THE POTENTIAL IMPACT OF RAILWAY INFRASTRUCTURE ON CONNECTIVITY WITHIN NAIROBI METROPOLITAN- A CASE OF LIMURU TOWN (KIAMBU COUNTY)

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A Research Project Submitted to the Department of Environmental Planning and Management in partial fulfillment of the requirement for the award of the degree of Masters in Environmental Planning and Management Kenyatta University

May, 2014
DECLARATION

This research project is my original work and to the best of my knowledge, has never been submitted for the award of a degree or any other academic qualification in any other university or institution.

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N50/22727/2012

This research project has been submitted for examination with our approval as University Supervisors.

Signature………………………………………………..Date:……………………

Dr. Peter. K. Kamau

Signature………………………………………………..Date:……………………

Mr. Allan Kirui
DEDICATION

This research work is dedicated to my family, for their endless love, support, and encouragement.
ACKNOWLEDGEMENT

The realization of this research project would not have been possible without your help I wish to acknowledge;

First and foremost I thank the Lord for positioning me in His vineyard and the honor to being a steward.

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ABSTRACT

This study finds ground from the fact that railway infrastructure provide effective transport and plays a significant role in enhancing and improving urban growth and urban dynamics. Railway transport is the second most-used mode of transport after roads in Kenya, for both freight and passenger traffic. It has been argued that improvement of this mode of transport in Kenya would boost the economic performance of business enterprises which would in turn contribute to social economic growth of the country. Railway infrastructure encompasses different type of trains such as Mass Rapid Transit System and Light Rail Transit, railway stations, and railroads. This infrastructure is needed to provide services for a rapidly expanding Nairobi including significant growth in satellite towns and areas outside the city periphery. Potential benefits of effective railway infrastructure include improved air quality, reduced travel costs, reduced traffic congestion and economic savings in time and fuel. Connectivity in transport implies increased pedestrian convenience, efficiency in freight transportation, reduced environmental pollution, enhanced land use patterns and increased socio-economic opportunities of a place. The study focuses on potential impact of railway infrastructure on improving connectivity within Nairobi metropolitan, effect of policy and regulatory framework on railway transport, and challenges affecting railway infrastructure in Kenya.

The sampling frame for the area of study comprised a number of institutions, users of railway network, residents and the business community in Limuru town. Primary data will be collected through survey of the study area, direct observation guides, personal interviews schedules and structured questionnaires were among instruments used in data collection exercise. This study underscores the need to evolve a plan that will provide a framework for effective planning and management of railway infrastructure in the Nairobi Metropolitan. It is strongly recommended that a comprehensive approach be employed in the planning and management of railway infrastructure. This approach wins support as it brings all stakeholders on board to plan and manage the rail infrastructure. In order to achieve this it is necessary to initiate, develop and sustain public-private partnership, railway infrastructure enhancement programmes and institutional capacity building.
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<tr>
<td>GoK</td>
<td>Government of Kenya</td>
</tr>
<tr>
<td>KRC</td>
<td>Kenya Railway Corporation</td>
</tr>
<tr>
<td>RVR</td>
<td>Rift Valley Railways</td>
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<tr>
<td>EARC</td>
<td>East African Railway Corporation</td>
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<td>EAC</td>
<td>East African Community</td>
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<td>NMR</td>
<td>Nairobi Metropolitan Region</td>
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<td>NCR</td>
<td>Nairobi Commuter Rail</td>
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<tr>
<td>HSR</td>
<td>High Speed Rail</td>
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<td>NaMSIP</td>
<td>Nairobi Metropolitan Services Improvement Project</td>
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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Many of the world’s cities grew in conjunction with railway lines, and today largest cities cannot rely on motor vehicles only for transportation (Takao O. and Norihisa T., 2000). Railway transport has been described as high-capacity public transport that has potentially improved the efficiency of the urban economies by reducing travel cost and time; increasing the level of city-centre activity, thereby enhancing agglomeration of economies which are crucial for the prosperity of urban areas (Baruch, 2013) With the increasing global environmental issues, efficient public transport systems are increasingly seen as an important way to expand and revitalize large cities, while consuming less energy and other resources. Among the first cities to adapt rail technology to public transport was London, in the mid-19th century where intercity rail links were constructed to facilitate movement into and out of the Greater London metropolis. Other cities that have grown tremendously as a result of adoption of rail technology include Paris, Berlin, Moscow, New York, Hong Kong, Seoul and Tokyo. Urban railways are viewed as greatly encouraging intensive development around stations, and also as an important tool in reducing dependency on cars and in protection of the urban environment (ibid).

In Africa, urban transport was not seen as a priority area until 1960s (Patrick et al., 2005), consequently, the African railway transport systems are still to a large extent structured by physical infrastructure, legislation and institutions developed during the colonial period, and by policies adopted during the first decades after independence which to a large extent have allowed the transport system to deteriorate. However, in the last two
decades the structural adjustment of policies in different countries such as South Africa have led to a renewed interest both from the government and the donors in developing the railway transport infrastructure (Irandu, 2000). It is trade liberalization, deregulation of domestic trade and privatization of the parastatals in the early mid-1990s that have led to reshaping of transport systems in Africa (Patrick et al., 2005).

Railway infrastructure has played significant role in facilitating efficiency in cities and urban areas. The dynamic technology has diversified railway transport from steam engine trains to electrified trains, with evolving of high speed trains and mass rapid transit for passengers and freight trains for haulage of cargo (Todd, 2012). Other rail infrastructure that have developed with technological innovation include trackage, train inspection system, right of way, railway signaling, railway stations and electrification system. Globally the metro railway systems have been seen as solving many urban transport issues such as air pollution, reducing traffic congestion and influencing change of land use patterns (Sekar, 2012). Well developed railway infrastructure has been viewed as having numerous benefits that include; lower average per capita vehicle ownership and annual mileage, less traffic congestion, lower traffic death rates, lower consumer expenditures on transportation, and higher transit service cost recovery (Ibid). Connectivity brought by railway infrastructure is concerned with increasing pedestrian convenience, efficiency in freight transportation, reduced environmental pollution, enhancing land use patterns and increasing socio-economic opportunities of a place.

Kenya is entirely served by Mombasa-Uganda railway which was developed in the early 1890s by the colonial government. Over the years the railway network in Kenya has undergone much dilapidation due to poor maintenance, lack of technological
development hence becoming almost obsolete in transportation within urban areas and the country at large (Mairura, 2010) hence affecting connectivity between various urban areas in Kenya. Due to ineffective rail transport, roads have been used as the major mode of transport in Kenya. However it has had significant problems especially in urban area and cities; such as traffic congestion and increased traffic death rates. In a study carried out in Nairobi (JICA, 2009), traffic projection indicated that number of cars accessing the city daily were more than 330,000 in 2007 and were likely to increase to 0.7 cars per every inhabitant hence the need to rethink on redeveloping railway infrastructure as an alternative mode of transport.

Kenya Railway Corporation is the institution given the mandate by the Government of Kenya of renewing, rehabilitating, managing and redeveloping the railway network system within the Nairobi Metropolitan and in Kenya (Nairobi Metro 2030, 2008) In adhering to the Vision 2030 the Corporation has begun working on various railway projects within the Metropolis as way of reducing the chronic traffic congestion in Nairobi that has negatively affected the economy. The plan, to be executed under the Vision 2030 development blueprint by the corporation, involves construction of a 167 kilometer rail transport linking the Kenyan capital with neighboring Kikuyu, Thika, Ruiru, Athi River, Kitengela, Machakos, Limuru and Kajiado towns. The Corporation has begun working on rehabilitation of approximately 100 km (60 miles) of the existing rail system within Nairobi, construction of 6.5 km (4miles) of new track to the Nairobi Airport and modernization of stations and other facilities (News Rail, 2013). Syokimau railway line is one of the rail projects being implemented by the Kenya Railway
Corporation with an objective of easing traffic congestion on roads to Nairobi city, to reduce cost of production and to provide cheaper and efficient transport means.

With economic boom complimented by car based sub-urbanization, the Nairobi Metropolitan has spread over vast unmanageable areas. Beyond a certain boundaries, long distance commuting becomes costly, and there are other associated public transport issues of congestion, and travel delay. The Nairobi city centre planned many decades back has narrow streets reducing accessibility and encouraging stand-still traffic across all arterials, and it becomes sensitive and uneconomical in terms of road widening Gonzale, et al (2009).

Traffic congestion is a growing problem in Nairobi, resulting from rapidly increasing population and the crowding of motorized traffic onto a limited street network. The Nairobi Metropolitan was developed as a way of spurring socio-economic growth in Kenya through creating a sustainable wealth and safe environment for the resident of Kenya, investors and offer unique experience for visitors (Nairobi Metro 2030, 2008). It is through well positioned urban areas and developed infrastructure that can create an arena for spurring economic growth and through a well defined national urbanization framework. The Nairobi Metro 2030 endeavors to build a robust, internationally competitive, dynamic, inclusive economy; world class infrastructure to support development enhance linkages and accessibility to national, regional and global contexts.

1.2 Problem statement

Nairobi Metropolitan has a huge transport backlog resulting from poor transport infrastructure that has consequently affected the socio-economic state of the metropolitan
The urban transport system in Nairobi has been characterized by a poorly connected street network crowded with competing modes of transport. Railway network in Kenya has suffered numerous problems ranging from mismanagement of railway resources, inadequate financial resources, encroachment of railway reserve land, and sidelining of technological development on railway infrastructure. Like other urban areas within Nairobi metropolitan, Limuru town an agricultural and industrial hinterland has suffered a share of many urban problems that have significantly hindered its growth. Notably the Nairobi-Uganda railway cuts through Limuru town, and by contrast the railway station in Limuru town is not operational hence having minimal benefits to the socio-economy of the town. The railway line reserved land and warehouses located at Limuru railway station have fallen into disuse, whereas the reserve land is currently used for farming and the warehouses turned into private business enterprises. Poor policy and regulatory framework could also have been a contributing factor to inefficiency of railway infrastructure in Limuru town.

The Nairobi-Uganda railway line in the early 1980s was a key element in facilitating transport of passengers and goods from Limuru town to other towns; it offered a cheaper and efficient means of transport, but two decades later the collapse of railway transport has significantly affected the local economy of these towns and the entire country. Development of the railway line infrastructure, would open up more opportunities for creating industries such as food processing, manufacturing that will in turn create employment, reduce rural-urban migration and decentralize the economy from the Nairobi city.
This study attempts to conceptualize better development scenarios in Limuru town as part of Nairobi Metropolitan, which may result from redevelopment of railway infrastructure. It is hypothesized that the redevelopment of metro railway is likely to change Nairobi Metropolitan land use pattern and intensity of use, thereby altering overall city structure.

1.3 Research questions

i) What is the policy and regulatory framework for railway infrastructure development in Kenya?

ii) What is the physical condition of railway infrastructure in Limuru town and how has it influenced railway transport?

iii) What is the socioeconomic contribution of Limuru town as part of Nairobi Metropolitan?

iv) What are the socio-economic and environmental challenges associated with ineffective rail infrastructure?

1.4 Research Objectives

i) To evaluate the policy and regulatory framework for railway infrastructure development in Kenya.

ii) To examine the physical condition of railway infrastructure in Limuru town and how it has influenced railway transport.

iii) To explore the socio-economic contribution of Limuru Town as part of Nairobi Metropolitan.

iv) To assess the socio-economic and environmental issues associated with ineffective rail infrastructure.
v) To formulate an action plan for revamping railway infrastructure between Nairobi-Limuru railway line to improve connectivity and enhance environmental protection.

1.5 Research premise

1. Policy and regulatory framework managing railway infrastructure has weaknesses that have affected connectivity of Limuru town to Nairobi metropolitan
2. There is a huge potential of improving railway infrastructure on connectivity between Limuru town and the Nairobi metropolitan.
3. The railway infrastructure in Limuru town is in poor condition and has consequently affected the urban growth.

1.6 Study justification

Since independence Nairobi has been experiencing tremendous population growth, hence resulting to pressure on urban resources that has contributed to the urban decay. Nairobi provides a good illustration of the rapid rate of urbanization – In 1948 Nairobi’s population was 120,000 people but this has rapidly grown to reach 3 million residents in 1999 (Irene and Jack, 2010). The population of Nairobi is currently estimated to be 6.5 million, and population growth per annum is estimated to be 3.5 per cent, while growth projection indicates that the NMR population may reach 8 million by 2030 (UN-HABITAT, 2008). Approximately 2.5 million people commute in and out of Nairobi city per day and 85% of the population in Nairobi metropolis utilizes public transport (Cyrus, 2012). As the population pressure increases within the Nairobi City, developing urban
railway infrastructure will help in decongesting the city as it will provide socio-economic opportunities within urban areas of Nairobi metropolitan such as Limuru town.

Traffic condition in Nairobi has been described as being unpredictable and heavy resulting to huge economic loss due to many hours spent on the road. Reduced and poor infrastructure in relation to population density of Nairobi Metropolitan has been regarded as the greatest contribution to traffic congestion (Gonzales, et al., 2009). Commuter train services were introduced in Nairobi in 1980s to provide a low cost public transport alternative to the urban poor in the city, as a way of building the urban economy (Mairura, 2010). However, the existing railway system in Kenya has not fully met the objectives hence continued inefficiency in urban transport.

The New Urbanism concept of urban planning aims at introducing mixed land uses, compact developments, and high-rise buildings into city centers, and it is dependent on reliable, fast and frequent high capacity rail systems (Cox, 2011). The development of metro rail system has positively resulted to growth of cities through creating jobs by creating connectivity between cities and urban areas. In reference to cities such as Tokyo with one of the largest Central Business District (CBD) in the world with more than 3 million jobs annually, which roughly translates to 58600 jobs per sq km, the high capacity rail system has made great contribution in enhancing proper connectivity and accessibility (Dinesh, 1990).

1.7 Study significance

This study is being conducted when the process of urbanization in Kenya is increasing at a tremendous pace estimated at 3.5% per annum and at a period when urban public...
transport need to be developed to regenerate the country’s economy (UN-HABITAT, 2008). The economic development and urbanization are pulling more people into Nairobi Metropolitan causing rapid growth in transport demand in urban areas.

Railway infrastructure has played a significant role in growth of cities and urban area, globally creating more economic opportunities and enhancing urban dynamics (Sekar, 2012). Efficient railway infrastructure would increase connectivity and reduce influx of people into the city hence reduce congestion. Improving connectivity also reflects positive growth on economic development of a place, due to increased investment. Among the urban challenges that will require the concerted attention of the government, local authorities, the private sector, local communities, civil society and development partners are: inadequate shelter, restrained urban resources, inadequate public transport and environmental degradation, urban poverty, unemployment, redeveloping and renewing pre-colonial towns etc.

Appreciation of this study befits all stakeholders in railway transport in Kenya to redirect their collective energies and meager resources in devising urban transport management strategies that are capable of addressing the existing problems in public railway transport and the utilization of the opportunities to restructure rail transport system in Nairobi Metropolitan. Planners must therefore be prepared to meet these challenges by delivering visionary strategic plan suitable for redeveloping and renewing railway infrastructure so as to enhance connectivity in urban areas within Nairobi Metropolitan as a way of diversifying the socio-economic, physical environmental aspects of the metropolitan.
1.8 Study scope

- The study focuses on factors that contribute to improved connectivity through an efficient railway infrastructure in Nairobi Metropolitan.
- How improved railway infrastructure can enhance exploiting the potential of urban centers within Nairobi Metropolitan such as Limuru town.
- The socio-economic, environmental benefits of improved connectivity and efficient railway infrastructure in Nairobi Metropolitan and its satellite towns.
- How improved railway infrastructure would increase transport capacity of goods and services within the Nairobi Metropolitan.

1.9 Definition of Terms

**Metropolitan**- This is a region consisting of an urban area with relatively high population density whose surrounding territory is socioeconomically linked to the centre by commuting (Nairobi Metro 2030, 2008).

**Connectivity**- is the availability of transport that enables people and goods to reach a range of destinations at a reasonable generalized cost (Oxera, 2010).
CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviews the related literature, on potential impacts of railway infrastructure on connectivity in Nairobi metropolitan. It focuses on theoretical and conceptual framework on aspects of transport connectivity, factors contributing to effective railway connectivity and case studies on effective metropolitan railway systems in parts of the world.

