PLANNING FOR THE OPERATIONS AND MANAGEMENT OF INTRA-URBAN PUBLIC TRANSPORT MODES IN NAIROBI (A CASE STUDY OF TRAFFIC CONGESTION IN THE C.B.D. ROUTES BUS STOPS AND TERMINALS)

BY

OTIENO CHARLES-KONYANGO

DEPARTMENT OF URBAN AND REGIONAL PLANNING
Faculty of Architecture, Design and Development
P. O. Box 30197 . Tel 27441
UNIVERSITY OF NAIROBI

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

Signed .....

OTIENO CHARLES KONYANGO

CANDIDATE

This thesis has been submitted for examination with my approval as the University Supervisor.

Signed .....

MAIRURA E.O.

SUPERVISOR

JUNE 1991

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ABSTRACT

PLANNING FOR THE OPERATIONS AND MANAGEMENT OF INTRA-URBAN PUBLIC TRANSPORT MODES IN NAIROBI

OTIENO CHARLES KONYANGO

The growth of Nairobi, both in terms of size and density that today stands at 690 Km^2 and 1.7 million people respectively has been accompanied with diverse problems in the planning and management of its urban sub-systems. One such problem has been in the area of the provision of adequate transport services, in particular the public transport segment.

The level of intra-urban activities generated by a city of such magnitude and density and with 73% of its population having no personal vehicles demands that it be supported with a well developed and efficient public transport system to sustain the growth and development of the urban economy. This study examines some problems in spatial planning for public transport in a situation where an informal mode of public transport ('Matatus') compete with formal public transport modes, Kenya Bus Services and Nyayo Bus Services and where the physical facilites provided for these modes are not adequate to accommodate the levels of demand raised thereof. The result has been heavy congestion and conflict on the C.B.D. roads, bus stops and terminals used by these modes. There is also competition for passengers that takes place on the city roads, as these modes operate on the same

routes and have common destinations in the residential estates.

This study describes in brief the present state of these modes in terms of their role in public transport and in details, how their needs are catered for in terms of provision of the supportive physical facilities in the form of bus stops and terminals.

The study provides evidence to show that the facilities are inadequate to cope with demand, and that the difficulties encountered in trying to provide for these modes is as a result of policy oversight where the spatial needs of Matatus were ignored in preference to promotion of K.B.S. and where public transport planning was only considered in terms of supply of the modes to meet rising demand with only low priority given to planning for their arrival and departure points in the city. Hence their increase in number has not been matched with provision of these facilities.

The planning aspect of this study is given in the form of a plan for action that attempts to alleviate the escalating congestion and conflict through a traffic circulation system that seeks to make maximum use of space in the C.B.D. and a rational distribution of terminal points among the three modes. Policy recommendations are also

given that should help the general management of the operations of the public transport modes in a way that they will supplement and complement rather than compete with each other.

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CHAPTER ONE: INTRODUCTION

1.0 General Introduction

Transport industry is an important sector in the economy charged with the responsibility of promoting economic growth and development. It facilitates the circulation of people and movement of goods within and between human settlements, moves the needed materials and labour to factories and workshops as well as deliver products to buyers.

This study concerns itself with the public transport segment of this industry, particularly the intra-urban public transport, whose efficient provision and management enhances the growth and development of a sustainable urban economy.

In Nairobi public transport is an important part of the working community, since 73% of Nairobis residents do not own any private vehicles and therefore depend on public transport for their travelling.*1 Earlier studies by Kapila et al (1982) showed that 50% of family members in Nairobi and 57% of household heads use public transport in the city. This underscores the importance of public tranport in Nairobi. The same study shows that in 1982, 45% of all

1. Nairobi Project, D.P.U. N.C.C. 1986 pg 24.

trips made to the C.B.D. area on public transport were work trips, 32% school trips 14% market trips and 6% recreation trips.

