developers and consumers which may include reduced costs of transportation, improved

quality of services, revenue generation through transport funding strategies, infrastructural development and reduced traffic congestion during peak hours.

7. The implementation of ITS should not start on a large scale, but rather on a smaller scale in order to establish its effectiveness and to ensure that the response that the system will get from the public and other sectors of development remains positive, keeping in mind that what has worked for one secondary city might not work for Port Shepstone.
8. Institutionalisation should be well-thought-through as this is one of the main areas of failure in implementation. Institutionalisation can be achieved by ensuring that the vision of the municipality in terms of becoming a smart municipality through implementation of ITS is not only realised at a local level, but also at both regional and national levels. Therefore, an institutional strategy needs to be part of the ITS implementation strategy to eliminate, or at least lessen, the majority of the barriers to sustainable transport development.

Besides the recommendations presented above based on analysed secondary data, the research study recommends ***four (4) possible ITS functional areas*** to be established to aid the transportation challenges of Port Shepstone. These are:

1. **The advanced traveller information system (ATIS),** because so many people across the world are connected to the Internet and other smart systems of the world in terms of smart phones, radio, television and social media. It is believed that it is through such smart systems that people will respond better. As part of the communication and traffic enforcement strategy, the municipality needs to integrate traffic information into its current information technology systems and to invest in the relevant infrastructure required to obtain accurate and real-time information for road users, as people often go to the same place at the same time, thus resulting in transportation challenges such as congestion. Such platforms always provide people with an opportunity to plan their trips properly without having to worry about any traffic glitches.
2. **The advanced public transportation system (APTS)** is also recommended for establishment. However, this requires extensive investment in infrastructural development prior to implementation. The system might be hard to achieve if the

municipality does not have any major funding in place to deal with the current transport infrastructural development issues. In implementing this system, it is recommended that the municipality enter into public-private partnerships (PPP) in order to lessen the negative impact that might come with implementation. As has already been mentioned, the benefits of establishing APTS is mostly visible when established on a regional scale and not on a local scale. It is further recommended that the system, once implemented, cover the coastal corridor from the town of Hibberdene to Port Edward, considering that these towns form a major part of the tourism sector of the municipality. Financing structures will also need to be established with good infrastructural maintenance put in place, and this should form part of the institutional strategy implementation. Lastly, the current plans on the implementation of the intermodal facility in Port Shepstone could form a strong base as a pilot project for APTS for an ITS solution for the town. As such, real benefits can be seen on a greater scale as the project has already won political support and public acceptance.

***3.*** For any transportation system to function efficiently in a city, the **data acquisition and management system (DAMS)** should be in place. This requires that the municipality also invest in data acquisition and management infrastructure (i.e., tested hardware and software that collect reliable information) in order to bring some sort of relief to the transport system of the municipality. Strategies on how data is acquired and disseminated to transport users and institutionalisation of data management in the municipality should be highly prioritised. The investment in such a system will improve the flow of traffic in the town and in the municipality as a whole, thus alleviating some transportation challenges such as traffic congestion at critical intersections such as R102 and R620 during peak hours. It is recommended that the DAMS also be envisaged as one of the best systems to be prioritised, particularly also for the management of the intermodal facility.

**4. The enabled transportation pricing systems (ETPS)** should be prioritised, particularly for parking. The municipality should ensure that it upgrades the current parking infrastructure and puts in place parking bylaws which will assist enforcement officers to ensure that compliance is achieved in this regard. This will

also play a significant role in funding the transportation system of the town. Increase in capacity of enforcement personnel should also be prioritised in support of the said ITS solution as systems often fail if there is no person managing and fully ensuring compliance on the ground.

## 6.3. FINAL CONCLUSION

The main objective of this research study was to establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone. In addressing the said objective, the study investigated the feasibility of establishing five (5) functional ITS areas which were shortlisted based on information gleaned from the literature review. It has been discovered that ITS is a broad topic, encompassing various technological aspects which are very dynamic and which address various issues in the transportation world. The limitation that came with the research study is that it could not investigate all ITS solutions available as it would have made the study too long with no clear and converging conclusion.

Regardless of the broad spectrum and availability of ITS solutions, it is acknowledged that such systems might be a nightmare for a secondary municipality like Ray Nkonyeni to implement for the town of Port Shepstone. However, with good public acceptance, political buy-in, good institutionalisation, and physical and financial resources in place, the research study is able to recommend an incremental implementation of four (4) ITS solutions for Port Shepstone. This should ensure successful implementation with less pressure on the resources required for such implementation.

In the implementation process, the anticipated barriers to sustainable development should not deter the municipality from trying and testing other technological solutions which have not been investigated in this research, or any other ITS solutions that may come its way. Considering its desire to become a smart municipality through its long-term spatial vision, the municipality should take into consideration all barriers to change that could hinder the transitioning to more sustainable ways of living. We can at least witness one secondary municipality in South Africa fully implementing ITS, even if it is not on a grand scale. There has to be a shift in how secondary cities see themselves in the broader

scale of development and the economy of the country, particularly in fulfilling their role of providing relief to primate cities to accommodate their expected growth in population.

The introduction of an innovative approach in Port Shepstone needs to aim at alleviating the unique transportation challenges of the town and the municipality as a whole, and should strive towards seeing the real benefits of ITS and becoming one of the success stories in implementation of ITS in the developing country of South Africa.

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# APPENDICES

***Appendix 1: Matrix analysis on interviews conducted – closed-ended questions***

| CRITERIA | INTELLIGENT TRANSPORT SYSTEMS FUNCTIONAL AREAS | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ATIS | | | | ATMS | | | | APTS | | | | ETPS | | | | DAM | | | |
| | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS |
| 1. Do you think that it is important to be provided with real-time travel information when travelling? | 9 | 1 | | The benefit should be analysed. This means that the benefit of developing the system vs. the benefit that you get from using it. It will cost the municipality a lot. | | | | | | | | | | | | | | | | |

| CRITERIA | INTELLIGENT TRANSPORT SYSTEMS FUNCTIONAL AREAS | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ATIS | | | | ATMS | | | | APTS | | | | ETPS | | | | DAM | | | |
| | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS |
| | | | | | | | | | | | | | | | | | | | | |
| 2. Would you use technical application solutions *(i.e. smartphone, digital road sign warnings, navigator, board computer displays, radio announcements, TV, email, etc.)* which provide accurate and real-time information about traffic and parking in Port Shepstone? | 9 | 1 | | | | | | | | | | | | | | | | | | |
| 3. Do you think social media will be the most appropriate platform to inform Port Shepstone residents about traffic congestion and parking? | 9 | 1 | | How will the system work as much more efficient systems are mostly electronic platforms such as digital signage; radio; etc. | | | | | | | | | | | | | | | | |
| 4. Do you think the traffic lights in the Port Shepstone | | | | | 7 | 2 | 1 | This might not be helpful if the | | | | | | | | | | | | |

| CRITERIA | INTELLIGENT TRANSPORT SYSTEMS FUNCTIONAL AREAS | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ATIS | | | | ATMS | | | | APTS | | | | ETPS | | | | DAM | | | |
| | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS |
| area should be re-synchronised for better management of the traffic flow during peak hours, particularly those located in critical intersections and how? | | | | | | | | road network is not improved, taking into account the time spent on the road during peak hours. | | | | | | | | | | | | |
| 5. Do you think secondary cities like Port Shepstone require the use of technical applications such as CCTV, digital road sign for traffic management and parking? | | | | | 8 | 2 | | | | | | | | | | | | | | |
| 6. To reduce traffic congestion in Port Shepstone: do you think the municipality should develop a bus rapid system which will not only support Port Shepstone but the entire municipal area | | | | | | | | | 3 | 7 | | | | | | | | | | |

| CRITERIA | INTELLIGENT TRANSPORT SYSTEMS FUNCTIONAL AREAS | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ATIS | | | | ATMS | | | | APTS | | | | ETPS | | | | DAM | | | |
| | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS |
| and surrounding settlements? | | | | | | | | | | | | | | | | | | | | |
| 7. Is there an existing public transport system in place? | | | | | | | | | 9 | 1 | | The effectiveness of the public transport system is questioned as it lacks ITS. | | | | | | | | |
| 8. If no, is the municipality in a process of initiating public transportation to aid transportation challenges of the town? | | | | | | | | | 0 | 0 | 0 | The municipality is developing an intermodal facility. However, integration of ITS in the facility is still in question. | | | | | | | | |
| 9. Do you think the initiation of promoting sustainable transportation such as a bus rapid system will reduce traffic in Port Shepstone? | | | | | | | | | 5 | 5 | | | | | | | | | | |
| 10. Do you think the promotion of sustainable transportation in Port Shepstone will result in reduction of $CO_2$, | | | | | | | | | 10 | 0 | | | | | | | | | | |

| CRITERIA | INTELLIGENT TRANSPORT SYSTEMS FUNCTIONAL AREAS | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ATIS | | | | ATMS | | | | APTS | | | | ETPS | | | | DAM | | | |
| | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS |
| taking into account the significant location of the town and the role that it plays in the broader economy of the municipality? | | | | | | | | | | | | | | | | | | | | |
| 11. Do you think that the Municipality can charge congestion pricing on cars as part of revenue collection? | | | | | | | | | | | | | 2 | 5 | 2 | This will depend on the desired effect as it works better in primate cities. | | | | |
| 12. Will the initiation of roadside parking metres assist in traffic management for Port Shepstone? | | | | | | | | | | | | | 6 | 4 | | If enforcement is not in place, the system of parking meters will not work. | | | | |
| 13. Should the municipality introduce various traffic pricing schemes which include charging for entry into an urban centre/ Port Shepstone town during peak hours? | | | | | | | | | | | | | 5 | 5 | | This might be impractical in secondary cities and will not adequately address the transportation issues. | | | | |

| CRITERIA | INTELLIGENT TRANSPORT SYSTEMS FUNCTIONAL AREAS | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ATIS | | | | ATMS | | | | APTS | | | | ETPS | | | | DAM | | | |
| | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS | Y | N | M | COMMENTS |
| 14. Do you think data acquisition and management tools such as CCTV cameras will be effective in traffic management of Port Shepstone? | | | | | | | | | | | | | | | | | 9 | 1 | | |
| 15. Do you think a secondary city like Port Shepstone needs to develop a data management centre for traffic management? | | | | | | | | | | | | | | | | | 9 | 1 | | |