2.2 Urban Transit in Nairobi Metropolitan

Nairobi Metropolitan Region covers 32000 square kilometers consisting of areas that depend on the Nairobi city for employment and social facilities and it is located at 40 kilometre radius from the city. The development of Nairobi metropolitan was spurred by population growth in the urban areas surrounding Nairobi such as Kiambu, Limuru, Ruiru, Thika, Machakos and Murang’ a, resulting to the need for expansion of the city physically, structurally and in terms of institutional framework (Nairobi Metro 2030, 2008). The aim of the development was to meet diverse needs of different population and landscapes covered by the region to ensure there is increased economic, social and environmental growth. Nairobi is a national, regional and international centre for education, commerce, transport, regional, cooperation and economic development, hence its development is critical for both local and global economic growth (Ibid).

According to (Takashi, 2003) effective urban transport is what contributes to growth of any metropolitan as it eases accessibility and distribution of land uses, consequently decentralizing the urban economy and stimulating suburbanization. Transit defines an
urban transportation mode, particularly in large urban agglomeration (Du and Malley, 2006); transit systems are made up of many types of services, each suitable to a specific set of market and spatial context. Nairobi Metropolitan lacks an effective urban transit system, as the currently one is associated with many problems ranging from increased road carnage, traffic congestion on roads, to increased air pollution from emission (Mairura, 2010). On the other hand the Nairobi Commuter train system introduced to reduce problems in urban transit is in the process of developing and faces various issues such as inadequate route coverage, competition from other transport modes, inefficient policy and regulatory system, inadequate inter-modal transfer facilities, inadequate funding and lack on infrastructure.

Nevertheless, in the Nairobi Metropolitan Transport Master Plan (2008), Nairobi Commuter Rail development as part of the plan is geared towards decongesting roads within Nairobi metropolitan and will integrate rail transport with other modes of transport such as road and air transport. It is through initiatives such as NCR project that the national government aims at improving urban transit within Nairobi metropolitan and other surrounding areas. The NCR project aims at increasing transport connectivity by providing passengers with safe, reliable and affordable transport services in and around Nairobi city. The envisioned features of Nairobi Commuter System will include increased passenger capacity, modern stations and rolling stock, upgraded track and signaling systems, higher speeds, and safety, comfort and reliability (Ministry of Transport, 2011).

In a study done by Ministry of Nairobi Metropolitan Development (2009) on Nairobi Metropolitan Services Improvement Project (NaMSIP), the train is the most efficient means to develop a Transport Oriented Development (TOD) strategy for Nairobi. The
Many commuter train services have the mass capacity to respond to the needs of a metropolis of the size and growth patterns of Nairobi. Most of great capitals in the world have a public transport system based essentially in a commuter rail and metro network (Du and Malley, 2006), hence the need for redevelopment of railway infrastructure and urban transit in Nairobi Metropolitan.

### 2.2 Policy and regulatory framework on management of railway infrastructure in Kenya

The origin of the modern transport system in Kenya was the port in Mombasa and the railway line built during the 1890s and the first years of the 20th century, linking the port to Nairobi and further on to Kisumu (Patrick et al., 2005). Railway operations in Kenya are managed by Kenya Railways Corporation (KRC) which was established in 1978 under the Kenya Railways Act Cap 397 of the Laws of Kenya. It is an entirely government owned parastatals that took over the operations of the defunct East African Railways Corporation (EARC), following the demise of the then East African Community (EAC) in 1977. The Act was revised in 1986 and amended in 2005, and it details the duty of the corporation as; to provide skills and technology for the railway sector, efficient and effective railway services, leverage assets to grow business and to promote, facilitate and participate in national and metropolitan railway network development.

Under the Act the corporation has the mandate to coordinate and integrated rail and inland waterway transport services, port facilities in relation to inland water transport and auxiliary road transport services. The corporation currently carries a freight volume of approximately 2.5 million metric tons (t) and has the potential to increase the volume to
five million tons per year (News Rail, 2013). In 1980, a freight level of 4.3 million was attained, while in 1989-1990, the railway carried 3.5 million tons (Irandu, 2000); the decline has been attributed to poor maintenance and management of railway system.

In 2006 GoK and KRC, under a concession agreement, leased the management and operation of railway services to RVR (Rift Valley Railways) for 25 years, to operate and manage of passenger services and freight services between Nairobi, Kisumu and Mombasa. Rift Valley Railways consortium is still operating passenger and cargo trains and it is the role of KRC to evaluate their performance and ensure they deliver transport services accordingly. According to Mairura (2010) RVR is tasked with ensuring safety in railway transport, mitigating stock derailment, and renewing the aging infrastructure.

Kenya railways were originally built for strategic reasons; first the colonial governments’ colonization policies was to create an agricultural export production, which could pay for the railway (Miller 1971); and both before and after independence Kenyan transport policies have been geared to keep the traffic on the railway, though often in vain (Hazlewood, 1964). Before the Second World War, road construction policies focused on building feeder roads to the railways as a way of improving railway transport. Railway transport was significant in transportation of country’s coffee and tea and a number of commodities. However, with deregulation of the domestic agricultural trade which started during the 1980s, railway transport development became a losing battle (Irandu, 2000).

For a long time Kenya had no comprehensive transport policy to govern the operation of railway and other modes (Irandu, 2000). The Integrated National Transport Policy was formulated in 2009 by Ministry of Transport with an aim of resolving the transport
problems besetting Kenya such as poor quality of transport services, inappropriate modal split, and unexploited regional role of the transport system, urban environmental pollution and lack of an urban/rural transport policy and institutional deficiencies. The policy was also developed in response to Kenya’s Long Term Development Strategy, Vision 2030 as transport is a key aspect of socio-economic growth in Kenya. The Integrated National Transport Policy 2009 aims at fostering national and regional economic integration and trade facilitation; establishing appropriate institutional systems; developing and maintaining an integrated and coordinated transport system; developing appropriate funding/financing mechanisms; integrating transport and land use planning and management systems; enhancing investments in the transport sector and developing a national transport information database; enhancing public awareness; improving safety and security; developing and promoting appropriate human resource capacities in the sector; and facilitating public private partnerships.

However, even with the new transport policy, major attempts to revamp railway in Kenya have not been effective in the late 1980s and 1990s; donor assistance to implement a performance contract between GoK and KRC never materialized (Irandu, 2000). Consequently KRC’s performance over the years has declined with inability to meet its traffic demand, losing most of its traffic to road transport.

2.3 Potential of railway infrastructure in Kenya

Railway infrastructure has huge potential of regenerating economic growth in Kenya. In the early 1900s revenue generated from railway transport in Kenya was estimated at 65.3 million US dollars however as shown in the Table 1 below there has been a great decline attributed to factors such as mismanagement of railway infrastructure leading to closure.
of some networks such as Butere-Kisumu line and lack of funds to add to existing infrastructure (Irandu, 2000). Nevertheless, besides some fluctuations in the mid-1990s (Table 1) due to devaluations, the average freight rate per ton-km increased from 3.2-3.3 US cents per ton-km around 1990 to 4.5 US cents per ton-km in 1998, but has since then dropped to 3.7 US cents per ton-km in 2001 and 2002. KRC’s freight revenue increased 70% in dollar from the low point of 38 million US $ in 1995 to 64 million US $ in 1999, however since 1999 the freight revenue has decreased slowly to 57 million US$ in 2002.

**Table 1-Trends in freight and freight revenues of the Kenyan Railways annually**

<table>
<thead>
<tr>
<th>Year</th>
<th>Freight revenue per ton</th>
<th>Freight revenue per ton-km</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-2002</td>
<td>2,192</td>
<td>1,460</td>
</tr>
<tr>
<td>1993-1997</td>
<td>2,418</td>
<td>1,273</td>
</tr>
<tr>
<td>1988-1992</td>
<td>3,385</td>
<td>1,867</td>
</tr>
<tr>
<td>1984-1987</td>
<td>3,486</td>
<td>1,857</td>
</tr>
</tbody>
</table>

**Source: Patrick et al. (2005)**

According to Irandu (2000) the monopolistic policies have continued the deterioration of railway transport with poor prioritization of container transport as a core business activity. While rail tonnage has decreased to a third, the port volumes have grown tremendously, tripling from 7 million tons in the 1980s to over 19 million tons annually (Patrick et al, 2005).

Globally, growth in rail transport has been significant in regional and global development because of its capabilities of increasing attractiveness and quality of urban public transport (Du & Malley, 2006), and thereby contributing to a sustainable and efficient transport network. Rail systems have been shown to increase land value around train
stations due to the increased levels of accessibility and reliability (Du and Malley, 2006). Suburban rail systems have benefits of being radical, and high profile alternative to the private motor-vehicle (Newman & Kenworthy, 1996; Mees, 2000). Other benefits of rail travel include comfort and reliability (Jefferson, 1996). Electrified rail systems can provide increased environmental benefits such as low emissions, noise and vibrations while the fixed nature of rail has been shown to increase pedestrian and passenger safety due to its high visibility and predictable travel path (Jefferson, 1996).

Research has shown railway stations are capable of attracting residential and commercial development resulting in high-density nodes (Edwards & Mackett, 1996; Gibbons & Machin, 2005). Suburban rail can also co-operate with the movement of regional and national freight and increasing rail transport capacities can be achieved through additional carriages. In 2009 Kenya Railways Corporation developed plans for development of modern commuter rail transport in Nairobi Metropolitan, Coast region and Kisumu environs. In the Nairobi Metropolitan Transport Master Plan, the corporation aimed at developing Nairobi Commuter Rail System in phases to ensure effective public and sustainable transport in the metropolitan (News Rail, June-September, 2013). In phase one the commuter system would be developed along existing railway network to provide commuter rail services between Nairobi Railway Station and destinations such as Ruiru, Syokimau, Imara Daima, JKIA, Kikuyu and Embakasi.

This phase would include 26 new modern passenger handling stations at the existing railway stations and at new locations. In phase two, commuter rail services would be extended along existing railway corridor covering Thika, Limuru and Luenya as shown in figure 1. The third phase would involve new railway corridors targeting the outlying
satellite towns such as: Ongata Rongai, Kiserian, Ngong, Kiambu, Ruai and Kangemi. Limuru town is located along the existing railway corridor (Nairobi-Kibera Dagoreti-Kikuyu-Muguga Line) hence may benefit once the Nairobi Commuter Rail project is fully implemented.

**Figure 1-Proposed Nairobi Metropolitan commuter rail services**

![Map of Nairobi Metropolitan commuter rail services](image)

Source: (News Rail, 2013)

Key drivers that contributed to development of Nairobi commuter rail system were; that Nairobi is the largest city in Kenya and a major transit point in the East African region, to increased number of daily commuters to 1.5 million people per day within Nairobi Metropolitan, the fact that 85% of Nairobi's population do not own automobiles and commute by public transportation and the ability of the system to handle 60 million passengers annually. The redeveloped rail system is projected to have social benefits such as creating new opportunities for employment, decentralizing the urban economy, low cost transport for all its users, including lower income residents of Nairobi and providing
reliable and affordable transport. According to KRC report (News Rail, 2013) construction of Syokimau, Imara Daima and Makadara sub-station is complete and awaiting to start operations. To ensure journey reliability, the corporation has developed a train schedule for the commuter train between Syokimau to Nairobi, the substation offers ‘park & ride’ services hence encouraging commuters to use the train to and from Nairobi. The commuter train takes 40 minutes from Syokimau to Nairobi a distance of 50km hence improving travel time and journey reliability (News Rail, 2013 June-September).

The objective of Nairobi commuter rail system was to decongest the major roads accessing the Nairobi city centre, hence improve the travel time. According to a study carried out by JICA, 2013 in developing a transport master plan for Nairobi metropolitan all major roads into the city centre were congested especially during morning and evening hours. Aligula et al., (2005) further highlights, as shown in Table 2 that congestion on major roads to Nairobi resulted from the increased vehicles/matatus for public transport and private cars, hence the need for an alternative mode of public transport and travel.

Table 2-Daily traffic counts by vehicle type on major roads in Nairobi

<table>
<thead>
<tr>
<th>Road</th>
<th>Cars</th>
<th>Matatus</th>
<th>Other</th>
<th>% Matatus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Langata Rd</td>
<td>14,835</td>
<td>3,688</td>
<td>1,064</td>
<td>19</td>
</tr>
<tr>
<td>Mombasa Rd</td>
<td>28,286</td>
<td>8,097</td>
<td>1,389</td>
<td>21</td>
</tr>
<tr>
<td>Jogoo Rd</td>
<td>17,741</td>
<td>13,303</td>
<td>2,354</td>
<td>40</td>
</tr>
<tr>
<td>Juja Rd</td>
<td>5,854</td>
<td>6,298</td>
<td>1,812</td>
<td>45</td>
</tr>
<tr>
<td>Thika Rd</td>
<td>16,580</td>
<td>13,326</td>
<td>3,176</td>
<td>40</td>
</tr>
<tr>
<td>Kiambu Rd</td>
<td>4,663</td>
<td>2,833</td>
<td>404</td>
<td>36</td>
</tr>
<tr>
<td>Limuru Rd</td>
<td>12,407</td>
<td>4,834</td>
<td>408</td>
<td>27</td>
</tr>
<tr>
<td>Waiyaki Way</td>
<td>25,243</td>
<td>8,451</td>
<td>2,494</td>
<td>23</td>
</tr>
<tr>
<td>Ngong Rd</td>
<td>8,348</td>
<td>4,291</td>
<td>1015</td>
<td>31</td>
</tr>
</tbody>
</table>

(Source: Aligula et al., 2005)
According to Aligua et al. (2005) of the nearly 4.8 million trips made each day in Nairobi in 2004, only 16% were made in private vehicles; 36% used public transport and 48% were made on foot. The vast majority (about 80%) of public transport trips in Nairobi are carried by matatus. The remaining public transport trips are served by traditional fixed route buses, a commuter rail line, and other shuttle services such as those run by schools hence justifying the increasing need for development of an efficient metro railway infrastructure.

2.4 Technological development of Railway infrastructure

Wagon ways or tramways are thought to have been the first railways, developed in Germany in the 1550s to facilitate the transport of ore tubs to and from mines, utilizing primitive wooden rails. The technology spread across Europe and had certainly arrived in Britain by the early 1600s (Georgius A. 1913). The Wollaton Wagonway was probably the earliest British installation, completed in 1604, and recorded as running from Strelley to Wollaton near Nottingham (Pacey A, 1990). Railway technology has further grown, in the early eighteenth century the wrought iron railway was developed and it proved efficient than the wooden wagon and tramways, and Stockton and Darlington Railway was utilized in 1825 for general shipping of goods.

According to Pacey (1990) steam propelled locomotive invented in early 1784, brought much relief as it was more efficient than the horse and self drawn carriers. The steam powered engine was later developed in early 1800s and the first commercially successful steam locomotive was Matthew Murray's rack locomotive *The Salamanca* built for the
narrow gauge Middleton Railway in 1812. As the industrial revolution grew better railways and speedy locomotives were developed.

In the early 1850s the diesel powered engines emerged and were more efficient than steam locomotives (Miller, 1971). By the 1890s, electric power became practical and more widespread, allowing extensive underground railways. Large cities such as London, New York, and Paris built subway systems. When electric propulsion became practical, most street railways were electrified. These then became known as "streetcars," "trolleys," "trams" and "Strassenbahn." In the twentieth century railway technology revolutionized urban transport; electric street railways grew beyond the metropolitan areas to connect with other urban centers.

The late 20th century and current century have seen the development of high-speed rail systems such as the Shinkansen of Japan, the TGV (Train à Grande Vitesse) of France, and the Eurostar of Maglev trains. According to Baruch (2013) high-speed rail (HRS) has different definitions in different countries. The International Union of Railways defines high-speed rail as lines specially built for speeds greater than or equal to 250 km/h/155 mph, or lines that are specially upgraded with speeds greater than 200 km/h or 124 mph. There are four major types of high speed rails (Ibid);

1. Dedicated: Japan’s Shinkansen is an example of dedicated service with separate high speed tracks that exclusively serve high-speed trains. The system was developed because the existing rail network was heavily congested with conventional passenger and freight trains and the track gauge did not support the new high-speed trains (Mamoru, 1992).
2. **Mixed high-speed:** Exemplified by France’s TGV (Train à Grande Vitesse), this model includes both dedicated, high-speed tracks that serve only high-speed trains and upgraded, conventional tracks that serve both high-speed and conventional trains.