According to N.C.C. 1979 projections C.B.D. area alone was projected to provide 190,000 jobs by the year 2000. Together with the fact that the C.B.D. is projected to have a wide range of commercial and other non commercial activities means that a large proportion of the city's growing population will still come to the C.B.D. for various neeeds other than employment, thus increasing demand for transport.

An analysis of the potential for public transport in Nairobi done by Transurb-Consult group (1986) showed that in 1985 a total of 676,000 passenger journeys per day were made to and from the C.B.D. Demand for 1990 was projected at 873,000 passenger journeys per day, and was projected to rise to 1,393,000 passenger journeys per day on public transport by the year 2000.

This rising demand for public transport is therefore significant enough to raise concern for planning to accommodate their activities in the C.B.D. which would largely remain their arrival and departure points in the city. Already, the city is experiencing an acute problem in trying to provide the requisite physical facilities for the levels of demand raised by the public transport modes. The

result has been congestion and scramble witnessed in the C.B.D. routes, bus stops and terminals. This forms the basic research problem in this study.

1.1 STATEMENT OF THE PROBLEM

In Nairobi, the intra-urban public transport sector has continued to face varied problems which threaten its efficient operations and management.

The major problem and which is taken for research in this study has been that of mismatch between the demand and supply of space (road space, lay-by space at bus stops, and terminals' space) in the C.B.D. despite the increasing number of public transport vehicular traffic.

The most conspicuous problems are faced by `Matatus'. In 1989 there were 1316 intra-urban Matatus in the city but only, 792 were on record as having been given terminal space in the C.B.D. (K.B.S. 1989). Even these were taken from N.C.C. rellocated car parks and traffic islands. This meant that the remaining 524 Matatus were left to float or make do with bus stops.

The state run commuter bus service (N.B.S.) is faced with a similar problem. Having started during the transport crisis of 1986, their number has since grown to 110 by 1990 but they are only given three terminal points. Of the

* The total number of N.B.S. fleet was 142 but only 110 operated in intra-urban services.

three, two are formerly bus stops and one a rellocated car park each with a capacity of accommodating 4 and 3 stationary buses respectively. As a result, there has been serious congestion at the N.B.S. depots, reflected in the form of long queues stretching backwards from the terminal space to the traffic lanes, as N.B.S. operators strive to accommodate their buses within the limited space provided.

The corporate bus services (K.B.S.) are the only ones that are provided with a bus station in the C.B.D. In addition, they also have bus stops within the C.B.D. where they can pick up or drop passengers. However they have had to share these bus stops with matatus and N.B.S, both of which have none. The result has been serious traffic congestion at these bus stops, especially during peak hours as the lay-by space is unable to cope with the extra demand not envisaged earlier in their planning. At certain points, Matatus have turned the bus stops into terminals where they stop for longer duration as they call for passengers.

These problems are most conspicuous around the existing bus stops and "on street" Matatu terminals in the C.B.D. These areas then are the major bottleneck areas to the smooth traffic flow. The scramble for space at these bus stops and Matatu terminals spreads on to the traffic lanes and results into heavy traffic jams that stretch several metres

backwards while ahead, the road is clear. The situation is worse in those bus stops that are located around road junctions where vehicles converge or need to diverge into different directions, as indicated in plate No. 1 below.

Plate No. 1 O.T.C. Bus Stop on Racecourse Road

Note the serious jam caused at this bus stop which also doubles up as "a long stop" for Matatus. The pick-up driver attempts to beat the jam by driving through the pedestrian side walk.

It is important to note that as traffic builds up in the city, there is need for an efficient traffic flow, yet as of now, traffic build up results in heavy congestion whose consequences in terms of hours lost and petrol consumed are enormous.