***Appendix 2: Matrix analysis on interviews conducted – open-ended question***

| CRITERIA | PARTICIPANTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **PART 1** | **PART 2** | **PART 3** | **PART 4** | **PART 5** | **PART 6** | **PART 7** | **PART 8** | **PART 9** | **PART 10** |
| **1. What new transportation services do you think would help meet your transportation needs?** | Having an advanced traveller information system will definitely meet my transportation needs. | Having a municipal **transport system (e.g. BRT and scholar buses)** that travel at certain hours in certain areas, particularly Port Shepstone. | Port Shepstone is not a big town. So, you can walk. However, if public transport is needed. **Meter taxis** will play a fundamental role even **the use of buses.** | A **public transport system** which will get to a place at required times and is safe, reliable and affordable. | The municipality should partner with private sector providers such as Uber, and Taxify and create a public environment that enable these service providers to participate In providing alternative transportation. The municipality should also consider non-motorised transportation systems such as the bike sharing initiative. | **Bus System** and Bicycle lanes to be initiated. | Not Answered | Not Answered | We **need lanes for buses**. This will reduce traffic. | Built new taxi rank as currently, the facility is small and we have to wait at a holding station outside the Port Shepstone CBD. So, renovating and expanding the taxi rank will be of great help for us. |
| **2. Most literature reveals that political opposition and lack of institutionalisation often results in poor ITS implementation. How can local municipalities institutionalise the implementation of ITS?** | Municipalities need to include such initiative in their policies and strategies such as an IDP and SDFs. **They should develop strategies on how to implement such initiatives.** And that can be achieved through partnership with private companies to assist in implementation. | Involve the public transport industry in terms of regulating ITS and distance should not vary in terms of traffic. The municipality when initiating ITS projects should also take into account **the issue of encroachment and should define borders clearly to manage traffic**, particularly within the public transport sector. | ITS should form part of the Protection Services unit of the municipality to **ensure enforcement.** | Municipalities need to prioritise ITS. Although political opposition exists, **they should take charge of their projects.** | Not Answered | The ITS system need to be managed through the Municipal Managers office to ensure that implementation is successful. | Not Answered | Not Answered | When we renew disks. They must notify us about the ITS systems that the Municipality is initiating. | The Port Shepstone Taxi Association needs to be notified of this system. |
| **3. How can municipalities win political support for implementation of ITS?** | Through **education and awareness of important benefits and the positive impact that ITS will have on the municipality** and | It should be noted that the masses to be served are voters. When the municipality is doing something to win votes, they will ensure that they are **taking positive strides in how they** | **Public participation and developing a strategy on ITS and bylaws.** | **Demonstrating the benefits of ITS in the municipality.** | They can achieve this by launching **pilot projects and ensuring those are a success,** which in turn will convenience necessary stakeholders that this system is able to | The municipality must be able to **illustrate the benefits of the system to the political ruling party to ensure successful implementation**. | Not Answered | Not Answered | They must put in bus lanes and during elections we will vote for them. | They must ensure that they provide us with a better taxi rank and we will vote for them during elections. |

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| | the communities at large. | **<u>are being supported</u>** and that will result in winning political support. | | | function which would then be rolled out. | | | | | |
| **4. What are the major financial implications that most cities face in implementing ITS for sustainable transportation?** | **<u>I am not sure how much implementation of ITS costs.</u>** However, it will be nice for the municipality to adopt at least one such as the advanced traveller management system (ATMS) or the advanced public transport system (APTS). | When municipalities decide to implement ITS in their areas of jurisdiction, t**<u>he issue of infrastructure maintenance becomes one of the critical financial implications</u>**. | **<u>Budget cuts</u>** by Councils force one to take into account the use of public and private partnerships (PPP) for implementation of these. | a) This depends on each municipality and the degree or extent to which some may introduce a physical approach of showing the benefits of ITS implementation. | Securing **<u>Budget for Implementation</u>** | Maintenance of the system. | Not Answered | Not Answered | Not Answered | **<u>Budget constraints</u>**. The Municipality does not prioritise us when they are doing the budget. Even during Izimbizo. We do attend and voice our concerns about the taxi industry. However, they are not addressed. |
| **5. To what extend do you think ITS will respond to transportation needs of Port Shepstone?** | a) As long as **<u>awareness or rather public participation is undertaken,</u>** it will have major benefits/impact. | **a)** It will be very helpful as it will organise and regulate in terms of data acquisition and how it is implemented on the ground. Such systems of ITS should be regulated or rather implemented based on the **<u>people life styles/ patterns.</u>** | It will help a lot as you can prioritise problematic areas. Although the municipal road departments deal with road infrastructure development such as road signs, there should be an **<u>establishment of an integrated technical committee</u>** to deal with the implementation of ITS. | This depends on each municipality and to what degree or extent some **<u>may introduce a physical approach of showing the benefits of ITS implementation.</u>** | Not Answered | If well implemented during peak hours. It will greatly help. | Not Answered | Not Answered | It will help because there will be less cars on the road. | I am not sure if it will help. But if the transport users are well consulted. Then it might help. |
| **6. We know that ITS might be new for most secondary cities of developing countries like Port Shepstone. How can the municipality create awareness for the use of ITS in aiding traffic challenges?** | Through **<u>social media/billboards and radio announcement and public meetings.</u>** | Awareness is the basic key towards partnership to implement ITS. The municipality should work closely with ward committees, public transport sector industry, schools, to name but a few, as traffic congestion and other transport challenges affect everyone. | Through **<u>public participation/ meetings.</u>** | They can only create awareness once they implement it. Even if it is a small degree of ITS. | Formal municipality communication **<u>channels, awareness campaigns, ITS competitions</u>** | Through I**<u>DP Imbizo and social media</u>** | Not Answered | Not Answered | **<u>They must come to bus ranks and taxi ranks so the road users can be aware of the system.</u>** Even on weekends we transport people to events such as Funerals, so they can be aware of the system. | Through I**<u>DP Imbizo.</u>** |

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| | | b) If the municipality can create awareness through social media alerting people or its citizens on road conditions throughout the day, that will help a lot. | | | | | | | | |
| **7. What policies and smart strategies can be put in place, particularly in the IDP and the SDF as a start in promoting ITS in secondary cities like Port Shepstone?** | The **policies must be realistic and should consider the status quo and vision of the municipality**. And must be aligned to the SDF and IDP. | The municipality should put forward **policies and strategies on public transport management**.<br>b) One cannot just sit in the office and collect data. Public participation processes with all relevant stakeholders should be undertaken and that will assist in implementation.<br>c) **Parking bylaws** is one of the fundamental strategies towards resolving one of the traffic challenges of Port Shepstone and must be implemented in line with the National Land Transport Act 5 of 2009 and the Road Traffic Act 93 of 1996. | The development of a committee that will have its own portfolio and direct implementation of ITS and should get political support. | **Policies on investment in infrastructure development** such as incorporating new lanes on existing roads. | Not Answered | The Municipality must d**evelop a strategy/ vision to become a smart city in their IDP and SDF** to deal with issues of traffic that should be implemented in phases so that people have a buy-in of the system. | Not Answered | Not Answered | When they do Izimbizo, they must tell us about the system. | **Creating awareness,** especially in rural areas that we are servicing such as Gamalakhe, Gcilima, Nyadezulu, etc. |
| **8. What ideas, thoughts, or suggestions do you have on this research study?** | The research should consider lifestyle of people i.e. low, middle and high income so that all concerns of people regarding ITS are addressed equally and meet the transportation needs. | The municipality over and above the ITS implementation should focus on the **initiation of re-synchronised traffic lights** during peak hours;<br>**changing the design of infrastructure** as it also needs to accommodate the current traffic congestion;<br>Implementation of traffic circles which will result in better flow of traffic;<br>development of traffic bylaws to eliminate some of the transportation challenges; and | The municipality over and above the ITS implementation should focus on the initiation of **re-synchronised traffic lights during peak hours**;<br>m**aking some of the streets one-way**; and<br>removing parallel parking, rather optimise the use of angled parking. | I would like to see the results of the study and will appreciate if I can get a copy of the research study once complete as I am interested in the results. | I would like to see the results of the study and will appreciate if I can get a copy of the research study once complete as I am interested in the results. | Nothing | Not Answered | Not Answered | This study must help us do bus lanes from the rural areas to town so we will not contribute to traffic. | I think the research its really good and I hope the Municipality take into account the recommendations put forward. |