3. **Mixed conventional:** Spain’s AVE (Alta Velocidad Española) has dedicated, high-speed, standard-gauge tracks that serve both high-speed and conventional trains equipped with a gauge-changing system, and conventional, nonstandard gauge tracks that serve only conventional trains.

4. **Fully mixed:** In this model, exemplified by Germany’s ICE (Inter-City Express), most of the tracks are compatible with all high-speed, conventional passenger and freight trains.

The world’s first high-speed rail line, known as the Shinkansen, was built in 1964 between Tokyo and Osaka, Japan (Takashi Endo, 2003). This line was built in a corridor well suited to rail travel, and the train was built to expand capacity on an overcrowded route. The world’s second high-speed rail line opened in Italy between Rome and Florence in 1977, Italy now has two lines: one connecting Turin and Venice and the second linking Milan to Salerno (Baruch, 2013). Parts of the Milan to Salerno line remain under construction. Italy has slowly expanded its track to connect most major cities by high-speed rail.

In Kenya, the national government is working on standardizing the railway gauge from Mombasa to Nairobi to allow introduction of high speed train that will redefine rail transport across the country (News Rail, 2013). The development for the new standard
gauge is aimed at reaping the benefits associated with high speed rail. According to Vision 2030 Transport Sector Plan (2008-2012), railway infrastructure in Kenya has not been redeveloped hence the effective old rolling stock, locomotives have largely contributed to the low operation capacity.

High speed rails have many advantages over automotives and plane travels (Baruch, 2013) that include;

1. **Environmental**: HSR uses one-third of the energy of air travel and one-fifth the energy of automobile travel, hence saving on cost of fuel utilized. HSR also reduces global warming by decreasing oil consumption and emissions.

2. **Economic Development**: Planning, designing and building HSR will create many green jobs. HSR may therefore spur economic development and the creation of some jobs, particularly around high-speed rail stations. HSR is reliable and operates in all weather conditions. It can spur the revitalization of cities by encouraging high-density mixed-use development around stations.

3. **Safety**: Each year, 43,000 people die in car accidents (United States High Speed Rail Association, 2012). Rail is a safer form of transportation than road, and building HSR services increases safety.

4. **Mobility**: High-speed rail reduces congestion on highways and at airport runways by shifting travel patterns. According to California High Speed Rail Authority (2013), this can provide extra mobility without costly new capital expenditures. Trains will travel on uncongested rails faster than cars and with fewer delays than
airline travelers. High speed rail can deliver more passengers per hour than roads and runways at a lower cost.

5. **Choice**: HSR will provide travelers with a choice of transportation modes. In congested corridors, frequent and reliable HSR could provide travelers an attractive alternative to dealing with traffic bottlenecks and airline delays.

6. **Reliability**: HSR increases the reliability and redundancy of the transportation system. Many different types of events, including floods, snowstorms and hurricanes, can dramatically disrupt a transportation system. Building redundancy into any system entails added costs, but the availability of alternatives tends to make the system as a whole more reliable during unusual events.

7. **Time Savings and Security Delays**: HSR offers time savings since travelers arrive in the city center instead of the periphery. This reduces total trip time as travelers do not have to include extra time to go through security.

8. **Comfort and Convenience**: Rail is a more comfortable and convenient way to travel than plane. Rail stations are located downtown, closer to the city center than airports on the periphery. Trains feature more comfortable seats and more leg room.

9. **Productivity**: High-speed rail allows people to work during their trips on laptops and cell-phones. Meeting space is also available on many trains. With better reliability and more frequent service, overnight stays are often not required. High-speed rail also allows travelers to take trips at the last minute or make changes to their schedule without large penalties.
However the high speed rails have some disadvantages of high cost of construction, where building a new rail infrastructure with 20th century engineering, including elimination of constrictions such as roadway at-grade (level) crossings, frequent stops, a succession of curves and reverse curves, and not sharing the right-of-way with freight or slower passenger trains, higher speeds (250–320 km/h) are maintained and also application of mature standard gauge rail technology using overhead electrification may be costly.

2.5 Case studies

2.5.1 Railway Connectivity in Japan

Global technological advancement in railway infrastructure has grown significantly and at different rates depending of individual countries growth in economies. In Japan the narrow gauge railway network was built in early 1870s and in 1938 the construction of new standard gauge was suggested to promote more rapid services. In 1940 construction of a Shinkansen bullet train running at 145mph and connecting Tokyo and Shimonoseki begun (Mamoru, 1992). After 1957 more new trunk lines were opened allowing for rapid transit from one city to another, Tokyo-Osaka line was opened in 1964 and had an average of 60,000 passengers per day and running at 131mph hence taking two hours as travel time. Other new lines included Sanyo, Tohoku, Joetsu, and the consequent effect was reduced travel time of less than three hours between Tokyo and Osaka 178km apart, and Joetsu with bullet trains operating at 172 mph maximum speed. Due to growth in rail technology in Japan more cities and town became more connected, average passengers carried per day rose from 30,967 in 1965 to 236,000 in 1969, whereas mileage travelled increased from 10,951 annually in 1965 to 65,964 in 1989 (Mamoru, 1992).
Despite the challenge with topography, Japan’s four main islands were joined by railway in 1988, where undersea Seikan Tunnel linked Honshu to the northern island of Hokkaido and the Ohashi Bridge linked Honshuto Island to Shikoku (Mamoru, 1992). According to Takao O. and Norihisa T., (2000) because of high land prices in urban areas many people have moved to the suburbs in search of affordable housing and more than 70% of this population commutes aboard trains as the most affordable and reliable means of transport. To ensure efficient transfers and improve access to railway station, all cities in Japan have developed subway lines to link to commuter lines, Tokyo city has 13 subway lines and operates more than 7 million passengers per day.

Other infrastructure such as monorail trains, escalators and elevators and other rail technology have been introduced to ensure convenience in travel and accessibility to station by the physically challenged. According to Takao O. and Norihisa T. (2000) Japan has continued to develop rail transport due to benefits accrued such as convenience in transport, energy efficiency, low pollution, and safety. Until 1987 nationwide and freight rail systems, were operated by Japan National Railways (JNR), which after privatization was split into six passenger railway companies, one freight railway company and several affiliated companies.

In Japan railway transport services are provided by private transport business entities and private businesses (Takashi Endo, 2003). The role of the national government is to secure supply of safe and smooth transport services by conducting supervision to the transport business entities and provide necessary support to the entities in line with particular policies regulating railway transport. These business entities include those in charge of
building and maintaining railroads, passenger services, shipping of passengers and cargo haulage.

2.5.2. Railway connectivity in Philippine-Manila

The Manila Metro Rail Transit System, popularly known as the MRT, Metro star Express or Metro star, is the main part of the metropolitan rail system in the Metro Manila area of the Philippines (Philippines Star, 2006). The rail transit system is characterized by a light rail, with a type of rolling stock that is more akin to a rapid transit system. The MRT forms part of Metro Manila's rail transport infrastructure, known as the Strong Republic Transit System, and overall public transport system. This MRT was built to decongest Epifanio de los Santos Avenue (EDSA), one of Metro Manila's main artery and also to promote use of the rail which was more efficient.

As reviewed from Philippines Star (2006), the MRT is operated by the Metro Rail Transit Corporation (MRTC), a private company operating in partnership with the Department of Transportation and Communications (DOTC) under a Build-Operate-Transfer (BOT) agreement. The single line serves 13 stations on 16.95 kilometers of line. It is mostly elevated, with some sections at grade or underground. The line commences at Taft Avenue and ends at North Avenue, serving the cities of Makati, Mandaluyong, Pasay, Pasig, Quezon City, and San Juan (Victor, 2013).

As shown in Figure 2, Manilla Metropolitan Rail systems consist of three lines, the LRT 1, LRT 2 and MRT 3. Metro-Manila, the metropolitan area of the capital of the Philippines is home to some 10 million people hence the need to develop an efficient public transport system. The LRT 1 is a fully elevated north-south route opened 1984
km) and 1985 (8 km). It runs along Rizal and Taft Avenues (15 km, 18 stations). The capacity of the line was increased in 1998. The line runs on a precast concrete structure 7 m above the street, designed to withstand earthquakes. It has 1435 mm gauge and 750 V overhead power supply. Average station distance is 825 m, stations are only accessible via stairs, and there are no elevators or escalators, hence creating a huge challenge to the physically disabled persons. Central, Monumento (northern terminal) and Baclaran (southern terminal) function as transfer station to buses.

**Figure 2-The Manilla Metropolitan Rail System**

According to Victor (2013) the trains are developed to ensure comfort of travelers through good ventilation in the carriage, comfortable seats and increased speed hence short travel time.

**MRT 3** (popularly called **Metrostar**) runs elevated along EDSA (Epifanio de los Santos Ave.) ring road (except Buendia station which is underground). The Metro star train introduced were air conditioned and had increased speed hence connecting the center of Manila to the outer ring. The operation of the Metrostar faced the challenge of operation in the first months, mainly due to high fares compared to buses and long flights of stairs to access the elevated stations (Philippines’ Star, 2006).

**LRT 2** (**Megatren** or **Purple Line**) runs from Manila in the west via Quezon City to Pasig in the east. The line is elevated except for Katipunan station, which is underground (ibid). Construction of this line started in 1998 and it runs along Recto Ave, Magsaysay Blvd and Aurora Blvd. The full length from Santolan to Recto Ave. is 13.8 km with 11 stations. Although called LRT, this line uses heavy rail metro vehicles. A footbridge linking the Purple Line to the Yellow Line was opened in March 2005.

Though in the process of further development the metropolitan rail transit system of Manila has contributed to increased connectivity in urban centers; contributing to the economic, physical and social growth of the metropolis.

2.6 Previous related studies on impacts of transport connectivity

In a study on Understanding the theory of International Connectivity (Department of Transport United Kingdom), Oxera (2010), indicates that connectivity has a direct
implication on transport and the wider economy of a place. Transport connectivity affects transport user benefits; the location of people and businesses; the degree of competition in markets; and employment, productivity and trade (ibid). Under transport user benefits, any change to transport conditions will, in principle, result to a change in demand, for instance, improving traveling frequency of a commuter train will increase the number of passengers due to increased convenience.

The connectivity of places will affect their competitiveness, as places effectively compete with each other to be attractive for people and businesses to locate and invest in Sabyasachee et al. (2012). Industries that operate in globalised markets must be well connected internationally in order to compete successfully. The level of international connectivity may affect the investment decisions of foreign and domestic firms. People and businesses are more likely to locate in places which are well connected, internationally and domestically. Agglomeration benefits may arise as a result of increased international transport connectivity through the attraction of people and businesses to the places concerned, and the resulting impacts on productivity. Lastly according to (Hadas and Ceder 2010) transport connectivity increases the labour market of a place where people are be able to move to more productive jobs, and more people may choose to participate in the labour force as a result of transport improvements.

In a study on performance indicators for public transit connectivity in multi-modal transportation networks by Sabyasachee et al. (2012), connectivity plays a crucial role as agencies at the federal and state level focus on expanding the public transit system to meet the demands of a multimodal transportation system. In the study a set of connectivity indexes was developed; (1) node, (2) link, (3) transfer center, and (4) region.
The node connectivity index includes the transit lines passing through it, their characteristics such as speed, capacity, frequency, distance to destination, activity density of the location, and degree centrality. The link connectivity index is the sum of connectivity indexes of all stops it passes through and normalized to the number of stops. Transfer centers are groups of nodes that are defined by the ease of transfer between transit lines and nodes based on a coordinated schedule of connections at a single node or the availability of connections at a group of nodes within a given distance or walk time. The sum of the connecting power of each node in the transfer center is scaled by the number of nodes in the transfer center. Lastly, the connecting power of a region is defined by the urban form, and the characteristics of nodes, lines, and transfer center.

Railway transport is the second largest and significant mode of transport in Africa and in Kenya. Effective railway transport is a product of well developed physical infrastructure, policies, legislation and institutions (Aligua et al, 2005). In a study of Development of African Freight Transport, Patrick et al. (2005) highlights that the deterioration of the African transport systems has not been just due to reduced investments in transport infrastructure but also the result of the economic institutions developed as part of the import-substitution policies introduced by most African countries during the late 1960s and 1970s. The shift from centralization to decentralization process gave transport low priority leading to downgrading of transport system at national plans and rural development programmes.

According to Irandu (2000) high costs, unreliability and poor quality of railway transport services have been stifling efforts to promote Kenya’s economic development. The large financial losses experienced by KRC over the years have put a considerable strain on
public finances. In addition, restrictive regulations have contributed to high costs and are a barrier to new innovations. Patrick et al (2005) further highlights, Kenya’s railway transport system, like the rest in Sub-Saharan Africa, is a precarious and expensive venture mainly because of the difficult terrain, low demand, poor transport policies and the scarcity of human and financial resources. In Kenya, poor performance of KRC can largely be attributed to inappropriate policies, especially reliance on public monopoly administrative structures, poor determination of tariffs, cross-subsidization of services and preference for national rather than regional approaches (Irandu, 2000). Consequently in view of the rapidly changing transport market situation, there is need for railway sector policy reform in Kenya, where such reforms will lead to more effective use of human and financial resources, improved financial sustainability and attract foreign investments and in totality improve rail transport connectivity.

Measure of transport connectivity can be used for various purposes (Hadas and Ceder 2010); first, in a public or quasi-public agency, transport connectivity can be used as a measure in public spending to quantify transit stop and route performance and to evaluate the overall system performance. Secondly, to serve as a performance measure in a large scale urban multi-modal transit network containing local buses, express buses, metro, local light rail, regional light rail, bus rapid transit, and other transit services which serve both urban and rural areas, where transit services are provided by different public and private agencies with little coordination. Thirdly, in a rural or suburban area where exact information on transit ridership, boarding, and alighting are not available (obtained from a comprehensive and well-designed transit assignment in a travel demand model or where smart cards are used to keep track of revenues) to obtain a measure of performance for
developing service delivery strategies. Fourthly, to provide an assessment of effectiveness and efficiency of a transit system with quantifiable measures that can be used to prioritize the nodes/links in a transit system, particularly in terms of emergency evacuation. Fifth, to assist transit agencies with the development of a set of tools for the potential transit users to assess the level and quality of transit services at their place of residence or work.

2.7 Theoretical framework on transport connectivity

A review of the relevant literature suggests that connectivity has a multi-dimensional nature and accepting this means that it is difficult to offer a precise single definition that can be operationalized for detailed analysis. To simplify the analysis, Oxera (2010) offered a generic definition: Connectivity is the availability of transport that enables people and goods to reach a range of destinations at a reasonable generalized cost. Connectivity defines the level of coordination of the transit routes, coverage, schedule, speed, operational capacity, urban form characteristics, and is an influential element of the image of any transit network (Sabyasachee et al., 2012).

The graph theory has been used to explain transport connectivity; graphs represent a collection of nodes and the links between them. According to Lam et al (1982), the precise terminology varies, depending on the context, with different names given to the two types of principal components: nodes (vertices) and edges (also called links or connections). In the transport context these nodes can be thought of as potential origins and destinations, such as airports, ports, stations or cities. The links between them, or edges, are roads, railways, shipping paths or air routes. Graphs themselves are sometimes referred to as networks, as in the case of transport.
If there is a path between two nodes, they are described as connected. If every pair of nodes in the graph is connected then we say the whole graph, or network, is connected. In Figure 3 the whole graph is not connected because there is no path from nodes 7 and 6 to any of the other five nodes, but nodes 1–5 form a connected graph. According to Sabyasachee et al. (2012) headway, frequency, speed, and capacity are critical terms that define the characteristics of a route for a transit link.