Apart from the lack of space for vehicles, the study survey also finds that there is lack of adequate waiting space at the bus stops to accommodate the huge number of passengers particularly in the evening peak hour. Such facility is found to be totally absent at `Matatu' terminals. The result is jostling and stampede as commuters try to find standing space while others try to break through the crowd to board the arriving vehicles. This problem is made worse in times of rain, when commuters also need shelter from the rain. It should be noted that as the general traffic builds up in the city, it becomes necessary that the bus stops and terminals should also be adequate enough to take care of the waiting passengers. This is an important planning parameter that must be considered in the provision of such facilities.

More precisely then, the problem isolated for study here includes:

(i) The lack of adequate supply of terminals for public transport modes in the C.B.D. area particularly the Matatu and Nyayo bus services (N.B.S.)

(ii) The congestion and conflict at the bus stops arising from their inability to cope with the high levels of demand by different public transport modes operating under different regulations, different management and with different goals.

(iii) The high levels of traffic congestion in the C.B.D. routes which inhibits efficient traffic flow particularly at peak hour time.

With respect to the above problem, there is need to provide a strategy that will facilitate a sound and efficient operation and management of the activities of public transport modes to ensure their complementarity. This can be facilitated through a number of policy options and strategies as recommended at the end of this study.

1.2 OBJECTIVES OF THE STUDY

The study was carried out with the following objetives.

1. To examine the nature and structure of the problems of traffic congestion and conflict at bus stops, public transport routes and terminals in the CBD.
2. To identify factors associated with these problems.
3. To suggest a circulation system that helps in the operation and management of public transport in the CBD area, so as to increase efficiency of flow, and limit conflict and congestion while it also serves the needs of commuters as conveniently as possible.

To be able to meet these objectives, the following parameters were used among others;

1. The capacity of the terminals, bus stop and lay by spaces.
2. The level of usage of terminals and the bus stops in terms of the rates of arrival and departure of public transport modes at different times of the day.
3. The waiting time at the terminals and bus stops while loading and off loading passengers at different times of the day.
4. The journey time through the CBD area by different public transport modes at different times of the day.
5. The volume capacity ratio of the CBD routes used by public transport modes.

1.3 ASSUMPTIONS OF THE STUDY

In undertaking this study, the following broad assumptions are made.

1. That the CBD area and industrial area will continue to be Nairobi's main employment and activity area attracting most of the commuters and vehicles.
2. That the rate of population growth and physical development of Nairobi city will continue, thus creating increased opportunities and leading to increased travel demand.

3. That most of Nairobis population will continue to be in the low income cadre hence will only afford public transport service.

The Specific Study Assumptions are

1. That there is congestion in the CBD routes, and bus stops, which therefore hinders efficient traffic flow especially during peak hour time.
2. That the terminals space provided for N.B.S. and Matatus in the C.B.D. is not adequate enough to cope up with demand.
3. That given the above situation Nairobians are generally dissatisfied with their public transport system, and are likely to be increasingly dissatisfied if current trends persist. Hence there is need for planning to improve efficiency of operations of the public transport system in Nairobi.

1.4 SCOPE OF THE STUDY

This study covers the three modes of public transport used in Nairobi namely `Matatu', Kenya bus services and Nyayo bus services. These three modes are the major actors in the problem being studied.

For purposes of detailed analysis, the study is confined to the CBD area as defined by the area bound by Uhuru Highway, Haile-Selassie avenue Nairobi river and University way.

The study concentrates on analysis of the situation at the CBD bus stops, terminals and public transport routes. The operational characteristics of the three public transport modes at these bus stops, routes and terminals is examined with a view to understand the spatial needs regarding these facilities as well as getting an indepth information into the nature and structure of the problem as it is faced by these modes. Information from this analysis forms the basis of knowledge upon which policy and planning recommendations are made at the end of the study.

The study is organised into the following parts:

Part 1. Gives the basic background of the study. It includes a statement of the problem, study objectives, scope, literature review and methodology.

Part 2. Looks at Nairobi's public transport in historical perspective, past and present planning responses to public transport, problems including policy issues pertaining to public transport.