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| | | working with businesses to come up with strategies that will assist the municipality in traffic management e.g. identify suitable loading bays and not use parking bays as loading bays; | | | | | | | | |
| | | ITS should also speak to prevention of accidents through information boards. | | | | | | | | |

***Appendices 3.1. to 3.10.: Interview transcripts***

## SEMI-STRUCTURED INTERVIEW

**Name of Interviewer**: G.L. Madihlaba
**Name of Interviewee:** Participant 1
**Place of the Interview:** Uvongo
**Date of Interview:** 19 June 2018
**Venue:** Uvongo Boardroom
**Time:** 16:00

**Objective:** *To establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone.*

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**PART 1: ITS FUNCTIONAL AREAS/ POTENTIAL ITS SOLUTIONS**

The table below outlines the five (5) functional areas which the research study focuses on in assessing the possibility of ITS establishment in the secondary city of Port Shepstone. Kindly provide details on which ITS solutions you prefer to be initiated in the secondary city of Port Shepstone:

| POTENTIAL ITS SOLUTIONS | ITS FUNCTIONAL AREAS INDICATORS | | |
|---|---|---|---|
| | YES | NO | PROVIDE COMMENTS |
| **1. Advanced traveller information systems (ATIS)** | | | |
| 1.1. Do you think that it is important to be provided with real-time travel information when travelling? | √ | | This will save travellers time to reach their destination. |
| 1.2. Would you use technical application solutions *(i.e. smartphone, digital road sign warnings, navigator, board computer displays, radio announcements, TV, email, etc.)* which provide accurate and real-time information about traffic and parking in Port Shepstone? | √ | | |
| 1.3. Do you think social media will be the most appropriate platform to inform Port Shepstone residents about traffic congestion and parking? | √ | | Because social media is used by most people. |
| **2. Advanced transportation management system (ATMS)** | | | |
| 2.1. Do you think the traffic lights in the Port Shepstone area should be re-scrutinised for better management of the traffic flow during peak hours, particularly those located in critical intersections and how? | | | Maybe, because of time spent at Port Shepstone due to traffic. The traffic lights should be re-scrutinised in order to respond to traffic at peak times. |
| 2.2. Do you think secondary cities like Port Shepstone require the use of technical applications such as CCTV, and digital road signs for traffic management and parking? | √ | | Maybe, because digital road signs are only required in certain areas. So, it will depend on how and where they are located that will define their effectiveness. |
| **3. Advanced public transport system (APTS)** | | | |
| 3.1. To reduce traffic congestion in Port Shepstone. Do you think the municipality should develop a bus rapid system which | √ | | |

| | | | |
|---|---|---|---|
| will not support only Port Shepstone but also the entire municipal area and surrounding settlements? | | | |
| 3.2. Is there an existing public transport system in place? | √ | | To an extent, as it does not currently have ITS system incorporated. |
| 3.3. If no, is the municipality in a process of initiating public transportation to aid transportation challenges of the town? | | | Not applicable |
| 3.4. Do you think the initiation of promoting sustainable transportation such as bus rapid system will reduce traffic in Port Shepstone? | √ | | This will assist with traffic congestion as it will result in less cars on the road and will encourage people to use the bus. |
| 3.5. Do you think the promotion of sustainable transportation in Port Shepstone will result in reduction of $CO_2$, taking into account the significant location of the town and the role that it plays in the broader economy of the municipality? | √ | | |
| **4. Enabled transportation pricing systems** | | | |
| 4.1. Do you think that the municipality can charge congestion pricing on cars as part of revenue collection? | | √ | I think it will be suitable in bigger cities because of economic state of citizens. |
| 4.2. Will the initiation of roadside parking meters assist in traffic management for Port Shepstone? | √ | | |
| 4.3. Should the municipality introduce various traffic pricing schemes which include charging for entry into an urban centre/ rather Port Shepstone town during peak hours? | | √ | Extensive consultation should be done first and the system should not be imposed on people. |
| **5. Data acquisition and management** | | | |
| 5.1. Do you think data acquisition and management tools such as CCTV cameras will be effective in traffic management of Port Shepstone? | √ | | |
| 5.2. Do you think a secondary city like Port Shepstone needs to develop a data management centre for traffic management? | √ | | |

**PART 2: GENERAL ITS QUESTIONS**

**2.1. What new transportation services do you think would help meet your transportation needs?**

a) Having an advanced traveller information system will definitely meet my transportation needs.

**2.2. Most literature reveals that political opposition and lack of institutionalisation often results in poor ITS implementation. How can local municipalities institutionalise the implementation of ITS?**

a) Municipalities need to include such initiatives in their policies and strategies such as an IDP and SDFs.
b) They should develop strategies on how to implement such initiatives.
c) And that can be achieved through partnership with private companies to assist in implementation.

**2.3. How can municipalities win political support for implementation of ITS?**

a) Through education and awareness of importance of benefits and positive impact that ITS will have on the municipality and the communities at large.

**2.4. What are the major financial implications that most cities face in implementing ITS for sustainable transportation?**

a) I am not sure how much implementation of ITS costs. However, it will be nice for the municipality to adopt at least one such as the advanced traveller management system (ATMS) or the advanced public transport system (APTS).

**2.5. To what extent do you think ITS will respond to transportation needs of Port Shepstone?**

a) As long as awareness or rather public participation is undertaken. It will have major benefits/impact.

**2.6. We know that ITS might be new for most secondary cities of developing countries like Port Shepstone. How can the municipality create awareness for the use of ITS in aiding traffic challenges?**

a) Through social media/billboards and radio announcement and public meetings.

**2.7. What policies and smart strategies can be put in place, particularly in the IDP and the SDF as a start in promoting ITS in secondary cities like Port Shepstone?**

a) The policies must be realistic and should consider the status quo and vision of the municipality and must be aligned to the SDF and IDP.

**2.8. What ideas, thoughts, or suggestions do you have on this research study?**

a) The research should consider lifestyle of people i.e. low, middle and high income so that all concerns of people regarding ITS are addressed equally and meet the transportation needs.

**3.2.**

**SEMI-STRUCTURED INTERVIEW**

**Name of Interviewer**: G.L. Madihlaba
**Name of Interviewee:** Participant 2
**Place of the Interview:** Port Shepstone
**Date of Interview:** 25 July 2018
**Venue:** Traffic Department, Port Shepstone
**Time:** 08h00

**Objective:** *To establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone.*

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**PART 1: ITS FUNCTIONAL AREAS/ POTENTIAL ITS SOLUTIONS**

The table below outlines the five (5) functional areas which the research study focuses on in assessing the possibility of ITS establishment in the secondary city of Port Shepstone. Kindly provide details on which ITS solutions you prefer to be initiated in the secondary city of Port Shepstone:

| **POTENTIAL ITS SOLUTIONS** | **ITS FUNCTIONAL AREAS INDICATORS** | | |
|---|---|---|---|
| | **YES** | **NO** | **PROVIDE COMMENTS** |
| **1. Advanced traveller information systems (ATIS)** | | | |
| 1.6. Do you think that it is important to be provided with real-time travel information when travelling? | √ | | |
| 1.7. Would you use technical application solutions *(i.e. smartphone, digital road signs warnings, navigator, board computer displays, radio announcements, TV, email, etc.)* which provide accurate and real-time information about traffic and parking in Port Shepstone? | √ | | |
| 1.8. Do you think social media will be the most appropriate platform to inform Port Shepstone residents about traffic congestion and parking? | √ | | |
| **2. Advanced transportation management system (ATMS)** | | | |
| 2.1. Do you think the traffic lights in the Port Shepstone area should be re-scrutinised for better management of the traffic flow during peak hours, particularly those located in critical intersections and how? | √ | | There is a lot of congestion on R102 linking Port Shepstone and other settlements. This is mostly felt on the confusion-junction, where there is traffic from south-bound in the morning and north-bound towards Durban in the afternoon. |
| 2.2. Do you think secondary cities like Port Shepstone require the use of technical applications such as CCTV, digital road signs for traffic management and parking? | √ | | |
| **3. Advanced public transport system (APTS)** | | | |
| 3.1. To reduce traffic congestion in Port Shepstone. Do you think the municipality should develop a bus rapid system which will not only support Port Shepstone but | √ | | |

| | | | |
|---|---|---|---|
| the entire municipal area and surrounding settlements? | | | |
| 3.2. Is there an existing public transport system in place? | | √ | |
| 3.3. If no, is the municipality in a process of initiating public transportation to aid transportation challenges of the town? | | √ | |
| 3.4. Do you think the initiation of promoting sustainable transportation such as bus rapid system will reduce traffic in Port Shepstone? | √ | | |
| 3.5. Do you think the promotion of sustainable transportation in Port Shepstone will result in reduction of $CO_2$, taking into account the significant location of the town and the role that it plays in the broader economy of the municipality? | √ | | |
| **4. Enabled transportation pricing systems** | | | |
| 4.1. Do you think that the municipality can charge congestion pricing on cars as part of revenue collection? | | √ | Even though it's a good idea. It will be difficult to implement in Port Shepstone as people may be resistant to the idea. |
| 4.2. Will the initiation of road side parking meters assist in traffic management for Port Shepstone? | √ | | |
| 4.3. Should the municipality introduce various traffic pricing schemes which include charging for entry into an urban centre/ rather Port Shepstone town during peak hours? | √ | | However, it might also come with a lot of resistance from the residents. |
| **5. Data acquisition and management** | | | |
| 5.1. Do you think data acquisition and management tools such as CCTV cameras will be effective in traffic management of Port Shepstone? | √ | | |
| 5.2. Do you think a secondary city like Port Shepstone needs to develop a data management centre for traffic management? | √ | | Effective and adequate infrastructure investment should be initiated to support such. |

**PART 2: GENERAL ITS QUESTIONS**

**2.1. What new transportation services do you think would help meet your transportation needs?**

b) Having a municipal transport system (e.g. BRT and scholar buses) that travel at certain hours in certain areas, particularly Port Shepstone.