However, connectivity is not simply a binary concept (Oxera, 2010), the concept of paths leads to several measures than can be used (both theoretically and practically) to measure the degree of connectivity between two nodes. This involves counting the number of edge-independent paths or the number of node-independent paths: paths between the two nodes that do not share an edge or a node respectively. The greater the number of independent paths between two nodes, the more connected they can be said to be. A practical example in the transport context might be the number of different road...
routes between two cities. The number of nodes in a connected network is a measure of the connectivity of the nodes/places within it.

Transit connectivity is influenced by multidimensional factors that include; service quality, such as walking distance, in-vehicle travel time, waiting time, number of destinations served and number of transfers needed to reach destinations (Sabyasachee et al., 2012). The extent to which the routes are integrated and coordinated also determines how connected a transport system is (Lam et al, 1982). Network connectivity can be used as a measure to study the performance of the transit system which will assist decision makers in prioritizing transit investment and deciding which stops/lines need immediate attention in regard to operation and maintenance (Hadas and Ceder 2010).

2.7.1 Components of connectivity

From the definition of connectivity and principles underlying graph theory, Oxera (2010) evolved two components of connectivity:-

Available destinations-this refers to available range of destination. In terms of the graph theory it captures the number of nodes available with edges between them and origin of interest. Oxera (2010) further explains that the value of additional destination implies the different basket of characteristics in every destination that would offer net benefit to an individual who travelled to that destination. These include factors and characteristics such as the number of businesses located there, the population, the tourist attractions and the climate.

However, the number of available destinations on its own may not give a complete assessment of this aspect of connectivity because not all potential destinations may be of
equal importance (Lam et al, 982). The importance of each connection to a potential destination ideally needs to be defined and measured. This relates to approaches in transport modeling whereby trip generation is inspired by the attractiveness of available destinations.

**Generalized costs** - it is the reasonable cost for traveling to an available destination. This suggests that the degree of connectivity between particular O–D pairs reflects the generalized cost of travelling between them. Journeys with high generalized costs will therefore contribute less to connectivity than less expensive journeys (Sabyasachee et al., 2012).

Generalized cost can therefore be used to represent the strength of a connection. In terms of graph theory it is viewed to represent the strength or thickness of each edge. In the context of gravity theory, transport demand is likely to reflect both the economic importance or size of the origin or destination concerned (a positive relationship) and some measure of separation, such as distance or generalized cost (a negative relationship). Oxera (2010) further explains that transport models which incorporate a degree of separation can take into account factors such as service frequency (through generalized cost) and can thus indicate that, even if two nodes are connected, the connection may be quite weak (e.g., a ferry service running once a week). Parameters from such models could be used to measure the strength of particular connections. Such measures could use some combination of time, distance and cost as the measure of separation.
Another component of generalized cost is journey time reliability, and in this context the number of different routes between particular Os and Ds—the edges in graph theory—may be relevant. The more routes available, the less unreliable journey time may be, because options are available to switch routes when others become more congested or unreliable. This may be important for some aspects of international connectivity—for example, when alternative routes are available for rail travel between cities.

The context used by Oxera (2010) to explain connectivity in transport was inclusive of;

- Connectivity for particular O–D pairs is relevant to analysis of travel between them and for other consequential effects;
- Connectivity of particular places is relevant to location decisions for businesses and people, and to economic characteristics such as degrees of competition and openness to trade;
- Connectivity of networks or sub-sets of networks has a bearing on policy decisions and priorities.
- Accessibility to transport hubs

The concept of connectivity applies to all modes of transport; however connectivity provided by specific mode may be particularly important in some context. Connectivity provided by individual modes may affect mode choice for particular journeys, and some modes may in practice dominate for some types of travel ((Sabyasachee et al., 2012)). Transport connectivity applies to all transport users; however connectivity may vary depending on journey purposes.
The literature review accompanying suggests that changes in connectivity of a place will have effects on:

- Transport user benefits;
- The location of people and businesses;
- The degree of competition in markets;
- Employment, productivity and trade

The aim of this research is to determine the potential impact of railway infrastructure on connectivity within Nairobi metropolitan.

2.8 Transport connectivity models

Attempt to model transport connectivity can be divided into three categories of research approaches:

2.8.1 Network theory model

The theory uses a natural network of well defined nodes (destinations) and arcs (flights or trips), and models transportation system using topology and mathematical graph theory. This model has been used in gauging air transport connectivity in past studies; Ivy (1993) constructed origin-destination matrices and used graph theory concepts and linear algebra to measure the connectivity for the largest hub airports in the United States. Network theory models analyze transport connectivity as a theoretical mathematical problem only, often failing to account the other competitive forces of transport connectivity hence giving different patterns of connectivity.
2.8.2 Temporal sensitivity models

The temporal sensitivity models developed by Veldhuis (1997), Bootsma (1997), Burghouwt and de Wit (2005), and others use time-of-day schedule data and “minimum connection time” rules to construct itineraries for passengers at individual airports or destinations. These transport models has been used to assess change in travel time in relation to monetary cost for operation of small airports.

These models have down sides as they requires constructing feasible itineraries and the use of much more detailed datasets, making these models harder to generalize across hundreds of airports in a country, or across multiple years of schedule data. Airline schedules change frequently, making it unclear which days or weeks to select for the itinerary construction.

2.8.3 Intuitive metrics models

These models developed by Arvis and Shepherd (2011) are often simpler than the network theory and temporal sensitivity metrics, and they possess some attractive features (Michael et al, 2013). Using a simpler model reduces the data requirements necessary for computing connectivity, making it easier to create connectivity scores for many destinations across a number of years. The models are also easier to understand for readers without mathematical training, and can make more sense when viewed in the context of the strategic decisions made in the transport industry. These models have been regarded as reliable by Pearce (2007) and Reynolds-Feighan and McLay (2006) as they not only measure quantity of available service and destination but also the quality of those destinations.
These models have limitations of neglecting the connectivity itineraries, hence only usable in limited contexts such as when computing connectivity for airports that are only served by ultra-low cost carriers, on which passengers generally fly only point-to-point), the advantages of nonstop service to a hub airport are lost when connecting traffic is not considered.

2.8.4 New Intuitive metric model

This model developed by Michael and Williams (2013) in a study to assess changes in connectivity between smaller airports in US, takes into account the possibility of connecting itineraries. The model retains the benefits of the existing intuitive metrics, as it is easy to compute and apply across many airports/destinations and many years of data. The model involves weighting of destinations, services available, travel time and generalized cost of travel. Since the metric is easier to understand than topology and mathematical graph theory, it is more likely to inform the policy debate.

The study has adopted a combinational of network theory model, temporal sensitivity and intuitive models on transport connectivity to develop a conceptual framework describing factors that would improve railway transport connectivity in Nairobi metropolitan. The graph theory is only used to show importance of connectivity, while the intuitive metric models on the emphasis of other competitive factors that affect transport connectivity such as the quality of services available.

2.9 Conceptual framework

Transport connectivity is a function of frequency of available scheduled trips, the quantity and quality of destination served, and quantity and quality of transport modes of
connecting destination (Michael et al, 2013). The net worth of a destination, its attractiveness, and cost of travel to the destination influences its transport demand hence the need for increased connectivity and accessibility. Other factors that influence transport connectivity between a destination and an origin is the quality of services available, service frequency, travel time, transit coverage and environmental sustainability of the mode of transport.

The railway transport system in Nairobi Metropolitan is a defined by policy and regulatory framework and existing physical rail infrastructure. It is the role of public and public sector to ensure streamlined management and operation so that benefits such as increased net benefit of an urban areas, services quality, cheaper transport, environmental protection, reduced travel time are accrued.
Figure 4-Conceptual framework-showing the relationship between railway infrastructure and sustained and improved connectivity

Rail transport policy and regulatory framework
- Management of KRC
- National government role
- Public Private Partnership

Railway Infrastructure
- Railway stations
- Railroads and tracks
- Railway services operation
- Condition of wagons and locomotives
- Safety measures

Private sector
- Integration and coordination of rail systems
- Maintenance systems

Public sector
- Policy decision and priorities
- Infrastructure development

Economic benefits
- Increase net benefit of destinations
- Reduced cost of travel

Social factors accrued
- Service quality
- Service frequency
- Journey time reliability

Infrastructure Improves
- Transit coverage,
- Transport schedule
- Operation capacity
- Urban form characteristics
- Transport speed

Environmental factors
- Environmental quality
- Environmental protection

Sustained and improved connectivity

Source: Author (2014)
CHAPTER THREE

STUDY AREA

3.1 Location

The study was carried out in Limuru town (Limuru Municipal Council) and immediate surrounding environments that benefit from the town such as milk processing plants. The town is located within Kiambu County and Nairobi Metropolitan, approximately thirty five kilometers north of Nairobi County and along the Nairobi-Nakuru highway. Kiambu County is located between longitudes $36^\circ 50'$ and $37^\circ 00'$ east and latitudes $1^\circ 15'$ and $1^\circ 10'$ south and it lies at an altitude of 1795 m above sea level. The Limuru Municipal Council covers 156 sq Km and is also located 12 kilometers from the edge of the Great Rift Valley. The town and surrounding environments consist of generally hilly terrain which makes construction and maintenance of railway lines and other infrastructures expensive and labour intensive.

![Figure 5-Map of Kenya showing Kiambu County and its location in Nairobi Metropolitan](image)

Figure 5-Map of Kenya showing Kiambu County and its location in Nairobi Metropolitan
Figure 6- Location of Limuru in the Nairobi Metropolitan Region and in Kiambu County (www.kiambucounty.co.ke)
3.2 Historical background

The history of Limuru town dates back 1890s during the British Colonial period when the Europeans settled in Limuru due to its proximity to Nairobi city, favorable climate and the presence of the railway line and railway station. Most of the surrounding areas in Limuru were previously referred to the ‘white highlands’ as it was among the first areas where the colonial government introduced tea, coffee plantation and dairy farm ranches. The Limuru railway station was a key transport element served as a transit and destination point for travelers. It is the railway line that spurred the growth of one of the

Figure 7—showing the location of Limuru town and location of the railway line (Source: Google Earth)
oldest industry in Kenya; Bata Shoe Company in the early 1904 as it provided efficient transport of finished products and raw materials.

3.3 Land uses

The main economic activities in Limuru town and surrounding areas include farming, due to rich agricultural land; large scale farming include tea, coffee, pyrethrum and horticultural farming, while small scale farming include carrots, potatoes, vegetables, legumes. Livestock farming include dairy, poultry, pig and sheep farming. The town has several manufacturing and processing industries such as Bata Shoe Company, Limuru Polypipes Products, Limuru Milk Processors and many tea factories located outside the town within the tea plantations. The center of the town is dominated by commercial activities ranging from the open air market, Jua Kali artisans to other different types of businesses. Residential developments form 35% of land use within the town and surrounding areas. As population within the town increases, land uses such as residential and industries are expected to diversify by 2030 as indicated in Figure 8 and 9.
Figure 8-Projected Occupational structure in 2030

Source: Spatial Concept Plan for Nairobi Metropolitan, 2011

Figure 9-Projected Land use distribution in 2030

Source: Spatial Concept Plan for Nairobi Metropolitan, 2011
3.4 Environmental data

3.4.1 Rainfall

Limuru town located in Kiambu West District falls in agro-climatic highland zone and is well-watered humid with annual rainfall average of 1100 mm - 2700 mm that should support rain-fed agriculture. The food crop productivity is high since climate is cool-wet and the town experience favourable conditions for plant growth almost throughout the year. Rainfall pattern in Limuru is mainly bi-modal (two rainfall seasons in a year). The major season occurs in March to May (the long-rains season) while the other season (short-rains) occurs in October to December (Abuodha & Omunge, 2004).

3.4.2 Soils

Limuru divisions have well-drained, deep, brownish and loamy soils with moderate water holding capacity and favors agriculture. The swampy areas in Limuru such as Manguo swamp have clay soils difficult to plough when wet or dry hence the swamps are utilized as graze fields for animals. Limuru constituency has two gazetted forests (Ngubi and Kiahiti forest) though the forests extend into other constituencies.

3.4.3 Topography and drainage

The topography of Limuru town is gently hilly with altitude of 1795 above sea level, Plate 1. The hilly topography poses challenges in construction and maintenance of the railway line with some parts of the railway line being elevated and in others tunneled underground Plate 2. The topography also contributes increased cost of installing rail and road infrastructure.
3.5 Transport infrastructure

The main mode of transport within Limuru town is by road, the town is accessed through tarmac roads and a few gravel roads. In the early 1980s the railway line was significant in offering passengers and cargo services in Limuru town. Passengers could be picked and alight at the railway station and then walk or use public service vehicles to reach their destinations out of the town. The Limuru railway station is no longer functional as can be seen from the Plates 3 and 4:-

Source: Field Study, 2014
3.6 Population

The town under study has a population of approximately 113,578 (Kenya Census Report, 2009) which is projected to increase with 15% in the next five years. The Municipal council of Limuru (ibid) generated approximately 20,000,000 shillings in 2008 as revenue hence the town can be described as having economic significance within the Nairobi metropolitan.

Table 3-Population forecast for Northern Nairobi Metropolitan

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Spatial Units</th>
<th>2009</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>Ruiru</td>
<td>238,858</td>
<td>973,911</td>
</tr>
<tr>
<td>ii.</td>
<td>Thika</td>
<td>139,853</td>
<td>570,232</td>
</tr>
<tr>
<td>iii.</td>
<td>Limuru</td>
<td>113,578</td>
<td>625,196</td>
</tr>
<tr>
<td>iv.</td>
<td>Kiambu</td>
<td>88,869</td>
<td>362,351</td>
</tr>
<tr>
<td>v.</td>
<td>Juja</td>
<td>40,446</td>
<td>164,913</td>
</tr>
<tr>
<td>vi.</td>
<td>Kikuyu</td>
<td>234,053</td>
<td>954,320</td>
</tr>
<tr>
<td>vii.</td>
<td>Karuri</td>
<td>129,934</td>
<td>529,788</td>
</tr>
<tr>
<td></td>
<td><strong>Sum (i-vii)</strong></td>
<td><strong>976,295</strong></td>
<td><strong>3,980,712</strong></td>
</tr>
</tbody>
</table>

Source: Spatial Plan for Nairobi Metropolitan Region of Kenya, 2011
CHAPTER FOUR
RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

This chapter focuses on the methodology that was used in carrying out the study, in evaluation of the potential impact of railway infrastructure on connectivity in Nairobi Metropolitan-case of Limuru town. The chapter also entails data collection and data analysis methods used.

4.2 Research design

The research carried was explorative as the researcher sought to measure various variables such as reliability of railway transport. The research design adopted was structured to obtain complete and accurate information. The objective of using the design was to get information from people, where individuals described what existed with respect to variables or factors under study (Kothari, 2004). Research design aimed at minimizing biasness and maximizing reliability. A good sample would be necessary to ensure results obtained would be helpful in evaluation of potential impact of railway infrastructure on connectivity. A survey of the pre-existing conditions, analysis of variability of variables/factors understudy, and measure of central tendency to describe any changes, were some of the areas covered by the methods involved. The research design touched on location of the study, the sources of data and target population, methods of sampling the population and data collection methods and also presentation and analysis of that data.
4.3 Sources of Data

4.3.1 Primary sources of data

Primary sources of data included households in Limuru town, resource persons from relevant institutions including Government ministries and business community in the town.

4.3.2 Secondary sources of data

Secondary sources of data included all the information that was retrieved from existing literature for the purposes of this study. This information was contained in publications, books, annual/quarterly reports, journals, Development plans, periodicals and existing spatial information like maps of the study area.

4.4 Target population

The study was conducted within Limuru Town and various departments, as this is where the population of interest was majorly located. The target population consisted of; Kenya Railway Corporation, Ministry of Transport service and Infrastructure-department of transport, Rift Valley Railways, residents of Limuru town and business community within two kilometer of Limuru town. The population of Limuru town was approximated at 113,578 persons hence the sample size for household was determined using the formula recommended by Nassiuma (2000) as follows:
\[
\frac{NCv^2}{n} = \frac{1}{(Cv^2 + (N-1)e^2)}
\]

Where \( n = \) sample size

\( N = \) population

\( Cv = \) Coefficient of variation (take 0.5)

\( e = \) Tolerance of desired level of confidence, take 0.05% at 95% confidence level

After using the above formula the sample size was found to be 115, hence forming a target population for the households. Through the researcher’s experience with the area of study business categories were identified namely: transport and communication, manufacturing and processing, educational, farming, hospitality, health services and banking and five businesses were selected under every category. Hence a total of 35 business questionnaires were administered to respective businesses.