Part 3. Contains data analysis, case studies and research findings, all of which forms the main substance of the study. This is given in two chapters.

Part 4. Gives, summary of the study, conclusion, policy and planning recommendations arising out of the study findings.

1.5 METHODOLOGY OF THE STUDY

In order to investigate the factors governing the problems of vehicular traffic congestion and conflict in the CBD routes bus stops and terminals, a field survey was conducted in all the bus stops, CBD public transport routes and terminals. The survey was aimed at assessing their actual physical conditions in terms of location, structure, and capacity. Their spatial distribution as well as vehicular behaviour particularly of Matatus was also considered.

The survey shows that there are 18 Matatu terminals distributed within and about the CBD area (map No. 6) of these 8 (eight) were located within NCC re-llocated car parks 8 (eight) on street side and 2 (two) on traffic islands. The survey also finds that there are 11 bus stops within and around the CBD shared by the three public transport modes and that NBS have only 3 (three) terminals, all from NCC re-llocated car parks.

Given the time constraint within which the study was conducted it was impractical to interview a population sample based on the total daily commuters to the CBD or total daily fleet of Matatu travels to the CBD. Consequently, it was decided to give a coverage of 4 (four) questionaires per route for the Matatu operators giving a total of 88 questionnaires. There were 22 intra-city Matatu

routes. For the commuters it was decided to cover 45% of both the total number of surveyed bus stops and terminals and 7 questionaires were administered in each terminal and bus stop sampled giving a total of 98. This was considered a sufficient coverage, given the little patience of the average commuter in the street.

The interviews and questionnaire for the operators was aimed at obtaining information concerning the manner of operation of these modes, their travel behaviour and its needs and problems particularly regarding terminal facilities and bus stops in the CBD area. Their opinion was sought on different possible alternative solutions proposed. Similar interviews were also done with NBS and KBS inspectors manning the various depots and bus stops. The operator's point of view was considered necessary since he is the most obvious actor who has a direct impact on the system.

The commuters questionnaire was broadly aimed at obtaining information on their travel behaviour, the problems they face in the CBD and their opinion sought on general operations of public transport in the CBD and on possible solutions to the problems identified. The opinion of the commuter was found to be essential since as the direct user of public transport he represents a raison de'tre of the system itself hence his point of view is most

appropriate as a complement to that of the operator.

The other source of information was spot checks done on Matatu terminals and 6 bus stops. Record was taken regarding the physical environments within which passengers board or alight from the vehicles, as well as the duration of time taken by these modes at the terminals and bus stops. The boarding and alighting times were recorded for both the peak and off peak times and the frequency of arrival and departure of the three modes at the bus stops and terminals recorded for both off and peak times.

To augment the information obtained by the methods above, journey time-speeds through the CBD was also done on all major public transport routes cutting across the CBD area from one end to the other. The moving vehicle observer technique was found to be most appropriate method for this survey. In analysis, the moving speeds and overall journey times are computed for each link surveyed. The distances on each link are scaled down from a map of the CBD area, and presented in kilometres. The transit time between each node is given in minutes.

Interviews were also held with KBS and NBS management and also the City Commission transport unit. The interviews covered the general problems of public transport operations and management in the CBD area and specifically regarding issues of CBD public transport routes, bus stops and

terminals. The various statistical details, maps and information that were gathered formed an important source of secondary data. They provided basic information on the research problem, based on past experiences.

For purposes of analysis and presentation of data, various statistical methods are used. These include charts, percentile distribution tables, photographs and the student `t' test. The findings obtained by the use of these analytical tools form the basis of information on which planning and policy recommendations are made at the end.

1.6 SIGNIFICANCE OF THE STUDY

The significance of this study lies in the fact that its results should be of interest and use to those involved in the planning and provision of improved public transport facilities in Nairobi and other towns in Kenya. As urban economies grow, intra-urban public transport needs to be adequate both in terms of quality and quantity so as to serve commuters more effectively, presently and in the future.