**2.2. Most literature reveals that political opposition and lack of institutionalisation often results in poor ITS implementation. How can local municipalities institutionalise the implementation of ITS?**

d) Involve the public transport industry in terms of regulating ITS and distance should not vary in terms of traffic.
e) The municipality when initiating ITS projects should also take into account the issue of encroachment and define borders clearly to manage traffic, particularly within the public transport sector.

**2.3. How can municipalities win political support for implementation of ITS?**

b) It should be noted that the masses to be served are voters. When the municipality is doing something to win votes, they will ensure that they taking positive strides in how they are being supported and that will result in winning political support.

**2.4. What are the major financial implications that most cities face in implementing ITS for sustainable transportation?**

b) When municipalities decide to implement ITS in their area of jurisdiction. The issue of infrastructure maintenance becomes one of the critical financial implications.

**2.5. To what extent do you think ITS will respond to transportation needs of Port Shepstone?**

b) It will be very helpful as it will organise and regulate in terms of data acquisition and how that it is implemented on the ground. Such systems of ITS should be regulated or rather implemented based on the people life styles/ patterns.

**2.6. We know that ITS might be new for most secondary cities of developing countries like Port Shepstone. How can the municipality create awareness for the use of ITS in aiding traffic challenges?**

b) Awareness is the basic key towards partnership to implement ITS. The municipality should work closely with ward committees, public transport sector industry, schools, to name few, as traffic congestion and other transport challenges affect everyone.
c) If the municipality can create awareness through social media alerting people or its citizens on road conditions throughout the day. That will help a lot.

**2.7. What policies and smart strategies can be put in place, particularly in the IDP and the SDF as a start in promoting ITS in secondary cities like Port Shepstone?**

b) The municipality should put forward policies and strategies on public transport management.
c) One cannot just sit in the office and collect data. Public participation processes with all relevant stakeholders should be undertaken and that will assist in implementation.
d) Parking bylaws is one of the fundamental strategies towards resolving one of the traffic challenges of Port Shepstone and must be implemented in line with the National Land Transport Act 5 of 2009 and the Road Traffic Act 93 of 1996.

**2.8. What ideas, thoughts, or suggestions do you have on this research study?**

b) The municipality over and above the ITS implementation should focus on the initiation of re-scrutinising traffic lights during peak hours;
c) Changing the design of infrastructure as it also needs to accommodate the current traffic congestion;
d) Implementation of traffic circles which will result in flow of traffic;
e) Development of traffic bylaws to eliminate some of the transportation challenges;
f) Working with businesses to come-up with strategies which will assist the municipality in traffic management e.g. identify suitable loading bays and not use parking bays as loading bays;
g) ITS should also speak to prevention of accidents through information boards.

**3.3.**

DUT DURBAN UNIVERSITY OF TECHNOLOGY

## SEMI-STRUCTURED INTERVIEW

**Name of Interviewer**: G.L. Madihlaba
**Place of the Interview:** Port Shepstone
**Date of Interview:** 31 July 2018

**Name of Interviewee:** Participant 3
**Venue:** Traffic Department, Port Shepstone
**Time:** 08h00

**Objective:** *To establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone.*

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### PART 1: ITS FUNCTIONAL AREAS/ POTENTIAL ITS SOLUTIONS

The table below outlines the five (5) functional areas which the research study focuses on in assessing the possibility of ITS establishment in the secondary city of Port Shepstone. Kindly provide details on which ITS solutions you prefer to be initiated in the secondary city of Port Shepstone:

| POTENTIAL ITS SOLUTIONS | ITS FUNCTIONAL AREAS INDICATORS | | |
|---|---|---|---|
| | YES | NO | PROVIDE COMMENTS |
| **1. Advanced traveller information systems (ATIS)** | | | |
| 1.1. Do you think that it is important to be provided with real-time travel information when travelling? | √ | | |
| 1.2. Would you use technical application solutions *(i.e. smartphone, digital road signs warnings, navigator, board computer displays, radio announcements, TV, email, etc.)* which provide accurate and real-time information about traffic and parking in Port Shepstone? | √ | | |
| 1.3. Do you think social media will be the most appropriate platform to inform Port Shepstone residents about Traffic congestion and parking? | | √ | I think radio stations will be more helpful than social media and also the use of electronic platforms like signage. |
| **2. Advanced transportation management system (ATMS)** | | | |
| 2.1. Do you think the traffic lights in the Port Shepstone area should be re-scrutinised for better management of the traffic flow during peak hours, particularly those located in critical intersections and how? | √ | | – R102 and R620 confusion junction;<br>– R102 and Bazely Street;<br>– R102 and Aiken Street; and<br>– R102 and Abington Road |
| 2.2. Do you think secondary cities like Port Shepstone require the use of technical applications such as CCTV, digital road signs for traffic management and parking? | √ | | |
| **3. Advanced public transport system (APTS)** | | | |

| | | | |
|---|---|---|---|
| 3.1. To reduce traffic congestion in Port Shepstone. Do you think the municipality should develop a bus rapid system which will not only support Port Shepstone but the entire municipal area and surrounding settlements? | √ | | Taxi association should also take part in the implementation of ITS and traffic management. |
| 3.2. Is there an existing public transport system in place? | √ | | Mini-buses and meter taxis. |
| 3.3. If no, is the municipality in a process of initiating public transportation to aid transportation challenges of the town? | | √ | Upgrading of the taxi rank through the intermodal facility development project. |
| 3.4. Do you think the initiation of promoting sustainable transportation such as bus rapid system will reduce traffic in Port Shepstone? | √ | | But it might not be the ultimate solution for Port Shepstone. |
| 3.5. Do you think the promotion of sustainable transportation in Port Shepstone will result in reduction of $CO_2$, taking into account the significant location of the town and the role that it plays in the broader economy of the municipality? | √ | | |
| **4. Enabled transportation pricing systems** | | | |
| 4.1. Do you think that the municipality can charge congestion pricing on cars as part of revenue collection? | √ | | |
| 4.2. Will the initiation of road side parking meters assist in traffic management for Port Shepstone? | √ | | The use of a smart system will be useful and every data required will be generated through GPS. |
| 4.3. Should the municipality introduce various traffic pricing schemes which include charging for entry into an urban centre/ rather Port Shepstone town during peak hours? | √ | | Once infrastructure is upgraded e.g. making some streets one-way instead of two-way. |
| **5. Data acquisition and management** | | | |
| 5.1. Do you think data acquisition and management tools such as CCTV cameras will be effective in traffic management of Port Shepstone? | √ | | – Municipality is currently using CCTV on some streets in Port Shepstone which include Raider Street and Aiken Street and within the municipal office precinct.<br>– The municipality is also using old technology, which often results in poor or no results. |
| 5.2. Do you think a secondary city like Port Shepstone needs to develop a data management centre for traffic management? | √ | | The municipality has a data management centre. However, it's not in a good state. |

**PART 2: GENERAL ITS QUESTIONS**

**2.1. What new transportation services do you think would help meet your transportation needs?**

a) Port Shepstone is not a big town. So, you can walk. However, if public transport is needed, meter taxis will play a fundamental role even the use of buses.

**2.2. Most literature reveals that political opposition and lack of institutionalisation often results in poor ITS implementation. How can local municipalities institutionalise the implementation of ITS?**

a) ITS should form part of the Protection Services unit of the municipality to ensure enforcement.

**2.3. How can municipalities win political support for implementation of ITS?**

a) Public participation and developing a strategy on ITS and bylaws.

**2.4. What are the major financial implications that most cities face in implementing ITS for sustainable transportation?**

a) Budget cuts by Council force one to take into account the use of public and private partnership (PPP) for implementation of such.

**2.5. To what extent do you think ITS will respond to transportation needs of Port Shepstone?**

a) It will help a lot as you can prioritise problematic areas. Although the municipal road departments deal with road infrastructure development such as road signs. There should be an establishment of an integrated technical committee to deal with the implementation of ITS.

**2.6. We know that ITS might be new for most secondary cities of developing countries like Port Shepstone. How can the municipality create awareness for the use of ITS in aiding traffic challenges?**

a) Through public participation/ meetings.