**4.4 Sampling technique and procedures**

**4.4.1 Simple Random Sampling**

In this method every member of the population had a known and equal chance of being selected (Kothari, 2004). During the administration of household and business questionnaires, transects were identified from inner most of the town to 2km radius outer most part of Limuru town.
4.4.2 Purposive Sampling

Purposive sampling also referred to judgmental, selective or subjective sampling; the procedure relies on the judgment of the researcher when it comes to selecting the units (e.g., people, cases/organizations, events, pieces of data) that are to be studied. This form of sampling assisted the researcher in getting specific information from a particular population of interest such key informants from Kenya Railway Corporation. It is through purposive sampling that administrative offices and major industries in Limuru Town were identified and interviews carried out.

4.5 Methods and instruments for Data Collection

Various methods and instruments of data collection were used and these included the following;

4.5.1 Observation

Physical aspects that were relevant to the study such as the physical condition of railway infrastructure in Limuru town were obtained through observation and recorded in an observation checklist (Appendix III). This data was very useful in verifying the other data collected through questionnaires.

4.5.2 Literature review

To document the progress made in restructuring railway transport in the Nairobi metropolitan, extensive search and review of relevant literature was carried. The published and unpublished sources provided statistical data on freight haulage levels, and socioeconomic potential of railway transport. The researcher visited various institutions including Kenya Railway Corporation headquarters and Ministry of Transport and Infrastructure, where some of the printed literature was obtained.
4.5.3 Photography

During the visit to the area of study photographs were taken and provided useful data such as illustrating topography of the town and land use distribution along the railway reserves.

4.5.4 Interviews

4.5.4.1 Oral interview guide

This method involved collection of data through face to face interaction with persons in the population of interest. Structured interview schedules were also used (Appendix I &II), where the interviewer sat with the respondent and administered structured questions. The interviews were conducted through visiting the administrative offices, industries and railway transport management offices. A pilot study before the actual interviews was undertaken to ensure final schedules were well formulated. Questions for the interview were well clarified to ensure respondents give clear answers hence increase data validity and accuracy.

4.5.4.2 Questionnaires

Data was also collected using questionnaires which consisted both open and closed questions. The open question gave the respondent a chance to express their feelings while in the closed questions the respondent was required to rank variability of various factors. The questionnaires were distributed to the sampled groups of respondents through drop and pick method, and they were given a few minutes to fill while some were left and picked later.
4.6 Data Analysis

Quantitative and qualitative method of data analysis was selected. Data gathered through the personal interviews was analyzed qualitatively and was used to make comparison with quantitatively analyzed data from questionnaires. Descriptive analysis was carried out, which as (Kothari, 2004) suggests as analysis of distributions of one variable which provides us with profiles of groups, persons and other subjects on any of the multiple characteristics such as size, frequency, preferences and efficiency. This data was presented using tables, pie charts, graphs, diagrams and frameworks of the flow of different scales brought up by respondents. The SPSS (Statistical Package for Social Sciences) package was used to analyze data. Descriptive statistics such as means, frequency, percentages, and frequency distribution were used to meaningfully describe the distribution measurement.

4.7 Study Limitation

Major limitations experienced while carrying out the study were inadequate time for data collection and also lack of cooperation with key informants especially from the government ministries.
<table>
<thead>
<tr>
<th>Objectives</th>
<th>Type of data and variables</th>
<th>Respondent/data collection</th>
<th>Method of data analysis and presentation</th>
</tr>
</thead>
</table>
| **Objective 1** | Primary and secondary data  
  • Effects of policy and regulatory framework  
  • Railway coverage  
  • Railway operation | Primary data & secondary data  
 Institutions- interview schedules | Statistical , flow charts, tables and graphs |
| **Objective 2** | Primary data  
  • Condition of railway infrastructure  
  • Operation capacity  
  • Reliability of the railway transport | Analysis of past statistics, household and business questionnaires | Statistical data in tables and graphs |
| **Objective 3** | Primary data  
  • Net benefit  
  • Destination characteristics  
  • Attractiveness of the destination  
  • Agglomerated benefits | Analysis of past statistics  
 Households, business owners- questionnaires -observation checklists | Statistical analysis using SPSS, graphs, tables, frequencies |
| **Objective 4** | Primary data  
  • Transport cost  
  • Operation capacity  
  • Influence on urban form characteristics  
  • Journey time  
  • Service quality  
  • Environmental effects | Households, industries, business owners- questionnaires | Statistical analysis using SPSS, graphs, tables, frequencies |
| **Objective 5** | Primary & secondary | Analyzed literature & study findings | Planning matrix, tables |

Source: Author (2013)
CHAPTER FIVE
RESEARCH ANALYSIS, FINDINGS AND DISCUSSION

5.0 Introduction
This chapter covers data analysis, discussions and findings of the research. The data was summarized by means of statistical averages (including rankings) and presented in form of graphs, tables and charts.

5.1 Policy and regulatory framework on railway development in Kenya

5.1.1 Legal and institutional framework
From field survey 65% of the respondents were not familiar with management of railway network connecting Limuru town to Nairobi City, Figure 10. The argument was that since the railway station was not operational there was no management. However the railway line cutting across the town is still utilized for cargo haulage from Mombasa to Kenya-Ugandan border but the trains do not make any stops at Limuru Railway Station.

Figure 10-Respondent awareness on management of railway between Limuru and Nairobi

Source: Field study, 2014
The Limuru Railway station was utilized for passenger services and commuters would travel to towns near Limuru such as Kikuyu, Lari, Dagoretti that had other railway stations. Management of Railway network in Kenya is carried out and regulated by various institutions and a given legal framework as discussed below.

5.1.1.1 Kenya Railway Corporation (KRC)

Kenya Railway Corporation is the main institution in charge of managing railway in Nairobi metropolitan. The corporation was formed under the Kenya Railways Act of 1978 which was later amended in 2005. The Kenya Railways Strategic Plan 2007-2012 was a foundational document that was revised in 2008, it reflected what Kenyans wanted from transport industry: affordable and efficient mode of transport with the perception that the railway was the most preferred mode for passengers and freight. Secondly, timely and reliable transport to facilitate movement of people and cargo in a safe, efficient, cost effective and predicable manner. The Plan spurred the key objectives of the corporation and implementation of most railway projects.

The Sessional Paper on integrated National Transport Policy identified key challenges or hurdles experienced by Kenya Railways that have hindered growth and development. The major ones outlined were; stiff competition from road and pipeline transport, unreliable ageing infrastructure and rolling stock particularly the single track, bridges, telecommunication, signaling and other facilities; lack of investment by the Government, KRC and the Concessionaire; and limited railway coverage.

Most of the Acts of Parliament under transport are more inclined on roads as a major mode of transport for instance the Traffic Act of 2012 and National Transport and Safety Authority Act 2012 focuses on road safety and operation of motor vehicles.
5.1.1.2 Ministry of Transport and Infrastructure

The Transport Department under the Ministry of transport and infrastructure ensures development of regulatory framework and oversees delivery of services by the corporation through formulation of relevant legislations, policy direction and performance monitoring and evaluation. KRC has the mandate of providing efficient and effective railway services, providing skills and technology for the railway sector and promotion, facilitation and participation in national and metropolitan railway network development.

In the Ministry of Transport Strategic Plan the strategic objective of the railway department is to increase passenger and freight traffic using rail network and promote private investment in the rail sub sector. The strategies according to the Plan were; develop new legislation and review rail enabling legislation; develop a railway bypass in Kibera and Mukuru; implement KRC support component of East Africa trade and transport facilitation project; develop guidelines for private sector participation in railway operation and development and to monitor and evaluate the railway sub sector performance.

5.1.1.3 Vision 2030

The corporation plays the role of realization of Vision 2030; to firmly interconnect the country through a network of roads, railways, ports, airports, water and sanitation facilities and telecommunications. To realize the Vision 2030, Kenya railway Corporation has laid out strategies such as enhancing private sector participation in the provision of infrastructure, developing and maintaining an integrated, safe and efficient transport network and benchmarking infrastructure with globally acceptable standards.
Some of the flagship projects in line with Vision 2030, being carried out within Nairobi metropolitan by the corporation include Nairobi mass transit commuter rail service development, LAPSSET to facilitate rail transport from Lamu port to South Sudan, Northern Kenya and Ethiopia, and installation of a standardized railway gauge from Mombasa to Kisumu and to Ugandan border.

The Kenya Railways Strategic Plan 2012-2017 is an ambitious plan through which the corporation and the government aims to ensure that railway transport plays its rightful role in improving national competitiveness and the quality of life for all Kenyans by providing safe, efficient and reliable transport services for passengers and goods. The Plan was prepared through consultation with customers, stakeholders, the government, and Kenya Railways Board of Directors and Management. The strategic plan is aligned with Kenya Vision 2030 which is the country’s long term strategy and blue print, Sessional Paper on Integrated National Transport Policy, Ministry of Transport Strategic Plan, East Africa Community Transport Master plan, and Economic Recovery Strategy for Wealth and Employment Creation.

5.1.1.4 The Constitution of Kenya

The Constitution of Kenya defines the role of county governments in their role to ensure socio-economic growth in their respective counties hence the need to work with the Kenya Railways to ensure economic viability and opening up of business opportunities through the railway network. The Kiambu County through their strategic plan supports the proposal of introducing a commuter train from Limuru Town to Nairobi as a way of spurring economic growth and opening up business opportunities in the county. The
strategic plan also supports the proposal for building a railway line connecting Kiambu town to Thika and Ruiru to facilitate efficient transport within the county.

5.1.1.5 Rift Valley Railways (RVR)

In 2006, the Rift Valley Railways Consortium led by South African companies took operating control of the Kenya and Uganda railways as part of a contract lasting at least 25 years. After criticism from the Kenya Railways Corporation, RVR doubled the frequency of service, and also imposed restrictions to reduce derailments on the ageing infrastructure.

RVR run passenger trains within Kenya only, primarily from Nairobi to Mombasa but also to local towns such as Kisumu. Passenger services on these lines are offered on peak periods only. Freight services are the bulk of RVR's operations. Major challenge faced by RVR was to source funding for operating railway services and for rehabilitating the dilapidated rail infrastructure.

Changes in ownership of RVR have partly affected their operation with increased perception that there are minimal profits accrued from railway services in Kenya. Tax policies and railway services subsidization have partly affected RVR through increased competition from other modes of transport such as the road and the pipeline.

5.1.1.6 County Government

Kiambu County government in their County Integrated Development Plan (2013-2017) have a proposal for rehabilitation of railway line from Limuru to Nairobi, the railway station and the associated car park and introducing commuter train services. The proposal aims at reducing traffic congestion on roads from Limuru to Nairobi and also the
opportunity to open up the town for investment through increased freight services and passenger commuter trains services.

5.1.2 Policy Framework

Key policies that influence operation of railway infrastructure in Nairobi Metropolitan include The Integrated National Transport Policy 2010 that aims at developing, operating and maintaining an efficient, cost effective, safe, secure and integrated transport system that links the transport policy with other sectoral policies, in order to achieve national and international development objectives in a socially, economically and environmentally sustainable manner. Some of the sectoral policies linked to integrated National Transport Policy 2010 include the draft National Energy Policy 2012 with overall objective of ensuring affordable, sustainable and reliable supply to meet development needs, while protecting and conserving the environment.

The poor performance of KRC can largely be attributed to inappropriate policies, especially reliance on “public monopoly” administrative structures, poor determination of tariffs, indirect subsidization of services and preference for national rather than regional approaches.

5.1.3 Stakeholder’s participation

The government is the main stakeholder in management, operation and rehabilitation of railway infrastructure Figure 11. Government investment in current rail transport development amount to US$ 60million, the money is to be utilized for upfront development costs, building new infrastructure (stations and railway tracks), rehabilitation of existing tracks and rehabilitation and modification of existing rolling
stock. Private sector is the other key stakeholder, and plays the role of developing infrastructure through an Engineering, Procurement and Construction (EPC) contract, providing and maintaining rolling stock and operating the commuter rail system. RVR is one of the private companies currently involved in operation of train services in Kenya.

Figure 11-The Kenya Railway Public-Private Partnership

Source: (Adopted from News Rail, 2013)

5.2 Socioeconomic contribution of Limuru town as part of Nairobi Metropolitan

The researcher wanted to establish the socioeconomic viability and potential of Limuru town as a destination that can promote use railway transport. From the field survey and analysis of past statistics the following information was gathered under key sectors and areas that influence the economy of Limuru town.
5.2.1 Agriculture and Rural development

This sector comprises of agriculture, livestock development, lands, forestry and wildlife and fisheries development. Limuru constituency is predominantly agricultural with the sector earning the constituency and the district a lot of income both at the household and institutional levels. Limuru town is located in Kiambu West where 75% of land is preoccupied by agricultural activities, 678.6km² constitute arable land and with increasing population land is highly subdivided into small uneconomical units. This sector employs more than 80% of the rural population and therefore contributes greatly to employment. As shown in the Table 5, agricultural sector largely influences the economic growth of Limuru town and the larger Kiambu District.

Table 5- Statistics on agriculture profile Kiambu West

<table>
<thead>
<tr>
<th>Crop Farming</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average farm size (small scale)</td>
<td>0.7 Hectares</td>
</tr>
<tr>
<td>Average farm size (large scale)</td>
<td>4 Hectares</td>
</tr>
<tr>
<td>Percentage of farmers with title deeds</td>
<td>80%</td>
</tr>
<tr>
<td>Total Acreage under food crops</td>
<td>237 hectares</td>
</tr>
<tr>
<td>Total Acreage under cash crops</td>
<td>5,800 hectares</td>
</tr>
</tbody>
</table>

**Livestock Farming**

| Dairy farming                      | 78,584 animals   |
| Sheep farming                      | 53,537 animals   |
| Pig farming                        | 19,295 animals   |
| Poultry farming                    | 734,625 animals  |

**Milk Production (Annually)**

| Ksh. 1, 082, 162, 700               |
| 60,120,150 litres                   |

**Poultry meat production (Ksh)**

| Ksh. 69,077,700                     |
| 460,518 Kgs                         |

**Pork production**

| Ksh. 14,860,000                     |
The main food crops grown are maize, beans, potatoes and vegetables whereas major cash crops are coffee, tea, pyrethrum, horticulture and flowers. Main food processing factories located within Limuru and around the town include Farmers’ Choice Ltd, Ken Chic Co. Ltd, Limuru Milk Processors, Maramba Tea factory, Karirana Tea Factory, Ngorongo Tea factory, and Limuru Horticulture Processing industry. The railway network would promote growth of agricultural production through facilitating movement of produce and also of raw materials such as fertilizers.

5.2.2 Trade and Industry

Though most of the industries around Limuru town are agricultural based, there are a few manufacturing industries namely Bata Shoe Company, Poly pipes Ltd and Jua Kali sector. Bata Shoes Company has been in existence since 1903 has greatly influenced growth of Limuru town and surrounding regions. The company has more than 17,000 employees and contributes a large portion of revenue to Kiambu county and former Limuru municipal council. From the field survey, it was established that the railway line played a significant role to the growth of Bata Shoe Company. Skins and hides used in the company for manufacturing were initially transported through the railway line for tanning until early 1990s when part of the processing was relocated. Dilapidation and poor maintenance of the railway infrastructure contributed to the company shifting entirely to road transport which is more reliable. Poly pipes Ltd has also significantly contributed to the economic growth of Limuru town as it employs between 200-300 workers, and their products are sold country wide.
Jua Kali sectors contribute to informal employment in Limuru town and also as a growing light industry. The sector is characterized by localized technology and utilizes the road reserve as their enterprise for selling and displaying their wares.

From the field survey the businesses engaged in Limuru town included farming, processing and manufacturing, transport and communication, educational, banking, tourism and hospitality and health services. Educational based businesses were the majority constituting of kindergartens, primary schools, secondary schools, colleges, and driving schools. Though banking was rated the lowest from data collected through observation Limuru town had several financial institutions such as banks, co-operative societies, and money transfer businesses for example M-pesa, Airtel money.