The need for research also arises because the work of improving urban public transport system presents many technical problems which require more than common sense and common knowledge for their solution. There are also many untested views which are in frequent disagreement as to the course of action and desirable remedies to the problem.

pressure within the limited time. Research assistants therefore had to be employed to complete the tedious exercise of data collection.

2. Crackdown on Matatus and their rellocation from some terminals like Gill House to street alleys like Mfangano took place during the study process. It became difficult therefore to extract information from the touts and operators who were now hostile and suspicious about the exercise.
3. The average commuter in the street was found to be impatient giving researchers very brief attention. Others were also suspicious and remained non commital on aspects seeking their opinion.
4. The rigid red tape in Nairobi City Commission made it difficult to obtain some vital data. Even after breaking through some ladders, the officials were mean on giving up vital information under the guise that it was being classified information.

1.8 LITERATURE REVIEW

The growth and expansion of urban areas both in terms of size, population and density of activities, has always raised problems in the transport sector. Such problems include zonal inaccessibility, delays, unreliability of vehicles and inadequacy or total absence of the supportive facilities for the movements within and about the urban area.

The magnitude of these problems may differ from one country to another depending on their level of development, means of transport and the transportation network. These differences makes it difficult for the developing countries to borrow the strategies that have been adopted by developed nations to check their urban transport problems. For example, while the metropolitan cities of developed nations like Toronto (Canada) may point to urban transit subway system as having solved most of their urban transportation problems, the majority of developing countries may not afford one due to their levels of technology and development. (Soberman R.M: 69).

Different transport planning methods have been developed the world over, in attempt to alleviate the transport problems. In the public transport sector different policies and operational frameworks have been formulated within which urban movement problems in each country could be solved.

Early urban transport planning mainly focused on road traffic and the accepted way of assessing the future transport demands was to examine the existing flows and extrapolate them to some future date. The problem then was seen as that of traffic congestion, so that the solutions proposed were by and large those of building more roads or expansion of the existing ones. However they were soon filled up with newly generated traffic and the problem continued. According to Meyer and Hillman (1979:343).

"Any action taken to reduce congestion in the central areas by for example changing the capacity of the transport channel or increasing the speed will, if effective, lead to higher accessibility levels in the central area and increase the intensity of use which in turn will generate more traffic and finally produce the same level of congestion as before".[2]

The central concern of these plans was therefore the highway which was designed to provide sufficient link between two areas with functional relationships for example residential areas were linked to employment areas. In general, the early planning laid more emphasis on modelling the town as an analogy to an artifact whereby those activities with strong functional relationships had to be linked together with a channel.

In Nairobi the early years of growth of the town were controlled more by economic forces, with no co-ordination of development other than a gridiron street pattern in the centre. An attempt was made to order the situation in 1926 through a town planning consultant. Development however continued in an uncontrolled manner until 1948 when a Master plan for the town was commissioned which laid down guidelines for development in the next twenty years.

2. Meyer & Hillman
The urban transportation problem Haward University Press, 1979 pg 343.

The 1948 master plan suggested a road system within the central areas which gives freedom of through-traffic as well as easy exit for traffic into the surburbs and industrial area. The present layout of the road network in the CBD area is largely the result of the 1948 plan. The major motorway access to the CBD is to the west by means of Uhuru Highway and its associated junctions at the University way, Kenyatta Avenue City Hall way and Haile-Selassie Avenue. On the whole there is no means of traffic circulation around the CBD area. This means that there are quite a number of cross town trips traversing the CBD even when such trips have no business there.

The master plan also gave no priority to the use of streets. For example no streets were designed mainly for traffic links, parking or access streets except for Harambee avenue, Kenyatta avenue, Unversity way, Racecourse road and Haile-Selassie avenue, that can be said to be distributory roads in the CBD. But even these have a dual purpose. They are both local service roads as well as local distributor.