**2.7. What policies and smart strategies can be put in place, particularly in the IDP and the SDF as a start in promoting ITS in secondary cities like Port Shepstone?**

a) The development of a committee that will have its own portfolio and direct implementation of ITS and should get political support.

**2.8. What ideas, thoughts, or suggestions do you have on this research study?**

b) The municipality over and above the ITS implementation should focus on the initiation of re-scrutinizing traffic lights during peak hours;
c) Making some of the streets one-way; and
d) Removing parallel parking, rather optimise the use of angled parking.

**3.4.**

## SEMI-STRUCTURED INTERVIEW

**Name of Interviewer**: G.L. Madihlaba
**Name of Interviewee:** Participant 4

**Place of the Interview:** Durban
**Date of Interview:** 17 August 2018
**Venue:** Aurecon Offices
**Time:** 10h00

**Objective:** *To establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone.*

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### PART 1: ITS FUNCTIONAL AREAS/ POTENTIAL ITS SOLUTIONS

The table below outlines the five (5) functional areas which the research study focuses on in assessing the possibility of ITS establishment in the secondary city of Port Shepstone. Kindly provide details on which ITS solutions you prefer to be initiated in the secondary city of Port Shepstone:

| POTENTIAL ITS SOLUTIONS | ITS FUNCTIONAL AREAS INDICATORS | | |
|---|---|---|---|
| | YES | NO | PROVIDE COMMENTS |
| **1. Advanced traveller information systems (ATIS)** | | | |
| 1.1. Do you think that it is important to be provided with real-time travel information when travelling? | | √ | This will depend on the benefit of implementation vs. the benefit that you will get out of the system as it relates to costs more than anything. |
| 1.2. Would you use technical application solutions *(i.e. smartphone, digital road signs warnings, navigator, board computer displays, radio announcements, TV, email, etc.)* which provide accurate and real-time information about traffic and parking in Port Shepstone? | √ | | |
| 1.3. Do you think social media will be the most appropriate platform to inform Port Shepstone residents about traffic congestion and parking? | | √ | This depends on how the system will work and who will be liable for managing it. |
| **2. Advanced transportation management system (ATMS)** | | | |
| 2.1. Do you think the traffic lights in the Port Shepstone area should be re-scrutinised for better management of the traffic flow during peak hours, particularly those located in critical intersections and how? | | √ | The re-scrutinisation of traffic lights will not work if the road network is not upgraded. |
| 2.2. Do you think secondary cities like Port Shepstone require the use of technical applications such as CCTV, digital road sign for traffic management and parking? | √ | | Digital road signs may be good for traffic management and parking does not require ITS systems, but rather enforcement. |
| **3. Advanced public transport system (APTS)** | | | |
| 3.1. To reduce traffic congestion in Port Shepstone. Do you think the municipality should develop a bus rapid system which | √ | | |

| | | | |
|---|---|---|---|
| will not only support Port Shepstone but the entire municipal area and surrounding settlements? | | | |
| 3.2. Is there an existing public transport system in place? | √ | | This will also depend on the effectiveness of the system. |
| 3.3. If no, is the municipality in a process of initiating public transportation to aid transportation challenges of the town? | | | Not applicable |
| 3.4. Do you think the initiation of promoting sustainable transportation such as bus rapid system will reduce traffic in Port Shepstone? | √ | | The system must be safe, reliable and safe. |
| 3.5. Do you think the promotion of sustainable transportation in Port Shepstone will result in reduction of $CO_2$, taking into account the significant location of the town and the role that it plays in the broader economy of the municipality? | √ | | |
| **4. Enabled transportation pricing systems** | | | |
| 4.1. Do you think that the municipality can charge congestion pricing on cars as part of revenue collection? | √ | √ | This is a Yes and No because it will depend on the effectiveness of the system and whether it will yield the desired results. |
| 4.2. Will the initiation of road side parking meters assist in traffic management for Port Shepstone? | | √ | The municipality should ensure that there is enforcement. So, if enforcement is poor, no effective results will yielded through parking meters. |
| 4.3. Should the municipality introduce various traffic pricing schemes which include charging for entry into an urban centre/ rather Port Shepstone town during peak hours? | | √ | It's not going to adequately address parking problems of the Port Shepstone area. |
| **5. Data acquisition and management** | | | |
| 5.1. Do you think data acquisition and management tools such as CCTV cameras will be effective in traffic management of Port Shepstone? | √ | | |
| 5.2. Do you think a secondary city like Port Shepstone needs to develop a data management centre for traffic management? | √ | | Every institution of government i.e. SANRAL, the province and the municipality should invest in development of a data management centre. |

**PART 2: GENERAL ITS QUESTIONS**

**2.1. What new transportation services do you think would help meet your transportation needs?**

a) A public transport system which will get at a place at required times and it is safe, reliable and affordable.

**2.2. Most literature reveals that political opposition and lack of institutionalisation often results in poor ITS implementation. How can local municipalities institutionalise the implementation of ITS?**

a) Municipalities need to prioritise ITS. Although the political opposition exists, they should take charge of their projects.

**2.3. How can municipalities win political support for implementation of ITS?**

a) Demonstrating the benefits of ITS in the municipality.

**2.4. What are the major financial implications that most cities face in implementing ITS for sustainable transportation?**

a) This depends on each municipality and to what degree or extent in which some may introduce physical approach of showing the benefits of ITS implementation.

**2.5. To what extent do you think ITS will respond to transportation needs of Port Shepstone?**

a) This will depend on the scale of implementation i.e. how big does the municipality want to implement ITS?

**2.6. We know that ITS might be new for most secondary cities of developing countries like Port Shepstone. How can the municipality create awareness for the use of ITS in aiding traffic challenges?**

a) They can only create awareness once they implement it. Even if it is a small degree of ITS.

**2.7. What policies and smart strategies can be put in place, particularly in the IDP and the SDF as a start in promoting ITS in secondary cities like Port Shepstone?**

a) Policies on investment into infrastructure development such as incorporating new lanes on existing roads.

**2.8. What ideas, thoughts, or suggestions do you have on this research study?**

a) I will like to see the results of the study and will appreciate if I can get a copy of the research study once complete as I am interested in the results.

**3.5**

## SEMI-STRUCTURED INTERVIEW

**Name of Interviewer**: G.L. Madihlaba
**Name of Interviewee:** Town Planner
**Place of the Interview:** Port Shepstone
**Date of Interview:** 14 June 2019
**Venue:** Port Shepstone Municipal Office
**Time:**10h00

**Objective:** *To establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone.*

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### PART 1: ITS FUNCTIONAL AREAS/ POTENTIAL ITS SOLUTIONS

The table below outlines the five (5) functional areas which the research study focuses on in assessing the possibility of ITS establishment in the secondary city of Port Shepstone. Kindly, provide details on which ITS solutions you prefer being initiated in the secondary city of Port Shepstone:-

| POTENTIAL ITS SOLUTIONS | ITS FUNCTIONAL AREAS INDICATORS | | |
|---|---|---|---|
| | YES | NO | PROVIDE COMMENTS |
| **1. Advanced Traveller Information Systems (ATIS)** | | | |
| 1.1. Do you think that it is important to be provided with real-time travel information when travelling? | √ | | By knowing the actual traffic situation on the road, I am able to save time and money by planning trips at the best time of the day or by taking an alternative route |
| 1.2. Would you use technical application solutions *(i.e. smartphone, digital road signs warnings, navigator, board computer displays, radio announcement, TV, Email, etc.)* which provide accurate and real-time information about traffic and parking in Port Shepstone? | √ | | I grew up I Port Shepstone thus I am aware of the traffic complexities in the area. As such, Yes I would and do use technical applications specifically the navigator, radio announcement and digital road sign warnings. |
| 1.3. Do you think social media will be the most appropriate platform to inform Port Shepstone residents about Traffic congestion and parking? | | √ | (I actually wanted to say maybe) This is attributed to the fact that social media platform usually require smart phone application systems. The population make-up of the Port is 1) largely rural, 2) Driving population is of a older age, 3) access to ICT infrastructure to support the use of social media is low. Thus, I am not of the opinion that social media is the most appropriate platform to inform residents. Exploring other inclusive technologies may be useful. |
| **2. Advanced Transportation Management System (ATMS)** | | | |
| 2.1. Do you think the traffic lights in the Port Shepstone area should be re-scrutinised for better management of the traffic flow during peak hours, particularly those located in critical intersections and how? | √ | | The traffic lights could be linked with biometrics systems that allow the traffic lights within the road stretch to turn green/red simultaneously and for longer periods of time. |
| 2.2. Do you think secondary cities like Port Shepstone require the use of technical | √ | | |