Figure 12-Different types of businesses in Limuru town

Source: Field study, 2014

Other elements that contribute to trade in Limuru town include presence of an urban market that accommodates more than 2000 traders; financial institutions namely banks,
village banks, building societies and micro-finance institutions; supermarket outlets, general merchandise shops, hotels and storage facilities. Kiambu west has approximately 2,517 trading centres with 6,634 registered retail traders and 750 registered wholesale traders (Kiambu West District Development Plan 2008-2012). As part of spurring economic growth in Limuru town, Kiambu County government has proposed to modernize and expand the urban market to attract more traders into the town.

5.2.3 Population profile

Records sourced from district statistical office, Kiambu West indicated increase in population by 7.5% in Limuru town from 1999 census to estimated population in 2012. The overall male-female ratio for Limuru constituency stood at 0.98:1 in 2009 and it was a fairly balanced sex ratio. The male population was thought to be lower due to proximity of the town to Nairobi and the argument that most have migrated to the city in search of employment. As shown from the Table 6 population has continually increased over the years and it is projected to rise by 15% in the next five years.

Table 6-Population Projection by constituencies

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Limuru</td>
<td>96,417</td>
<td>98,104</td>
<td>194,521</td>
<td>113,337</td>
<td>115,357</td>
<td>228,730</td>
<td>121,835</td>
<td>123,970</td>
<td>245,805</td>
</tr>
<tr>
<td>Kikuyu</td>
<td>56,651</td>
<td>56,927</td>
<td>113,578</td>
<td>66,614</td>
<td>66,938</td>
<td>133,552</td>
<td>71,588</td>
<td>71,934</td>
<td>143,522</td>
</tr>
<tr>
<td>Lari</td>
<td>54,628</td>
<td>56,674</td>
<td>111,302</td>
<td>64,235</td>
<td>66,441</td>
<td>130,876</td>
<td>69,031</td>
<td>71,615</td>
<td>140,646</td>
</tr>
<tr>
<td>Total</td>
<td>207,696</td>
<td>211,750</td>
<td>419,401</td>
<td>244,222</td>
<td>248,936</td>
<td>493,158</td>
<td>262,459</td>
<td>267,519</td>
<td>529,978</td>
</tr>
</tbody>
</table>

Source: District statistical Office, Kiambu, 2009
From the field survey 37% of the population of interviewed in Limuru town work in Nairobi City, while 46% worked within Limuru town and 17% in towns around Limuru. As gathered from the interview with Kenya Railways the proposal to introduce commuter trains services was a projection would be based on the population of the origin which can be moved from one place to another. On average, only about 19,000 passengers are transported per day to and from the outskirts through the commuter train service, amounting to less that 1% of the total daily commuters in the city.

**Figure 13-Respondents’ place of work**

![Bar chart showing place of work distribution.]

Source: Field study, 2014

From the interviews conducted among the business community in Limuru town it emerged that 48% of the respondents were aged between 31-40 years contributing to the highest portion of people engaged in businesses. Based on the statistics approximately 72% of the businesses in Limuru town are operated by young people below the age of 40.
years hence an indication of much potential of attracting a larger population of the youth in search of employment.

**Figure 14-Age of respondent**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-30 yrs</td>
<td>24%</td>
</tr>
<tr>
<td>31-40 yrs</td>
<td>48%</td>
</tr>
<tr>
<td>41-50 yrs</td>
<td>8%</td>
</tr>
<tr>
<td>51 and above</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: Field study, 2014

### 5.2.4 Physical Infrastructure

This sector comprises of sub sectors such as transport, energy, housing and public works. The main mode of transport utilized in and out of Limuru town is bitumen road, graveled road and earth surface roads. From Districts Roads Office, Kiambu West, 2008 Limuru Division has a total of 195km length of roads, where 100km is bitumen, 50km gravel and 45km earth. However most of the roads within Limuru town are poorly maintained and poor drainage has been the main contributing factor. Other key elements of transport infrastructure in the town include a bus park with an average capacity of 250 vehicles and a railway station which has fallen into disuse. From observation the bus park lacks key
utilities such as street lighting, garbage bins and lack of proper maintenance of the access roads.

From the field survey 72% of the household utilized public service vehicles to travel in and out of the town, while a significant portion of the population used motorcycles as the means of transport. The unutilized railway transport has monopolized public transport to roads and to usage of public service vehicles.

**Figure 15-Means of transport used by respondent**

![Pie chart showing the distribution of transport modes used by respondents.](source)

Source: Field study, 2014

Problems encountered through the different modes of transport ranged from high cost of travel, to poorly maintained roads, increased traffic deaths, unregulated public transport to changing or wavering taxes on transport. From the statistics in Figure 16 increased cost of travel was the main problem associated with different means of transport attributed to rising cost of fuel and taxes levied by the local government.
Electricity is the main source of energy utilized within the town with 76.3 households supplied with electricity. 75% of structures within Limuru town consist of housing where majority are privately owned, 20% constitute of informal settlement (Misri slums) and only a small percentage are owned by the Kenya Railway and former Limuru Municipal council. From observation most of structures under construction are for housing hence increasing opportunities for attracting a larger population in search of affordable housing outside Nairobi County. Limuru Waste and Sanitation Services Company Limited is the institution in charge of water and sanitation and operate the piped water supply and sewer systems in the town.

5.2.5 Governance, Justice, Law and Order

Constitutionally Limuru town is under Kiambu County and Limuru Constituency and any economic developments within the town are determined by the county government. In
the Kiambu County Integrated Development Plan (2013-2017), the county government has proposed to carry out numerous development projects to spur economic growth in Limuru Constituency which include; modernizing the Limuru Railway station by introducing a car park and commuter train services, rehabilitating Limuru open air market, modernizing Limuru Horticulture factory, rehabilitating the bus park, and repair and maintenance of access roads. Since Limuru town is surrounded by agricultural hinterland modernizing the open air market and the horticulture factory will increase business opportunities and trading. Rehabilitating access roads, modernizing the railway station and bus park are projects aimed at opening up the town to more investment and facilitating movement of people, goods and services out and into the town.

Limuru town hosts Limuru sub-county offices and Kiambu West District offices that provide leadership, policy direction and security, the rule of law and administration of justice. The town has a law court that facilitates administration of justice. As gathered from the Kiambu West District Development Office robbery with violence, drunkenness, stealing are major crimes that have interfered with social, economic and political development. However crime rate has declined from 2,212, 1,523 and 1,468 cases reported in 2005, 2006 and 2007 respectively.

5.2.6 Research, innovation and technology

Communication in Limuru town is served by all main mobile service providers i.e. Safaricom, Airtel, Telkom, and Yu. The Limuru post office has also contributed to communication in the town though currently facing huge competition from courier services. ICT development has been enhanced with most financial institutions in Limuru town offering computerized banking services. More ICT development is expected with
establishment of fiber optic cable connection into the town. Limuru constituency has one university namely St Paul University, located at Kabuku, 6km from Limuru town; the growth of the university and other tertiary institution have spurred growth of local economy through the population attracted by the institutions.

5.3 The physical condition of railway infrastructure in Limuru town and how it has influenced railway transport

5.3.1 Unreliability of railway transport

The researcher observed that 48% (Figure 17) of households’ respondents strongly agreed that railway transport in Limuru town was unreliable. Railway operation in Limuru town was reliable in early 1980s and passenger services were available for long distance such as from Limuru to Gilgil and to Nakuru, commuters would also travel to closer towns along the railway line such as Kikuyu and Dagorreti. The Nairobi sub-urban commuter services were described as only connecting a small portion of Nairobi East lands sub-urban areas and west of Nairobi to the city centre.

Figure 17-Unreliability of railway transport between Limuru and Nairobi

![Bar chart showing unreliability of railway transport between Limuru and Nairobi]

Source: Field study, 2014
The trains run 6 days in a week during the morning and evening peak hours and unlike road transport which is available for more hours, train services does not experience traffic jams.

5.3.2 Poorly maintained railway infrastructure

The researcher observed Plate 5 and 6, that railway infrastructure in Limuru town was run down, the railway stations, the railway reserve; and the go-downs were abandoned.

Plate 5-Dilapidated Limuru railway station

![Image of dilapidated railway station]

Source: Field study, 2014

Plate 6-Rundown structures at the station

![Image of rundown structures]

Source: Field study, 2014
The railway station as observed from the field survey was longer in use, while other structures at the station are dilapidated, the railway line reserve are used for cultivation and grazing. Essential features along the railway line such as barriers at rail-road intersection were missing hence posing a threat to road safety.

5.3.3 Low operation capacity

Through the interviews carried among major manufacturing and processing industries in and around Limuru town many agreed that operation capacity of rail transport in Limuru was inadequate. Bata Shoe Company which relied on railway transport for supply of materials, shifted to road transport due to its flexibility, availability and reliability. As gathered from Kenya Railway Corporation old, inadequate and dilapidated rail infrastructure such as the, locomotives, rolling stocks and carriages were the contributing factor to low operation. Rift Valley Railways given concession for management of railway operation has been working on renewing and rehabilitation of infrastructure. However, lack of adequate maintenance capacity for locomotives and rolling stock has been a contributing factor to the cargo congestion at Mombasa port.

5.3.4 Encroachment of railway reserves

The researcher observed that railway reserves in Limuru town were encroached for human activities such as farming and business enterprises. The railway depots and go downs were used for private businesses hence the reserves are underutilized due to low operation of the railway.

5.4 Problems associated with Railway infrastructure in Limuru town

From the study it emerged that major problems affecting railway infrastructure were as shown in the Table 7, 29% of the respondent indicated poor maintenance of rail
infrastructure was the main problem affecting railway operations. While 23% felt that management of railway was not streamlined, suggesting that corruption has resulted to negative growth of railway transport in Kenya. 13% of the respondents felt that lack technological growth was a key factor affecting railway transport. The fact that technological advancement has resulted to growth of different sectors such as ICT, manufacturing and processing, railway in Kenya has not benefited from such technology. Lack of funds for maintaining and modernizing railway infrastructure was also a key factor. Other problems associated to rail transport by respondent included lack of safety, lack of comfort, inadequate intermodal transfer facilities and limited commuter train routes and services.

Table 7- Problems associated with railway infrastructure

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor maintenance railway infrastructure</td>
<td>9</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Lack of well streamlined management</td>
<td>7</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Lack of funds</td>
<td>4</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Lack of technological development</td>
<td>3</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Poor and unreliable operation of railway</td>
<td>4</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Inadequate railway coverage</td>
<td>4</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Field study, 2014

5.5 The socio-economic and environmental issues associated with ineffective rail infrastructure

5.5.1 Socio-economic issues

5.5.1.1 Increased cost of travel

From the field survey 85% of respondents indicated that railway infrastructure would provide cheaper public transport as opposed to public service vehicles. Being that 75% of
the population in Limuru town relied on public service vehicles for transport many felt that railway transport would solve some problems such as increased cost of travel, increased traffic death, traffic congested and delays, unregulated cost of travel associated to public transport.

**Figure 18 - If railway infrastructure would provide cheaper transport to respondents**

![Bar chart showing responses to the question about cheaper transport.](chart.png)

Source: Field study, 2014

**5.5.1.2 Increased cost of production**

The findings showed that 80% strongly agreed that ineffective railway transport has resulted to increased cost of production hence increasing cost of goods. From the interviews carried out among the manufacturing industries namely Polypipe Limited, effective railway would provide cheap transport for moving finished products to consumers and also transportation of some of the raw materials. While others argued that road transport was expensive due to factors such as corruption among traffic police, rising cost of fuel, loss of goods on transit through robbery, increased road carnages, traffic congestion especially on weighbridges. Effective rail transport would accelerate
industrialization through easier and cheaper transport and the establishment of new industries.

**Figure 19-If effective railway transport would reduce cost of production**

Source: Field study, 2014

### 5.5.1.3 Reduced transport capacity of goods and services

The findings from field study showed that 45% of business owners in Limuru town felt that ineffective railway infrastructure had reduced transport capacity of goods and services. The frequency of cargo train had also declined indicating reduced cargo haulage along Mombasa –Uganda railway. Kenya Railway Corporation also confirmed, declined of rail cargo haulage from 4.5 million tons annually in 1980s to current 1.5 million tons. The corporation aims at increasing the transport capacity after installation of standard gauge 45 million tons annually. The current narrow rail gauge limits commercial speed to 40kph hence slow movement of goods but proposed standardized gauge will allow introduction of high speed train with speed limit of 100kph.
5.5.1.4 Reduced business competitiveness

The researcher observed that 32% of respondent were not sure if railway transport had influenced business competitiveness in Limuru town. Part of business community strongly disagreed on contribution of railway transport to their growth of their businesses. However interviews with county representative Limuru ward indicated that if the railway line accessing Limuru town was effective, more business and investment opportunities would be created. From observation railway reserve along Limuru railway station would be utilized for storage facilities and depots for businesses in the region hence contribute to increased job opportunities.
5.5.1.5 Increased travel time

53% of household respondents strongly agreed that effective railway transport would increase journey time reliability or reduce travel time. Traffic congestion and delays are some of the factors that affect travel time while using public service vehicles especially during morning hours and evening hours. Kenya Railway Corporation plan for introducing commuter trains within Nairobi Metropolitan was first; to reduce traffic congestion along major roads accessing Nairobi City, secondly, was to reduce travel time, thirdly to provide quality services for users of public transport. If travel time was reduced then the time saved on transit would contribute to socioeconomic growth across different sectors.
5.5.2.1 Environmental pollution

The finding showed that 42% of respondent felt that effective railway infrastructure would reduce air pollution through reduced carbon emission. Developing rail technology such electrical high speed rail minimizes environmental pollution by ensuring zero emissions hence reducing global warming and its effects. In addition rail technology through reduced aerodynamic drag, lower train weight, regenerative breaking and higher efficiency propulsion systems can make significant reductions in rail energy use.
5.5.2.2 Unsafe mode of transport

As observed from the field study 61% of household respondents strongly agreed that effective railway infrastructure would provide safer mode of transport for people, goods and services. While faulty railway infrastructure would expose people to more traffic deaths and accidents such as frequent derailing of trains. Effective railway transport would reduce traffic deaths majorly associated with careless driving, poorly maintained roads, and drunken driving. Though considered safer than other modes of transport, rail derailment resulting from inadequate rail maintenance also causes traffic deaths.

Table 8 - If effective railway transport would provide environmentally safe transport

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>44</td>
<td>61</td>
<td>61</td>
</tr>
<tr>
<td>Agree</td>
<td>20</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Neutral</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Disagree</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>72</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Field study, 2014
5.5.2.3 Unsustainable utilization of energy

36% of household respondent strongly agreed that effective railway transport would promote sustainable utilization of energy. Mass rail transit promotes usage of lesser fuel energy compared to other modes of transport such as public service vehicles, air transport and personal vehicles. While ineffective railway infrastructure would result to increased consumption of more fuel and energy due to faulty and dilapidated engines and locomotives.

Table 9-Effective Railway transport would promote sustainable utilization of energy

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>26</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Agree</td>
<td>8</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Neutral</td>
<td>14</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Disagree</td>
<td>18</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>6</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>72</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Field study, 2014

5.5.2.4 Ineffective railway infrastructure restrains land use distribution

From the study findings 39% strongly agreed that effective rail transport would influence distribution of land uses appropriately. Rail transport opens up areas and changes the land use from derelict land to industrial based land use hence regenerating economic status. Through railway transport services are distributed, there is efficient distribution in the formal economy, and development of intense rural-urban linkages at both urban and household levels.
5.6 Recommendation suggested by respondents on improving railway infrastructure

- Improve safety of railway infrastructure such as introducing barriers at rail-road intersection and proper maintenance of the railway line to reduce chances of derailment.

- Improve comfort of rail travel-modernizing the carriages so that facilities inside such as seats are comfortable and also modernizing ticketing and access control system.

- Increase number of routes and services so that more regions within Nairobi Metropolitan are accessible through railway as an alternative reliable public transport such as Kiambu town

- Ensure adequate inter-modal transfer facilities to reduce long walk between station and places of work such as introduction of subways from major railway station to the inside of cities.
As seen in Figure 25-35% of the respondents felt that if railway infrastructure were modernized then most of the problems on railway transport would be resolved. 25% of respondents felt that if operation of railway services was streamlined through restructuring KRC then railway transport in Nairobi Metropolitan would be effective.