In these early days, little attention was given to public transport demands. Looking at urban transport as a system, its component parts were not seen to include the interaction of urban communities but was rather seen and applied as an Engineering exercise which culminated in the design of a physical transport system only to link the

various functional zones with strong relationships. Yet, the town must also be seen as an organism which adapts to changing circumstances. If the city is conceived as a system, then its traffic related problems like congestion can be shown to depend on the level of traffic generated in an area and the capacity of the channels to handle it and in this case also the capacity of the terminals and bus stops. The discrepancy of the urban transport planning therefore lay in its static nature in the face of mounting traffic volume and changing types of development in and around the city.

From the early 1970's, there was a shift of focus in transport planning the world over, at the realization that it was not possible, neither was it desirable to cater for unrestrained car use in the cities. In any case, most urban dwellers, it was realised rely more on public transport services than on private car, to supplement walking over distances not conducive to travel on foot. 73% of Nairobians for example depend on public transport. (N.C.C. - D.P.U. 1986).

The concern now is with interaction between activities and flows of people, vehicles and goods which it generates. (Buchanan Malcolm 1974). The emphasis then has been to design a transport system that maximizes mobility and accessibility of people between and within the various but interrelated activity zones which form part of the urban system. Public transport has by and large been seen as the

most economical way of utilising the urban transport system to maximise mobility and accessibility to various activity zones located at different points in space.

In Nairobi, little comprehensive work has been done with regard to planning for public transport. Most of the existing work and studies are general and are mainly concerned with supply and demand side of the public transport system.

The Metropolitan growth strategy by N.U.S.G. (1973) gave a comprehensive plan for the development of Nairobi in which recommendations were made for a feasibility study of the bus ways and restraint on car ownership through the increase of road licence fee, import and purchase tax and an increase of tax on petrol, while promoting the overal operation of buses throughout the city.

The findings of N.U.S.G. showed that major traffic generators to the city and its adjacent industrial area were the various residential areas, and that they commute by public means especially K.B.S. and Matatus, but Matatus had no official stops or terminals so they tended to compete with KBS and country buses in utilizing the stops and terminals. It was also common site to find `Matatus' stopping anywhere on the streets to pick up or drop their passengers thereby causing serious traffic obstruction. There was therefore need for well co-ordinated transport particularly at their arrival and departure points in the CBD area.

The N.U.S.G. then identified the major problems of the city transport as being that of growth in demand coupled with population growth and vehicle congestions in the central area and failure of public transport to match this demand. With regard to these problems, it recommended the increase in use of public service vehicles particularly buses on exclusive bus ways and a mass transit system. Also recommended was the issue of staggering working hours in the CBD in order to spread the effect of traffic peak over considerable period. A comprehensive parking policy for the city was also seen as necessary.

Although 'Matatus' had by this time become an important mode of public transport supplementing KBS however no recommendation was made with regard to planning for them in the city, save for the concern with the safety of their users. In conclusion N.U.S.G. came up with three major policy recommendations on transport, and upon which future planning was to be tailored.

1. The provision of minimum facilities for both private and public transport, with the road network being determined by the minimum facilities needed to cater for commercial vehicles, service traffic and public transport. This policy would tend to encourage the better off commuters to resort to private motoring to avoid travelling on the congested public transport

modes. Far from solving the problem it would therefore worsen the transportation stress in Nairobi if implemented. The majority of commuters would take up private motoring when costs can be accommodated irrespective of the minimum facilities provided for private transportation.

2. The policy of no restraint on car ownership or usage.. This meant that infrastructural development would be based on the levels of demand. This policy alternative would require capital investments too high for the country. In any case there would be limited space within the down town area that cannot meet the demand. If the main objective of the study group was to establish a sound transportation network for Nairobi, then these two policy options fails to meet the objective.

3. The policy of restraint on the ownership and use of private vehicles coupled with a much more improved public transport system in attempt to maximise their usage. This was a better policy option that is neither capital intensive nor space demanding. However, this policy needs to go a step further.