| | | | |
|---|---|---|---|
| applications such as CCTV, digital road sign for traffic management and parking? | | | |
| **3. Advanced Public Transport System (APTS)** | | | |
| 3.1. To reduce traffic congestion in Port Shepstone. Do you think the Municipality should develop a Bus Rapid System which will not only support Port Shepstone but the entire Municipal area and surrounding settlements? | | √ | For a BRT system to function optimally and efficiently, it requires a high population and population density as well as high urban density developments. The population of Ray Nkonyeni Municipality and the current densities that exist in the municipality would yield inefficient results for the operations of a BRT system. This would be the equivalent of developing a hospital for one patient. |
| 3.2. Is there an existing public transport system in place? | √ | | |
| 3.3. If no, is the Municipality in a process of initiating public transportation to aid transportation challenges of the town? | | | |
| 3.4. Do you think the initiation of promoting sustainable transportation such as Bus Rapid System will reduce traffic in Port Shepstone? | | √ | Please refer to question 3.1 |
| 3.5. Do you think the promotion of sustainable transportation in Port Shepstone will result in reduction of $CO_2$, taking into account the significant location of the town and the role that it plays in the broader economy of the Municipality? | √ | | |
| **4. Enabled Transportation Pricing Systems** | | | |
| 4.1. Do you think that the Municipality can charge congestion pricing on cars as part of revenue collection? | √ | | However this will trigger a legal debate and effective pricing should be thoroughly investigated. |
| 4.2. Will the initiation of road side parking metres assist in traffic management for Port Shepstone? | | √ | This doesn't address the problem it merely creates a financial burden on a functional issue. |
| 4.3. Should the Municipality introduce various traffic pricing schemes which include charging for entry into an urban centre/ rather Port Shepstone town during peak hours? | | √ | The municipality should strategically address the problem of parking in urban centres, such as the construction of mutli-use parkades and explore basement parking strategies. Should the problem persist then the municipality may explore other price shifting solutions. |
| **5. Data Acquisition and Management** | | | |
| 5.1. Do you think data acquisition and management tools such as CCTV cameras will be effective in traffic management of Port Shepstone? | √ | | |
| 5.2. Do you think a secondary city like Port Shepstone need to develop a data management centre for traffic management? | √ | | |

**PART 2: GENERAL ITS QUESTIONS**

**2.1. What new transportation services do you think would help meet your transportation needs?**

The municipality should partner with private sector providers such as Uber, and Taxify and create a public environment that enable these service providers to participate In providing alternative transportation. The municipality should also consider non-motorised transportation systems such as the bike sharing initiative.

**2.2. Most literature reveals that political opposition and lack of institutionalisation often results in poor ITS implementation. How can local municipalities institutionalise the implementation of ITS?**

**2.3. How can Municipalities win political support for implementation of ITS?**

They can achieve this by launching pilot projects and ensuring those are a success, which in turn will convenience necessary stakeholders that this system is able to function which would then be rolled out.

**2.4. What are the major financial implications that most cities face in implementing ITS for sustainable transportation?**

Securing Budget for Implementation

**2.5. To what extend do you think ITS will respond to transportation needs of Port Shepstone?**

**2.6. We know that ITS might be new for most secondary cities of developing countries like Port Shepstone. How can the Municipality create awareness for the use of ITS in aiding traffic challenges?**

Formal municipality communication channels, awareness campaigns, ITS competitions

**2.7. What policies and smart strategies can be put in place, particularly in the IDP and the SDF as a start in promoting ITS in secondary cities like Port Shepstone?**

**2.8. What ideas, thoughts, or suggestions do you have on this research study?**

**3.6**

## SEMI-STRUCTURED INTERVIEW

**Name of Interviewer**: G.L. Madihlaba
**Name of Interviewee:** Participant 6
**Place of the Interview:** Bus Rank
**Date of Interview**: 08 July 2019
**Venue:** Port Shepstone
**Time:** 13h00

**Objective:** *To establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone.*

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**PART 1: ITS FUNCTIONAL AREAS/ POTENTIAL ITS SOLUTIONS**

The table below outlines the five (5) functional areas which the research study focuses on in assessing the possibility of ITS establishment in the secondary city of Port Shepstone. Kindly, provide details on which ITS solutions you prefer being initiated in the secondary city of Port Shepstone:-

| POTENTIAL ITS SOLUTIONS | ITS FUNCTIONAL AREAS INDICATORS | | |
|---|---|---|---|
| | YES | NO | PROVIDE COMMENTS |
| **1. Advanced Traveller Information Systems (ATIS)** | | | |
| 1.1. Do you think that it is important to be provided with real-time travel information when travelling? | √ | | |
| 1.2. Would you use technical application solutions *(i.e. smartphone, digital road signs warnings, navigator, board computer displays, radio announcement, TV, Email, etc.)* which provide accurate and real-time information about traffic and parking in Port Shepstone? | √ | | |
| 1.3. Do you think social media will be the most appropriate platform to inform Port Shepstone residents about Traffic congestion and parking? | | √ | |
| **2. Advanced Transportation Management System (ATMS)** | | | |
| 2.1. Do you think the traffic lights in the Port Shepstone area should be re-scrutinised for better management of the traffic flow during peak hours, particularly those located in critical intersections and how? | √ | | |
| 2.2. Do you think secondary cities like Port Shepstone require the use of technical applications such as CCTV, digital road sign for traffic management and parking? | √ | | |
| **3. Advanced Public Transport System (APTS)** | | | |
| 3.1. To reduce traffic congestion in Port Shepstone. Do you think the Municipality should develop a Bus Rapid System | | √ | The Municipality need to have a bus system and not necessarily a Bus Rapid System as I believe |

| | | | |
|---|---|---|---|
| which will not only support Port Shepstone but the entire Municipal area and surrounding settlements? | | | that a Bus Rapid System work better in a bigger city. |
| 3.2. Is there an existing public transport system in place? | √ | | |
| 3.3. If no, is the Municipality in a process of initiating public transportation to aid transportation challenges of the town? | | | |
| 3.4. Do you think the initiation of promoting sustainable transportation such as Bus Rapid System will reduce traffic in Port Shepstone? | | √ | |
| 3.5. Do you think the promotion of sustainable transportation in Port Shepstone will result in reduction of $CO_2$, taking into account the significant location of the town and the role that it plays in the broader economy of the Municipality? | √ | | |
| **4. Enabled Transportation Pricing Systems** | | | |
| 4.1. Do you think that the Municipality can charge congestion pricing on cars as part of revenue collection? | | √ | Because as a public transport user, I don't think we are the cause of traffic. Rather I believe the Municipality often does not plan well which as a result causes traffic. |
| 4.2. Will the initiation of road side parking metres assist in traffic management for Port Shepstone? | | √ | |
| 4.3. Should the Municipality introduce various traffic pricing schemes which include charging for entry into an urban centre/ rather Port Shepstone town during peak hours? | | √ | |
| **5. Data Acquisition and Management** | | | |
| 5.1. Do you think data acquisition and management tools such as CCTV cameras will be effective in traffic management of Port Shepstone? | √ | | |
| 5.2. Do you think a secondary city like Port Shepstone need to develop a data management centre for traffic management? | √ | | But it must be only used during peak seasons. |

**PART 2: GENERAL ITS QUESTIONS**

**2.1. What new transportation services do you think would help meet your transportation needs?**

Bus System and Bicycle lanes to be initiated.

**2.2. Most literature reveals that political opposition and lack of institutionalisation often results in poor ITS implementation. How can local municipalities institutionalise the implementation of ITS?**

The ITS system need to be managed through the Municipal Managers office to ensure that implementation is successful.

**2.3. How can Municipalities win political support for implementation of ITS?**

The municipality must be able to illustrate the benefits of the system to the political ruling party to ensure successful implementation.

**2.4. What are the major financial implications that most cities face in implementing ITS for sustainable transportation?**

Maintenance of the system.

**2.5. To what extend do you think ITS will respond to transportation needs of Port Shepstone?**

If well implemented during peak hours. It will greatly help.

**2.6. We know that ITS might be new for most secondary cities of developing countries like Port Shepstone. How can the Municipality create awareness for the use of ITS in aiding traffic challenges?**
Through IDP Imbizo and social media

**2.7. What policies and smart strategies can be put in place, particularly in the IDP and the SDF as a start in promoting ITS in secondary cities like Port Shepstone?**

The Municipality must develop a strategy/ vision to become a smart city in their IDP and SDF to deal with issues of traffic that should be implemented in phases so that people have a buy-in of the system.

**2.8. What ideas, thoughts, or suggestions do you have on this research study?**

Nothing

**3.7**

## SEMI-STRUCTURED INTERVIEW

**Name of Interviewer**: G.L. Madihlaba
**Name of Interviewee:** Participant 7
**Place of the Interview:** Taxi Rank
**Date of Interview**: 08 July 2019
**Venue:** Port Shepstone
**Time:** 13h45