**Figure 25-Recommendations for improving railway infrastructure**

Source: Field study, 2014
CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATION

6.1 Summary

Efficient railway infrastructure has a huge impact on connectivity within urban areas and metropolitans. There many social and economic benefits associated with efficient railway infrastructure namely provision of cheaper, modern and efficient transport, reduced cost of doing business, increased environmental safety, increased travel time, increased service quality, improved land use distribution and accessibility, decentralization of urban economy and stimulation of suburbanization. Efficient railway transport regenerates economies of urban centers around the railway station and opens up opportunities for more investments. However railway infrastructure in Limuru town as part Nairobi metropolitan are ineffective and unreliable hence poor connectivity between the town, Nairobi city and other urban centers within Nairobi metropolitan. Net economic and attractiveness of a destination is a key factor that influences transport connectivity, if a place has low economic worth then few people will travel to that town, or urban center. Limuru town as destination and an origin has huge socioeconomic potential and the redevelopment of railway infrastructure would trigger more growth. Other aspects that influence transport connectivity of two places include the quality of available services, cost of travel, travel time, environmental safety, comfort, travel services availability and environmental sustainable transport system. Railway transport connectivity is a function of efficient rail transit system and well developed railway infrastructure. Most of the developed metropolis of the world relies majorly on commuter trains and metro network.
for urban transit, consequently the rising need for redeveloping railway infrastructure in Nairobi metropolitan due to its rapid growth and expansion.

6.2 Conclusion

To enhance railway transport connectivity in Nairobi Metropolitan the future lies in firstly, improving services on existing line through ensuring reliability on transport, reducing travel time, improve user comfort, and efficient intermodal transfers such as increasing parking lots in railway stations.

Secondly, reorganizing urban railway structure through introduction of new lines, commuter services that will allow express services to suburban area hence encourage suburbanization. As the urban structure becomes multi-polar traffic volume from Nairobi City will become enormous, thereby the rail transport will make decentralization and suburbanization possible.

Thirdly, reinforced transfers and through operation; increasing number of railway lines and commuter services will enhance services levels by shortening commuter trip time. Increasing transfer from one transport mode to another such as introducing urban buses within Nairobi will encourage use of railway transport as opposed to private vehicles. Building railway lines and introducing new railway infrastructure between urban centres in Nairobi metropolitan will increase transfer and operations such as linking Kiambu town to Ruiru town or Kiambu and Limuru town.
Lastly, is building sustainable urban environment through ensuring that as energy use by transport sector grows, transport policies should aim at reducing air pollution by making better use of environment friendly railways. Efficient railways transport system will reduce use of public service vehicles and private cars hence also reduce noise and air pollution emitted by other modes of transport.

6.3. Recommendations on policy and regulatory framework, and on improving railway infrastructure in Nairobi metropolitan

6.3.1 Redefining operations of Kenya Railways Corporation (KRC)

Redefining the railway’s role through change of the existing institutional, policy and legal framework; developing commitment to that role; implementing appropriate transport policy framework for achieving that role; implementing strategic reform and restructuring to ensure efficiency under the circumstances; strengthening top management through training and facilitation; improving resource availability; and finally implementing reorganization and management control.
Providing clear management objectives, strengthening incentives, and granting real management autonomy that requires reforming the legal status of the railway enterprise such as revised KRC Act with the objective of securing management autonomy, nurturing accountability and stimulating business-oriented behavior.

KRC need to create an environment conducive to the management of railway business. This can be achieved by fostering a competitive transport market; offering PSO rail services under special compensatory arrangements with the government; defining clear and adequate performance indicators for railway operations.

6.3.1.1 Competitive transport market
KRC should operate as a commercial enterprise; reducing government role as a ‘supplier’ to be managed along business principles and rules, in active competition with other transport modes such as road and pipeline. In a competitive transport market, customers have total freedom to choose transport modes and operators and there is no mandatory allocation of traffic. KRC should freely determine the configuration of its commercial services, in reference to its own commercial interest. It should also freely set tariffs, fares and freely negotiate contracts with major clients such as Bamburi Cement, Kenya Planters Cooperative Union (KPCU) and FFK.

6.3.1.2 Public Service Obligation (PSO)
Since the government has a major role in providing efficient public transport, they should ensure that Kenya Railways operate commercially rail services. However, the government can request KRC to provide services under a Public Service Obligation scheme. This should involve signing a special agreement between the government and
KRC for each PSO service. The PSO agreement should define the configuration of service to be provided, tariffs or fares to be applied and PSO compensation formula.

6.3.1.3 Performance Indicators

Defining and monitoring performance indicators as a prerequisite for making KRC management fully accountable. Currently much emphasis is given on physical indicators such as volume of freight, locomotive availability, and wagon turnaround time and productivity. However monitoring performance should constitute valuable measures of technical management. Such indicators should be supplemented by company profit, which is defined as a weight indicator of value of services minus costs (including capital costs).

6.3.2 Quality, efficiency and reliability of service providers

Competence of private and public service providers of railway services is key determinant of transport cost because their level of efficiency determines the reliability of supply chain. In order to optimize service delivery there is need to enhance competence, preparedness and capacity of service providers. Charges for service provision should be competitive based on the ability to provide efficient and reliable services.

In movement of cargo, the service providers should fasten revenue clearance and documentation systems to reduce delay that may result to increased cost of transport. Developing a national transport strategy, that will ensure a definite linkage in multi-modal transport with the performance of the ports being linked to the feeder transport by rail, road and other inland services. Linking air, sea, road and rail transport based on convenience, reliability, cost effectiveness and efficiency will provide regional and international competitive advantage.
6.3.3 Increased Private Investment

Increasing KRC is privatization may reflect positively or expected to increase private investment in the sector leading to rapid economic development of the country. However, investment by the private sector is always dependent on other factors such as political stability which may be used by investor as a measure of certainty and risk reduction. Other enabling factors of private investors include institutional and regulatory reforms for private sector participation.

6.3.4 Better policies for transport infrastructure

Improved infrastructure is thus a major policy objective, but so far the results have been modest. A recent budget strategy paper (Kenya, 2008b) reports that there has been considerable progress in the development of roads and other infrastructure, but that very much remains to be done, not least when it comes to maintenance of existing infrastructure. Transport policies should ensure:

- Improvement of urban railway and bus systems through; continuously extending railways and building dedicated bus lanes, improving service speed and convenience
- Effective controls on private cars: discouraging private car use by using road tolls and fuel taxes and controlling parking in dense areas.
- Expansion of railway infrastructure and introduction of intelligent transport system (ITS), constructing urban expressways (circular, radial) and automating control of traffic flow by developing ITS
• Integration and coordination of transport systems in metropolitan area by; easing transfer between transport modes and linking urban rail and expressway networks for regional travel demand.

• Reduction of traffic accidents and improvement in traffic environment through; improving pedestrian facilities and encouraging green travel modes and improving traffic facilities

Mobility management of the local residents and providing incentives to the residents in order to enhance their awareness and to support the maintenance and improvement of the public transport. If railway transport fares are regulated and lower than for buses then more people may be inclined to use trains as opposed to private vehicles or public vehicles.

6.3.4 Increased Privatization in railway subsectors

Deliberate cost recovery efforts and modalities for private sector participation in the provision of railway services are possible alternatives. This is because reliance on public ownership and provision of services is characterized by inefficiencies in resource allocation and enterprise management. Privatization of some of railway subsectors will encourage provision of quality, reliable services and will increase competitiveness in rail transport. The private sectors with their objective of making huge returns would intensify marketing of railway services and spur up growth of rail transport industry.

Other reforms that would promote privatization include leasing of go-downs to private operators, commercialization of the Railways Training Institute (RTI) and privatization of cleaning and maintenance of railway infrastructure.
6.4 Re-developing and rehabilitating railway infrastructure

Re-development of railway infrastructure and railway services in Limuru town; through introduction of commuter train services, modernizing the railway station, creating adequate parking to allow park and ride services. Introducing Mass Rapid Transit System consisting of Bus Rapid Transit, Mass Rail Transit and Light Rail Transit for Nairobi metropolitan, to ease transit from the inner core of the city to the outskirt of the metropolitan. This system is needed to provide services for a rapidly expanding Nairobi including significant growth in satellite towns and areas outside the city proper. Potential benefits include improved air quality, reduced health costs, and congestion reduction (economic savings in time and fuel).

6.5 Integrating public transport mode

Integrating different public transport modes such as urban railway and urban buses will significantly reduce use of private cars that contribute largely to congestion within cities. Transport policy in place must be coordinated with several strategies such as road tolls, fuel tax and parking schemes to discourage use of private cars.

6.6 Increasing public participation

Increase public participation in provision of commuter train services and management of railway infrastructure so as to ensure transparency and accountability. Commuter train users and users of railway transport should be involved in decision making to ensure their transport needs are meet. Acts of corruption within the supply chain are blamed for increased cost of travel especially in cargo haulage.
## 7.0 Planning Matrix for Revamping Railway Infrastructure in Nairobi Metropolitan

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Planning Issues</th>
<th>Strategies</th>
<th>Activities</th>
<th>Timeframe</th>
<th>Actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>To evaluate the policy and regulatory framework for railway infrastructure</td>
<td>• Lack of specific policies on provision of better railway infrastructure</td>
<td>• To establish a regulatory and legal framework for railway services and for infrastructure development</td>
<td>• Enacting policies to aid rapid expansion of railway network</td>
<td>Short</td>
<td>National government, County government, Kenya Railway Corporation, Ministry of Transport and Infrastructure, Rift Valley Railways, Private investors, General Public</td>
</tr>
<tr>
<td></td>
<td>• To design policies that promote growth of urban infrastructure</td>
<td>• Engaging technocrats and stakeholders</td>
<td>• Engaging technocrats and stakeholders</td>
<td>Medium</td>
<td>National government, County government, Kenya Railway Corporation, Ministry of Transport and Infrastructure, Rift Valley Railways, Private investors, General Public</td>
</tr>
<tr>
<td></td>
<td>• Tax policies that result in the railways subsidizing road transport,</td>
<td>• Lobbying and advocacy to compel Parliament enact law on running railway services</td>
<td>• Lobbying and advocacy to compel Parliament enact law on running railway services</td>
<td>Long</td>
<td>National government, County government, Kenya Railway Corporation, Ministry of Transport and Infrastructure, Rift Valley Railways, Private investors, General Public</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pursuing Public partnership as an option for railway investment</td>
<td>• Pursuing Public partnership as an option for railway investment</td>
<td></td>
<td>National government, County government, Kenya Railway Corporation, Ministry of Transport and Infrastructure, Rift Valley Railways, Private investors, General Public</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Discouraging use of private cars using the transport policy</td>
<td>• Discouraging use of private cars using the transport policy</td>
<td></td>
<td>National government, County government, Kenya Railway Corporation, Ministry of Transport and Infrastructure, Rift Valley Railways, Private investors, General Public</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>National government, County government, Kenya Railway Corporation, Ministry of Transport and Infrastructure, Rift Valley Railways, Private investors, General Public</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>National government, County government, Kenya Railway Corporation, Ministry of Transport and Infrastructure, Rift Valley Railways, Private investors, General Public</td>
</tr>
<tr>
<td>Inadequate funding and financial resources</td>
<td>To promote capacity building at all levels</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>To mobilize funds from government and donors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To harness local capacity and opportunities to acquire funding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To strengthen KRC’s funding capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Creating enabling factors for private investors such as appropriate institutional framework |
| Integrating and coordinating of transport systems in metropolitan areas |

| Establishing single line funding at both national and county levels |
| Running workshops, seminars, barazas and public awareness campaigns |
| Advocating railway stimulus funding |
| Re-investing 50% of concession fee in railway development |

<p>| National government, County government, Ministry of Transport and Infrastructure, Kenya Railway Corporation, Rift Valley Railways, Private investors, General Public |</p>
<table>
<thead>
<tr>
<th>Poor co-ordination among infrastructure related agencies</th>
<th>To monitor and apply sanction on agencies such as RVR to ensure they meet contractual obligation</th>
<th>Promoting transparency in concession structure</th>
<th>✓</th>
<th>✓</th>
<th>✓</th>
<th>National government, County government, Ministry of Transport and Infrastructure, Kenya Railway Corporation, Rift Valley Railways, Private investors, General Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor co-ordination among infrastructure related agencies</td>
<td>To develop a performance business plan and support KRC in implementing the opportunities</td>
<td>Increasing privatization in railway sub sectors</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>National government, County government, Ministry of Transport and Infrastructure, Kenya Railway Corporation, Rift Valley Railways, Private investors, General Public</td>
</tr>
</tbody>
</table>

| Inadequate skilled and competent staff capacity | To establish a nationally recognized curriculum in railway technology | Advancing railway technology education in Railway institute | ✓ | ✓ | ✓ | National Government, Ministry of transport and infrastructure and KRC |
| Inadequate skilled and competent staff capacity | To train technocrats in the area of Railway technology | Identifying and equipping training facilities | ✓ | ✓ | ✓ | National Government, Ministry of transport and infrastructure and KRC |
| Inadequate skilled and competent staff capacity | To train technocrats in the area of Railway technology | Organizing seminars and workshops | ✓ | ✓ | ✓ | National Government, Ministry of transport and infrastructure and KRC |
| Inadequate skilled and competent staff capacity | To train technocrats in the area of Railway technology | Availing scholarships in railway technology as incentives | ✓ | ✓ | ✓ | National Government, Ministry of transport and infrastructure and KRC |
| ii) To examine the physical condition of railway infrastructure in Limuru town and how it has influenced railway transport. | • An unreliable and ageing infrastructure and rolling stock | • To acquire and rehabilitate of rolling stock | • Introducing Light rail transport to enhance urban transit | ✓ |
| • To redevelop railway infrastructure such as railway station | • To redevelop railway infrastructure such as railway station | • Constructing urban rail along radial trunk road to encourage intermodal transfer | ✓ |
| • To ensure marketing of passenger services | • To ensure marketing of passenger services | • Advancing railway technology education in Railway institute | ✓ |
| • To redesign and re-plan the rail urban transit in Nairobi Metropolitan | • To redesign and re-plan the rail urban transit in Nairobi Metropolitan | • Implementing the initial transport master plan | ✓ |

| National government, County government, Ministry of Transport and Infrastructure, Kenya Railway Corporation, Rift Valley Railways, Private investors, General Public | ✓ | ✓ | ✓ | National government, County government, Ministry of Transport and Infrastructure, Kenya Railway Corporation, Rift Valley Railways, Private investors, General Public | ✓ | ✓ | ✓ |
- Limited railways network coverage.
- Limited operation capacity

To rehabilitate and improve existing core system
To expand railway network so as to increase capacity
To increase the number of commuter trains

- Securing railway corridors to prevent encroachment
- Constructing new lines to increase routes and expand rail transport
- Integrating public transport mode

| National government, County government, Ministry of Transport and Infrastructure, Kenya Railway Corporation, Rift Valley Railways, Private investors, General Public |

iii) To explore the socio-economic contribution of Limuru Town as part of Nairobi Metropolitan.