As Bruton J.W. argues, "Travel is a function of human activity and it is therefore necessary to understand the determinants of trip production for the nature of future

demand to be assessed..... That it is necessary to understand the population characteristics of an area in order to assess the transportation demands".[3] This policy therefore calls for need to examine the factors that govern the choice of means of transport. Why they prefer private motoring to public transport.

In 1978, a Nairobi bus ways feasibility study carried out by N.C.C. recommended the construction of 27.7 Km network of bus priority routes aimed at regulation and administration of private and public transport in the CBD area as well as parking supply, demand and traffic circulation.

A transport unit (N.T.U.) was formed in 1978 with a view to control both the city's public transport policy and its private car parking policy among other things. Its review report No. 1 1979 carried out a comprehensive transport review of the city with an aim of presenting a set of policies for consideration by the government. The report identified two major policy issues needing resolution viz. the role of `Matatu' within a co-ordinated public transport network and the future of KBS franchise. The second draft report of August 1979 put forward another two proposals namely: the introduction of protected rights of way through

*3 Bruton J.W. - Introduction to Transport Planning pg.15 Hutchinson & Co. 1970.

the central area for use by high occupancy vehicles, and the reduction of traffic congestion through area traffic control system.

While all these measures are sound, there is need however to identify a methodology of implementation that is not only appropriate to the current situation but one that is economically and socially implementable. G.W. Woolner and Dalaney R.E. in their book "Elements of transport" point out that transport is not an end in itself, but rather a means to many ends. Its justifications depends on the purpose to be served and the advantages to be gained, taking into account the factors of space and resources, both financial and temporal.

Most recent studies include that by Mazingira Institute of 1982. This study covered adequately both demand and supply side of Nairobi's transport, emphasizing the congestion problem in public transport modes and how supply of these modes can be increased to meet the existing demand. It touched only descriptively on the terminals and no analytical examination of the problem is given.

Mangat H.S. (1986) on urban traffic problems in Nairobi city sets out the existing transport means within the city, its traffic arrangements and the problems arising out of the system. He also considered the future prospects and planning to prepare the city to meet the transport requirements for the year 2000.

A study by the Transurb Consult Group 1986 report analysed the potential for public transport system in Nairobi. The report considers demand in terms of passenger journeys per day for both KBS and `Matatus' and makes projections for the year 2000. It identifies three major problems as needing urgent attention.

These are:

1. The congestion phenomenan
2. Absence of by-pass for avoiding the CBD area

and 3. Parking problem in the CBD.

Missing so conspicously from consideration by the Transurb report is the issue of terminals and bus stops for public transport modes in the city. While looking at congestion and parking problems the report only considers capacity of parking space for private vehicles, and lack of discipline among Matatu drivers, lack of staggering of peak hours and the un adaptability of the roads to traffic intensity as being the major contributing factors.