**Objective:** *To establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone.*

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### PART 1: ITS FUNCTIONAL AREAS/ POTENTIAL ITS SOLUTIONS

The table below outlines the five (5) functional areas which the research study focuses on in assessing the possibility of ITS establishment in the secondary city of Port Shepstone. Kindly, provide details on which ITS solutions you prefer being initiated in the secondary city of Port Shepstone: -

| POTENTIAL ITS SOLUTIONS | ITS FUNCTIONAL AREAS INDICATORS | | |
|---|---|---|---|
| | YES | NO | PROVIDE COMMENTS |
| **1. Advanced Traveller Information Systems (ATIS)** | | | |
| 1.1. Do you think that it is important to be provided with real-time travel information when travelling? | √ | | |
| 1.2. Would you use technical application solutions *(i.e. smartphone, digital road signs warnings, navigator, board computer displays, radio announcement, TV, Email, etc.)* which provide accurate and real-time information about traffic and parking in Port Shepstone? | √ | | |
| 1.3. Do you think social media will be the most appropriate platform to inform Port Shepstone residents about Traffic congestion and parking? | √ | | |
| **2. Advanced Transportation Management System (ATMS)** | | | |
| 2.1. Do you think the traffic lights in the Port Shepstone area should be re-scrutinised for better management of the traffic flow during peak hours, particularly those located in critical intersections and how? | √ | | |
| 2.2. Do you think secondary cities like Port Shepstone require the use of technical applications such as CCTV, digital road sign for traffic management and parking? | √ | | |
| **3. Advanced Public Transport System (APTS)** | | | |
| 3.1. To reduce traffic congestion in Port Shepstone. Do you think the Municipality should develop a Bus Rapid System which will not only support Port | √ | | |

| | | | |
|---|---|---|---|
| Shepstone but the entire Municipal area and surrounding settlements? | | | |
| 3.2. Is there an existing public transport system in place? | √ | | I am currently using a bus from home to get to work as is cheaper than a taxi. |
| 3.3. If no, is the Municipality in a process of initiating public transportation to aid transportation challenges of the town? | | | |
| 3.4. Do you think the initiation of promoting sustainable transportation such as Bus Rapid System will reduce traffic in Port Shepstone? | √ | | |
| 3.5. Do you think the promotion of sustainable transportation in Port Shepstone will result in reduction of $CO_2$, taking into account the significant location of the town and the role that it plays in the broader economy of the Municipality? | √ | | |
| **4. Enabled Transportation Pricing Systems** | | | |
| 4.1. Do you think that the Municipality can charge congestion pricing on cars as part of revenue collection? | | √ | No, because it means that if I knocked off late. The taxi or bus cannot come into town and I will not have transport to come to work or go home. |
| 4.2. Will the initiation of road side parking metres assist in traffic management for Port Shepstone? | √ | | |
| 4.3. Should the Municipality introduce various traffic pricing schemes which include charging for entry into an urban centre/ rather Port Shepstone town during peak hours? | | √ | |
| **5. Data Acquisition and Management** | | | |
| 5.1. Do you think data acquisition and management tools such as CCTV cameras will be effective in traffic management of Port Shepstone? | √ | | |
| 5.2. Do you think a secondary city like Port Shepstone need to develop a data management centre for traffic management? | √ | | |

**PART 2: GENERAL ITS QUESTIONS**

**2.1. What new transportation services do you think would help meet your transportation needs?**

**2.2. Most literature reveals that political opposition and lack of institutionalisation often results in poor ITS implementation. How can local municipalities institutionalise the implementation of ITS?**

**2.3. How can Municipalities win political support for implementation of ITS?**

**2.4. What are the major financial implications that most cities face in implementing ITS for sustainable transportation?**

**2.5. To what extend do you think ITS will respond to transportation needs of Port Shepstone?**

**2.6. We know that ITS might be new for most secondary cities of developing countries like Port Shepstone. How can the Municipality create awareness for the use of ITS in aiding traffic challenges?**

**2.7. What policies and smart strategies can be put in place, particularly in the IDP and the SDF as a start in promoting ITS in secondary cities like Port Shepstone?**

**2.8. What ideas, thoughts, or suggestions do you have on this research study?**

**3.8**

## SEMI-STRUCTURED INTERVIEW

**Name of Interviewer**: G.L. Madihlaba
**Name of Interviewee:** Participant 9
**Place of the Interview:** Taxi Rank
**Date of Interview**: 15 July 2019
**Venue:** Port Shepstone
**Time:** 15h30

**Objective:** *To establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone.*

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### PART 1: ITS FUNCTIONAL AREAS/ POTENTIAL ITS SOLUTIONS

The table below outlines the five (5) functional areas which the research study focuses on in assessing the possibility of ITS establishment in the secondary city of Port Shepstone. Kindly, provide details on which ITS solutions you prefer being initiated in the secondary city of Port Shepstone:-

| POTENTIAL ITS SOLUTIONS | ITS FUNCTIONAL AREAS INDICATORS | | |
|---|---|---|---|
| | YES | NO | PROVIDE COMMENTS |
| **1. Advanced Traveller Information Systems (ATIS)** | | | |
| 1.1. Do you think that it is important to be provided with real-time travel information when travelling? | √ | | |
| 1.2. Would you use technical application solutions *(i.e. smartphone, digital road signs warnings, navigator, board computer displays, radio announcement, TV, Email, etc.)* which provide accurate and real-time information about traffic and parking in Port Shepstone? | √ | | Because most of us have smart phones |
| 1.3. Do you think social media will be the most appropriate platform to inform Port Shepstone residents about Traffic congestion and parking? | √ | | I use social media like facebook or Watsapp and I think it will help. |
| **2. Advanced Transportation Management System (ATMS)** | | | |
| 2.1. Do you think the traffic lights in the Port Shepstone area should be re-scrutinised for better management of the traffic flow during peak hours, particularly those located in critical intersections and how? | √ | | |
| 2.2. Do you think secondary cities like Port Shepstone require the use of technical applications such as CCTV, digital road sign for traffic management and parking? | √ | | |
| **3. Advanced Public Transport System (APTS)** | | | |
| 3.1. To reduce traffic congestion in Port Shepstone. Do you think the Municipality should develop a Bus Rapid System which will not only support Port | √ | | It will be cheap than a taxi. |

| | | | |
|---|---|---|---|
| Shepstone but the entire Municipal area and surrounding settlements? | | | |
| 3.2. Is there an existing public transport system in place? | √ | | But I don't use it as often as sometimes I knock off late from work so, I will use a taxi to get home. |
| 3.3. If no, is the Municipality in a process of initiating public transportation to aid transportation challenges of the town? | | | |
| 3.4. Do you think the initiation of promoting sustainable transportation such as Bus Rapid System will reduce traffic in Port Shepstone? | √ | | |
| 3.5. Do you think the promotion of sustainable transportation in Port Shepstone will result in reduction of $CO_2$, taking into account the significant location of the town and the role that it plays in the broader economy of the Municipality? | √ | | |
| **4. Enabled Transportation Pricing Systems** | | | |
| 4.1. Do you think that the Municipality can charge congestion pricing on cars as part of revenue collection? | √ | | |
| 4.2. Will the initiation of road side parking metres assist in traffic management for Port Shepstone? | √ | | |
| 4.3. Should the Municipality introduce various traffic pricing schemes which include charging for entry into an urban centre/ rather Port Shepstone town during peak hours? | √ | | |
| **5. Data Acquisition and Management** | | | |
| 5.1. Do you think data acquisition and management tools such as CCTV cameras will be effective in traffic management of Port Shepstone? | √ | | |
| 5.2. Do you think a secondary city like Port Shepstone need to develop a data management centre for traffic management? | √ | | |

**PART 2: GENERAL ITS QUESTIONS**

**2.1. What new transportation services do you think would help meet your transportation needs?**

**2.2. Most literature reveals that political opposition and lack of institutionalisation often results in poor ITS implementation. How can local municipalities institutionalise the implementation of ITS?**

**2.3. How can Municipalities win political support for implementation of ITS?**

**2.4. What are the major financial implications that most cities face in implementing ITS for sustainable transportation?**

**2.5. To what extend do you think ITS will respond to transportation needs of Port Shepstone?**

**2.6. We know that ITS might be new for most secondary cities of developing countries like Port Shepstone. How can the Municipality create awareness for the use of ITS in aiding traffic challenges?**

**2.7. What policies and smart strategies can be put in place, particularly in the IDP and the SDF as a start in promoting ITS in secondary cities like Port Shepstone?**

**2.8. What ideas, thoughts, or suggestions do you have on this research study?**

**3.9.**

## SEMI-STRUCTURED INTERVIEW

**Name of Interviewer**: G.L. Madihlaba
**Name of Interviewee:** Participant 9
**Place of the Interview:** Taxi Rank
**Date of Interview**: 15 July 2019
**Venue:** Port Shepstone
**Time:** 11h00

**Objective:** *To establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone.*

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**PART 1: ITS FUNCTIONAL AREAS/ POTENTIAL ITS SOLUTIONS**

The table below outlines the five (5) functional areas which the research study focuses on in assessing the possibility of ITS establishment in the secondary city of Port Shepstone. Kindly, provide details on which ITS solutions you prefer being initiated in the secondary city of Port Shepstone:-

| POTENTIAL ITS SOLUTIONS | ITS FUNCTIONAL AREAS INDICATORS | | |
|---|---|---|---|
| | YES | NO | PROVIDE COMMENTS |
| **1. Advanced Traveller Information Systems (ATIS)** | | | |
| 1.1. Do you think that it is important to be provided with real-time travel information when travelling? | √ | | |
| 1.2. Would you use technical application solutions *(i.e. smartphone, digital road signs warnings, navigator, board computer displays, radio announcement, TV, Email, etc.)* which provide accurate and real-time information about traffic and parking in Port Shepstone? | | √ | |
| 1.3. Do you think social media will be the most appropriate platform to inform Port Shepstone residents about Traffic congestion and parking? | | √ | |
| **2. Advanced Transportation Management System (ATMS)** | | | |
| 2.1. Do you think the traffic lights in the Port Shepstone area should be re-scrutinised for better management of the traffic flow during peak hours, particularly those located in critical intersections and how? | √ | | |
| 2.2. Do you think secondary cities like Port Shepstone require the use of technical applications such as CCTV, digital road sign for traffic management and parking? | | √ | |
| **3. Advanced Public Transport System (APTS)** | | | |
| 3.1. To reduce traffic congestion in Port Shepstone. Do you think the Municipality should develop a Bus Rapid System which will not only support Port | | √ | This will be our competitor as bus drivers. |