- Inadequate investment

- To identify economic viability of different industries in Limuru town
- To engage county government in partnership framework
- To streamline coordination of all the actors in railway infrastructure development

- Pursuing Public partnership as an option for railway investment
- Identifying strategic partner in development of capacity

| National government, County government, Ministry of Transport and Infrastructure, Kenya Railway Corporation, Rift Valley Railways, Private investors, General Public |

<p>| National government, County government, Ministry of Transport and Infrastructure, Kenya Railway Corporation, Rift Valley Railways, Private investors, General Public |</p>
<table>
<thead>
<tr>
<th>vi) To assess the socio-economic and environmental issues associated with ineffective rail infrastructure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Limited railways network coverage.</td>
</tr>
<tr>
<td>• Increased cost of travel</td>
</tr>
<tr>
<td>• Reduced transport capacity for goods and services</td>
</tr>
<tr>
<td>• Increased travel time</td>
</tr>
<tr>
<td>• Increased air pollution</td>
</tr>
<tr>
<td>• Unsustainable utilization of energy</td>
</tr>
<tr>
<td>• Encroachment on railway reserves</td>
</tr>
<tr>
<td>• To expand railway network in Nairobi Metropolitan</td>
</tr>
<tr>
<td>• To redevelop and renew railway infrastructure</td>
</tr>
<tr>
<td>• Redesigning urban transit to integrate LRT, MRT and BRT</td>
</tr>
<tr>
<td>• Technological advancement in rail infrastructure</td>
</tr>
<tr>
<td>• To promote transport policy that discourage use of private cars</td>
</tr>
<tr>
<td>• To plan relocation and resettlement of people living along the reserves</td>
</tr>
<tr>
<td>• Construction of standardized railway gauge to increase rail share of freight transported</td>
</tr>
<tr>
<td>• Expanding commuter train services to decongest current urban transit</td>
</tr>
<tr>
<td>• Introducing high speed rail</td>
</tr>
<tr>
<td>• Introducing electric trains and other modern technology to reduce emissions and ground pollution through oil spillage from default locomotives</td>
</tr>
<tr>
<td>• Resettling communities along the railway reserves</td>
</tr>
</tbody>
</table>

| | | National government, County government, Ministry of Transport and Infrastructure, Kenya Railway Corporation, Rift Valley Railways, Private investors, General Public |
8.0 References


Baruch Feigenbaum, (2013). High-Speed Rail in Europe and Asia: Lessons for the United States, Foundation Reasons, and Policy Study California May 2013, California High Speed Rail Authority, Sustainability (Sacramento CA, 2013),


Constitution of Kenya, 2010


Cyrus N. (2012), Overview of Transport Infrastructure Development Plans and Private Sector Investment Opportunities


Hospitality Magazine; June/July, 2000 pp.14-20, Nairobi

Irene Wangari Karanja and Jack Makau (2010), An Inventory of the Slums in Nairobi, Unpublished


Kenya Railway Corporation (2011), Strategic Plan 2012-2017


Mairura Omwenga (2010), Nairobi - Emerging Metropolitan Region: Development Planning and Management Opportunities and Challenges, Nairobi Metropolitan Region, 46th ISOCARP Congress 2010


Ministry of Nairobi Metropolitan Development (2009), Nairobi Metropolitan Services Improvement Project (NaMSIP),

Ministry of Nairobi Metropolitan Development, (2011), Development of a Spatial Planning Concept for Nairobi Metropolitan Region, 2010063/UPD


Ministry of Transport (2009), Integrated National Transport Policy, Government Printer Press, Nairobi


Oxera (2010), Understanding the theory of International Connectivity, A report from Department of Transport, United Kingdom, Park Central, 40/41 Park End Street, Oxford, OX1 1JD, UK,


Sabyasachee Mishra, Timothy F. Welch, Manoj K. Jha (2012), Performance indicators for public transit connectivity in multi-modal transportation networks, National Center for Smart Growth Research and Education, University of Maryland, College Park, MD 20742, United States


APPENDICES

APPENDIX I

Kenyatta University

Department of Environmental Planning & Management

I am Masters Student from the Department of Environmental Planning and Management at Kenyatta University. In order to fulfil the requirement of this degree programme, I am carrying out a study entitled The Potential Impact of Railway Infrastructure on Connectivity within Nairobi Metropolitan- a Case of Limuru Town (Kiambu County). I kindly seek you assistance in filling this questionnaire. The information and data provided will be confidential and intended for academic purposes only.

Interview Schedule for institutions

Please answer these questions to the best of your knowledge

Name of Interviewer__________________________ Date_______________________

Q1 a) Name of the institution_______________________________________________

b) What is the role of your institution in managing, developing and maintenance of railway infrastructure in Nairobi metropolitan?

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

 c) Name any stakeholders and their role who works together with in management and development of railway infrastructure.

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

105
d) Please comment on existing arrangement for stakeholders’ coordination as you endeavor to support growth and operation of railway transport?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Q2. a) How would you describe the current condition of railway infrastructure in Nairobi metropolitan?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

b) Are there any current initiatives by your institution on ensuring the railway infrastructure in Nairobi metropolitan is effective?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

i) How are the initiatives being implemented or actualized?
______________________________________________________________________________

ii) What challenges/problems do you encounter in executing your role?
______________________________________________________________________________

iii) How can the above problems be addressed and by which institution?
______________________________________________________________________________

Q3) State the socioeconomic and environmental benefits you would associate with redeveloped railway infrastructure.
Q4. a) What specific areas do you think need to be improved in making railway infrastructure efficient?

______________________________________________________________________________
______________________________________________________________________________

b) What recommendation would you give for improving these areas?

______________________________________________________________________________
______________________________________________________________________________

Q5. How do you perceive the future of railway transport in Nairobi Metropolitan?

______________________________________________________________________________
______________________________________________________________________________

Thank you for your cooperation
Appendix II

Kenyatta University

Department of Environmental Planning & Management

I am Masters Student from the Department of Environmental Planning and Management at Kenyatta University. In order to fulfil the requirement of this degree programme, I am carrying out a study entitled The Potential Impact of Railway Infrastructure on Connectivity within Nairobi Metropolitan- a Case of Limuru Town (Kiambu County). I kindly seek you assistance in filling this questionnaire. The information and data provided will be confidential and intended for academic purposes only

Interview schedules for major Industries

1. What are your responsibilities and duties in this industry?
2. What type of business is carried out in this premise?
3. List the approximate number of employee working in this premise.
4. What mode of transport do you use for transporting goods and services in and out of your premises?
5. State any problems encountered with the means of transport mentioned.
6. In your opinion, do you think the railway line connecting Limuru and Nairobi Metropolitan has had a significant impact on growth of this industry as a major business?
7. Is the railway operation connecting Limuru and Nairobi Metropolitan currently reliable?
8. Has the railway line so far contributed to growth of Limuru town?
9. What potential lies in redeveloping the railway infrastructure to Limuru town?
10. What specific areas in management and development railway infrastructure, do you think need improvement?
11. Briefly comment on problems facing operation of railway system connecting Limuru and Nairobi Metropolitan.

Thank you for your cooperation
Appendix III

Observation checklist

<table>
<thead>
<tr>
<th>INFRASTRUCTURE</th>
<th>DESCRIPTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Railway</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Condition of railway</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• State of the reserves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Activities and land uses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Railway station</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Condition of railway station</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Activities at the station</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other transport infrastructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Condition/status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAND USES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban characteristics of Limuru</td>
<td></td>
<td></td>
</tr>
<tr>
<td>town</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Major activities/land uses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Distribution of land uses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Condition of urban infrastructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Urban growth pattern</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-economic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Types and categories</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Accessibility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Presence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Types and categories</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educational</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Presence of educational blocks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Presence of any educational activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Types of education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administrative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Presence of administrative blocks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Type of administration</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix IV

QUESTIONNAIRE FOR BUSINESSES– LIMURU TOWN

The information and data provided will be confidential and is intended for academic purposes only.

Name of the Interviewer ___________________
Date of interview ________________________

SECTION 1: BIO DATA

A1 – Please indicate your age.
   1) 20 – 30 [  ]
   2) 31 – 40 [  ]
   3) 40 – 50 [  ]
   4) 50 and above [  ]

A2 – Please indicate your gender.
   1) Male [  ]
   2) Female [  ]

A3 – What type of business do you operate? ________________________

A4. How many employees are in your business? _____________________

<table>
<thead>
<tr>
<th>Employee</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
</tr>
</tbody>
</table>

A5. What modes of transport do you to transport good and services to and from your business?

________________________________________

A5b. List any problems associated with the mode of transport named above.

________________________________________
A6. What is your business monthly income?
   a) Less than 5,000 ( )  b) 5,001-10,000  c) 10001-15000 ( )  d) 15001-20,000 ( )  e) Above 20,000 ( )

SECTION B – RAILWAY INFRASTRUCTURE (NAIROBI TO LIMURU TOWN)

B1 – Please indicate by ticking to what extent you agree with the following statements. Selected from Strongly Agree (1), Agree (2), Neutral (3), Disagree (4) and Strongly Disagree (5).

<table>
<thead>
<tr>
<th>QUESTIONS</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1(a) The railway transport between Limuru and Nairobi city is unreliable</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>B1(b) Railway infrastructure coverage is inadequate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1(c) There is low operation capacity of Railway transport</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>B1(d) There is poor railway infrastructure</td>
<td></td>
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<tr>
<td>B1(e) Railway transport would influence urban dynamic of Limuru town</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>B1(f) There is huge potential in developing railway infrastructure in Limuru town</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

B2. Do you think railway infrastructure in Limuru town has affected the growth of your business?
   1) Yes [ ]
   2) No [ ]

B3. If yes, elaborate the impacts

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

B4. Are there specific problems associated with railway infrastructure in promoting growth of Limuru Town?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

B5. What recommendation would you give for improving railway infrastructure connecting Limuru town and Nairobi Metropolitan?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
SECTION C- SOCIO-ECONOMIC IMPACTS ASSOCIATED WITH INEFFECTIVE RAILWAY INFRASTRUCTURE

C1 – Please indicate by ticking to what extent you agree with the following statements. Selected from Strongly Agree (1), Agree (2), Neutral (3), Disagree (4) and Strongly Disagree (5)

<table>
<thead>
<tr>
<th>QUESTIONS</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1(a) Railway infrastructure has promoted business competitiveness of Limuru town</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1(b) Railway infrastructure has not contributed to growth of Limuru town</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1(c) Ineffective railway infrastructure has resulted to reduced transport capacity of goods and services</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>C1(d) Effective railway infrastructure would reduce cost of production</td>
<td></td>
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</tr>
<tr>
<td>C1(e) Improved railway infrastructure can cause economic growth of Limuru Town</td>
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</tbody>
</table>

C2. Are there specific socio-economic impacts you would associate with ineffective railway infrastructure?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

C3. In your opinion is there any underlying potential impact of improved railway infrastructure on the socio-economic growth of Limuru town.

1) Yes [ ]
2) No [ ]

C4. If yes, list the potential positive and negative impacts.
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

C5. What benefits would associate with effective railway transport to your business?

SECTION D- ENVIRONMENTAL IMPACT

D1. Are there any environmental impacts associated with ineffective railway infrastructure in Limuru town?

1) Yes [ ]
2) No [ ]
D2 If yes, which are they?

______________________________________________________________________________
______________________________________________________________________________

D3. Do you think improved railway infrastructure would contribute towards safe and sustainable environment?

1) Yes [   ]
2) No [   ]

D4. If yes, please explain how
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

SECTION E – MANAGEMENT AND INSTITUTIONAL FRAMEWORK

E1 (a) – Are you aware of any management and maintenance structure for railway infrastructure connecting Limuru town to Nairobi Metropolitan?

1) Yes [   ]
2) No [   ]

E1 (b) – If ‘Yes’, are you satisfied with the management of railway infrastructure connecting Limuru Town to Nairobi Metropolitan?

1) Yes [   ]
2) No [   ]

E2 – What specific areas in the management of railway infrastructure need improvement?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

E3 – What suggestions would you give for the improvement of these areas?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Appendix V

QUESTIONNAIRE FOR HOUSEHOLDS – LIMURU TOWN

The information and data provided will be confidential and is intended for academic purposes only.

Name of the Interviewer ___________________
Date of interview ________________________

SECTION A: BIO-DATA

A1. Background information

<table>
<thead>
<tr>
<th>Household members</th>
<th>Sex</th>
<th>Age</th>
<th>Level of education</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

A2. Which is your district of birth?

A3. How long have you lived in Limuru Town?

Less than 5 years ( ) 5-10 years ( ) 11-15 years ( ) Above 15 years ( )

A4. Why did you migrate into Limuru Town?

a) Join family members ( )  
b) Marriage ( )  
c) Business  
d) Employment ( )  
d) Other specify _______________

A5. What is your family monthly income? Tick where appropriate

b) Less than 5,000 ( )  
b) 5,001-10,000  
c) 10,001-15000 ( )  
d) 15,001-20,000 ( )  
e) Above 20,000 ( )

A6. Where do you work? ________________

A7. What mode of transport do you use to and from your work place? ________________

A7b. List any problems you would associate with the mode of transport named above
SECTION B – RAILWAY INFRASTRUCTURE (LIMURU TOWN TO NAIROBI)

B1 – Please indicate by ticking to what extent you agree with the following statements. Selected from Strongly Agree (1), Agree (2), Neutral (3), Disagree (4) and Strongly Disagree (5).

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>1</th>
<th>2</th>
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</thead>
<tbody>
<tr>
<td>B1(a) The railway transport between Limuru and Nairobi city is unreliable</td>
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<tr>
<td>B1(b) Railway infrastructure coverage is inadequate</td>
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<tr>
<td>B1(c) There is low operation capacity of Railway transport</td>
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<tr>
<td>B1(d) There is poor railway infrastructure</td>
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<tr>
<td>B1(e) Railway transport would influence urban dynamic of Limuru town</td>
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<tr>
<td>B1(f) There is huge potential in developing railway infrastructure in Limuru town</td>
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</tbody>
</table>

B2 (a) List any specific problems associated with railway infrastructure affecting growth of Limuru town.

B3 (b) What recommendations do you think would assist in the improvement of the areas mentioned in B2(a) above?
SECTION C- SOCIO-ECONOMIC ISSUES ASSOCIATED WITH INEFFECTIVE RAILWAY LINE

C1 – Please indicate by ticking to what extent you agree with the following statements. Selected from Strongly Agree (1), Agree (2), Neutral (3), Disagree (4) and Strongly Disagree (5)

<table>
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<tbody>
<tr>
<td>C1(a) The railway infrastructure would provide cheaper transport in and out of Limuru town</td>
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<tr>
<td>C1(b) Current railway infrastructure has contributed to increased cost of production</td>
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<td>C1(c) Railway infrastructure would provide quality service transport</td>
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<tr>
<td>C1(d) Ineffective railway infrastructure has resulted to reduced transport capacity of goods and services</td>
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<tr>
<td>C1(e) Journey time reliability can be improved through effective railway transport</td>
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<tr>
<td>C1(f) Improved railway infrastructure can cause economic growth of Limuru Town</td>
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</tbody>
</table>

C2. In your opinion is there any underlying potential of improved railway infrastructure on the socio-economic growth of Limuru town.

3) Yes [ ]
4) No [ ]

C3. If yes, list the potential impacts (either negative or positive)

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

C4. If no, why
C5. What benefits would you associate with effective railway transport in your daily life?

______________________________________________________________________________
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SECTION D- ENVIRONMENTAL FACTORS

D1 –Please indicate by ticking to what extent you agree with the following statements. Selected from Strongly Agree (1), Agree (2), Neutral (3), Disagree (4) and Strongly Disagree (5)

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<tbody>
<tr>
<td><strong>D1(a)</strong> Effective railway infrastructure can promote environmentally safe transport</td>
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<tr>
<td><strong>D1(b)</strong> Railway transport minimizes environmental pollution</td>
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<tr>
<td><strong>D1(c)</strong> Effective railway infrastructure would promotes transport safety</td>
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<tr>
<td><strong>D1(d)</strong> Land use pattern and distribution is affected the status railway infrastructure</td>
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<tr>
<td><strong>D1(e)</strong> Effective railway infrastructure would promote sustainable utilization of energy resources</td>
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</table>

D2. Do you think railway infrastructure can promote less polluted transportation?

1) Yes    [  ]
2) No     [  ]

D3. If yes, give reasons.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

D4. In your opinion, how can improved railway infrastructure promote safe and sustainable environment in Limuru and surrounding areas.
SECTION E – MANAGEMENT AND INSTITUTIONAL FRAMEWORK

E1 (a) – Are you aware of any management and maintenance structure for railway infrastructure connecting Limuru town to Nairobi Metropolitan?

3) Yes [ ]
4) No [ ]

E1 (b) – If ‘Yes’, are you satisfied with the management of railway infrastructure connecting Limuru Town to Nairobi Metropolitan?

3) Yes [ ]
4) No [ ]

E2 – What specific areas in the management of railway infrastructure need improvement?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

E3 – What suggestions would you give for the improvement of these areas?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________