| | | | |
|---|---|---|---|
| Shepstone but the entire Municipal area and surrounding settlements? | | | |
| 3.2. Is there an existing public transport system in place? | √ | | Our buses are operational and services most of the rural areas as most people work in the Port Shepstone town. |
| 3.3. If no, is the Municipality in a process of initiating public transportation to aid transportation challenges of the town? | | | |
| 3.4. Do you think the initiation of promoting sustainable transportation such as Bus Rapid System will reduce traffic in Port Shepstone? | | √ | |
| 3.5. Do you think the promotion of sustainable transportation in Port Shepstone will result in reduction of $CO_2$, taking into account the significant location of the town and the role that it plays in the broader economy of the Municipality? | √ | | The car drivers must leave cars at home and use our buses to travel. |
| **4. Enabled Transportation Pricing Systems** | | | |
| 4.1. Do you think that the Municipality can charge congestion pricing on cars as part of revenue collection? | | √ | No, the Municipality should not charge us for coming to town because it means that we will need to increase our bus fares which will have a negative impact on our customers. |
| 4.2. Will the initiation of road side parking metres assist in traffic management for Port Shepstone? | √ | | But they must not charge public transport owners such as buses or taxis. |
| 4.3. Should the Municipality introduce various traffic pricing schemes which include charging for entry into an urban centre/ rather Port Shepstone town during peak hours? | √ | | They must charge only private cars and not public transport. |
| **5. Data Acquisition and Management** | | | |
| 5.1. Do you think data acquisition and management tools such as CCTV cameras will be effective in traffic management of Port Shepstone? | | √ | |
| 5.2. Do you think a secondary city like Port Shepstone need to develop a data management centre for traffic management? | | √ | |

**PART 2: GENERAL ITS QUESTIONS**

**2.1. What new transportation services do you think would help meet your transportation needs?**

We need lanes for buses. This will reduce traffic.

**2.2. Most literature reveals that political opposition and lack of institutionalisation often results in poor ITS implementation. How can local municipalities institutionalise the implementation of ITS?**

When we renew disks. They must notify us about the ITS systems that the Municipality is initiating.

**2.3. How can Municipalities win political support for implementation of ITS?**

They must put in bus lanes and during elections we will vote for them.

**2.4. What are the major financial implications that most cities face in implementing ITS for sustainable transportation?**

None

**2.5. To what extend do you think ITS will respond to transportation needs of Port Shepstone?**

It will help because there will be less cars on the road.

**2.6. We know that ITS might be new for most secondary cities of developing countries like Port Shepstone. How can the Municipality create awareness for the use of ITS in aiding traffic challenges?**

They must come to bus ranks and taxi ranks so the road users can be aware of the system. Even on weekends we transport people to events such as Funerals, so they can be aware of the system.

**2.7. What policies and smart strategies can be put in place, particularly in the IDP and the SDF as a start in promoting ITS in secondary cities like Port Shepstone?**

When they do Izimbizo, they must tell us about the system.

**2.8. What ideas, thoughts, or suggestions do you have on this research study?**

This study must help us do bus lanes from the rural areas to town so we will not contribute to traffic.

**3.10.**

## SEMI-STRUCTURED INTERVIEW

**Name of Interviewer**: G.L. Madihlaba
**Name of Interviewee:** Participant 10
**Place of the Interview:** Taxi Rank
**Date of Interview**: 01 August 2019
**Venue:** Port Shepstone
**Time:** 10h00

**Objective:** *To establish the possibilities of using intelligent transport systems (ITS) to address transportation challenges of the secondary city of Port Shepstone.*

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**PART 1: ITS FUNCTIONAL AREAS/ POTENTIAL ITS SOLUTIONS**

The table below outlines the five (5) functional areas which the research study focuses on in assessing the possibility of ITS establishment in the secondary city of Port Shepstone. Kindly, provide details on which ITS solutions you prefer being initiated in the secondary city of Port Shepstone:-

| POTENTIAL ITS SOLUTIONS | ITS FUNCTIONAL AREAS INDICATORS | | |
|---|---|---|---|
| | YES | NO | PROVIDE COMMENTS |
| **1. Advanced Traveller Information Systems (ATIS)** | | | |
| 1.1. Do you think that it is important to be provided with real-time travel information when travelling? | | √ | |
| 1.2. +Would you use technical application solutions *(i.e. smartphone, digital road signs warnings, navigator, board computer displays, radio announcement, TV, Email, etc.)* which provide accurate and real-time information about traffic and parking in Port Shepstone? | | √ | Because so many people in Port Shepstone have smart phones. Including myself, so I believe it will really help. |
| 1.3. Do you think social media will be the most appropriate platform to inform Port Shepstone residents about Traffic congestion and parking? | | √ | |
| **2. Advanced Transportation Management System (ATMS)** | | | |
| 2.1. Do you think the traffic lights in the Port Shepstone area should be re-scrutinised for better management of the traffic flow during peak hours, particularly those located in critical intersections and how? | | √ | Especially during peak hours. People are always late for work and they want you as a taxi driver to take them to work on time. And they forget that it is not your fault that they are late. |
| 2.2. Do you think secondary cities like Port Shepstone require the use of technical applications such as CCTV, digital road sign for traffic management and parking? | | √ | |
| **3. Advanced Public Transport System (APTS)** | | | |
| 3.1. To reduce traffic congestion in Port Shepstone. Do you think the Municipality should develop a Bus Rapid System which will not only support Port | | √ | They will take our customers. Currently, the taxi industry is doing well and we have designated routes in which we operate. So, if they introduce a bus system that will take away our business. |

| | | | |
|---|---|---|---|
| Shepstone but the entire Municipal area and surrounding settlements? | | | |
| 3.2. Is there an existing public transport system in place? | √ | | Which currently few people are not using it as the time-frequency that it is operating doesn't suite most travellers. So, we are benefiting as a taxi industry from that. |
| 3.3. If no, is the Municipality in a process of initiating public transportation to aid transportation challenges of the town? | | | |
| 3.4. Do you think the initiation of promoting sustainable transportation such as Bus Rapid System will reduce traffic in Port Shepstone? | √ | | But it will be bad for our business as taxi industry as it will be a competitor for us. |
| 3.5. Do you think the promotion of sustainable transportation in Port Shepstone will result in reduction of $CO_2$, taking into account the significant location of the town and the role that it plays in the broader economy of the Municipality? | √ | | |
| **4. Enabled Transportation Pricing Systems** | | | |
| 4.1. Do you think that the Municipality can charge congestion pricing on cars as part of revenue collection? | | √ | That will have a negative impact on us as taxi drivers. As it stands, the taxi owners are not paying us enough salaries. So, if they introduce congestion charge, it means the employer will have to reduce our salaries to accommodate for the charges. |
| 4.2. Will the initiation of road side parking metres assist in traffic management for Port Shepstone? | | √ | |
| 4.3. Should the Municipality introduce various traffic pricing schemes which include charging for entry into an urban centre/ rather Port Shepstone town during peak hours? | | √ | |
| **5. Data Acquisition and Management** | | | |
| 5.1. Do you think data acquisition and management tools such as CCTV cameras will be effective in traffic management of Port Shepstone? | √ | | |
| 5.2. Do you think a secondary city like Port Shepstone need to develop a data management centre for traffic management? | √ | | |

**PART 2: GENERAL ITS QUESTIONS**

**2.1. What new transportation services do you think would help meet your transportation needs?**

Built new taxi rank as currently, the facility is small and we have to wait at a holding station outside the Port Shepstone CBD. So, renovating and expanding the taxi rank will be of great help for us.

**2.2. Most literature reveals that political opposition and lack of institutionalisation often results in poor ITS implementation. How can local municipalities institutionalise the implementation of ITS?**

The Port Shepstone Taxi Association needs to be notified of this system.

**2.3. How can Municipalities win political support for implementation of ITS?**

They must ensure that they provide us with a better taxi rank and we will vote for them during elections.

**2.4. What are the major financial implications that most cities face in implementing ITS for sustainable transportation?**

Budget constraints. The Municipality does not prioritise us when they are doing the budget. Even during Izimbizo. We do attend and voice our concerns about the taxi industry. However, they are not addressed.

**2.5. To what extend do you think ITS will respond to transportation needs of Port Shepstone?**

I am not sure if it will help. But if the transport users are well consulted. Then it might help.

**2.6. We know that ITS might be new for most secondary cities of developing countries like Port Shepstone. How can the Municipality create awareness for the use of ITS in aiding traffic challenges?**

Through IDP Imbizo.

**2.7. What policies and smart strategies can be put in place, particularly in the IDP and the SDF as a start in promoting ITS in secondary cities like Port Shepstone?**

Creating awareness, especially in rural areas that we are servicing such as Gamalakhe, Gcilima, Nyadezulu, etc.

**2.8. What ideas, thoughts, or suggestions do you have on this research study?**

I think the research its really good and I hope the Municipality take into account the recommendations put forward.