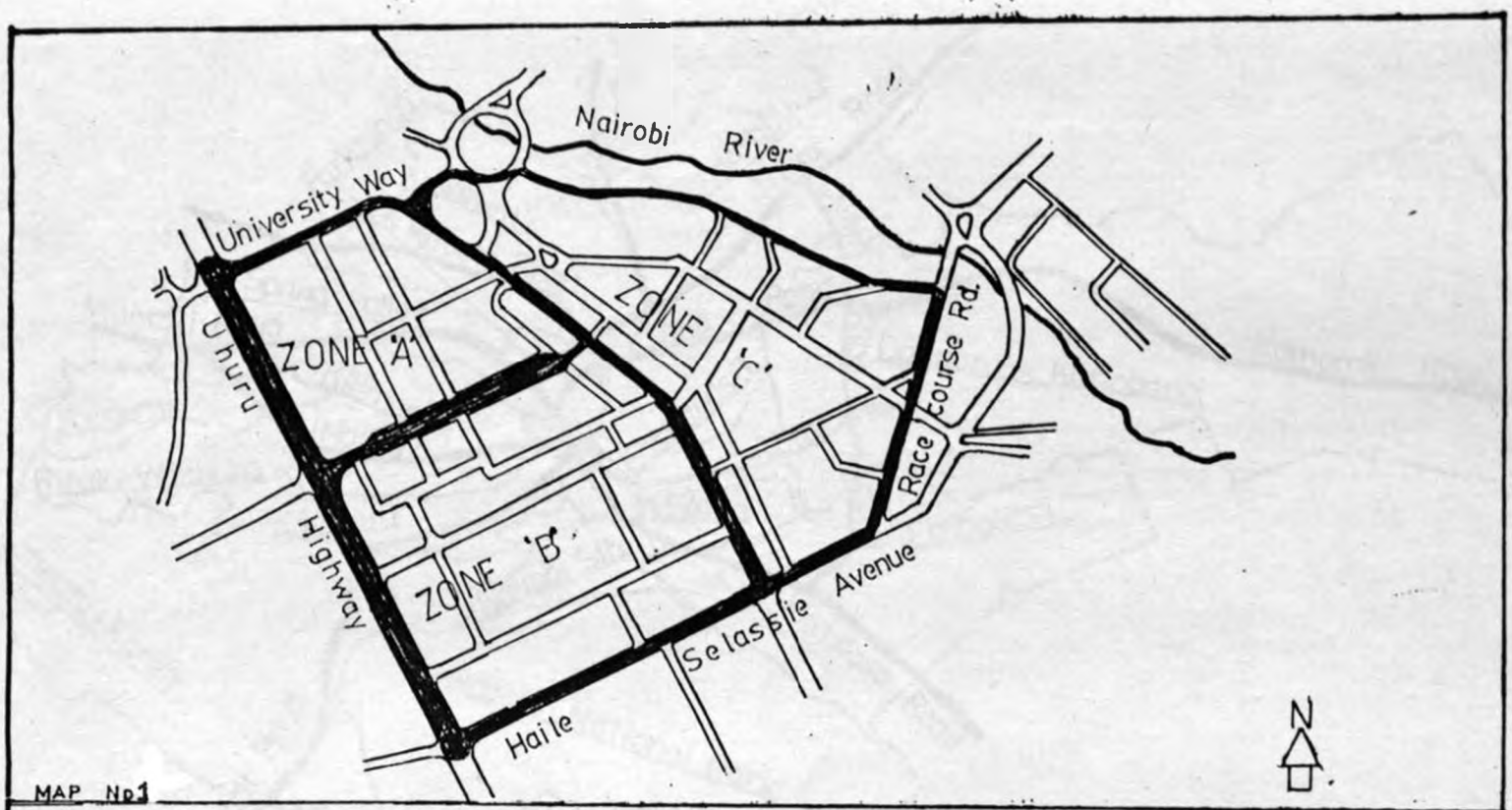
Kenya government seminar on urban transport management in December 1987 at K.I.A. recommended three major areas as needing serious attention. These were:

1. Problems of provision of urban transport infrastructure at the level of planning, designing, financing and implementation.
2. Problems of provision of urban public transport at the levels of supply, demand distribution and quality of service.

3. Traffic management and safety aspects. The problem of traffic flow was identified as the major cause of delays, frustrations and accidents on the roads.

While the seminar paper concerned itself with the general transport management system in the country at large, its recommended areas of action can be seen to be more relevant in Nairobi where the problems identified are high in intensity.

This study sets out to examine similar problems but at a planning level. The study is also similar to those reviewed above in the sense that it seeks to enhance knowledge on how to solve urban public transport problems in Nairobi city. It however focuses mainly on the problem of vehicular traffic flow, congestion and conflict at bus stops and terminals in the CBD and hence their inadequacy to handle the present levels of demand.



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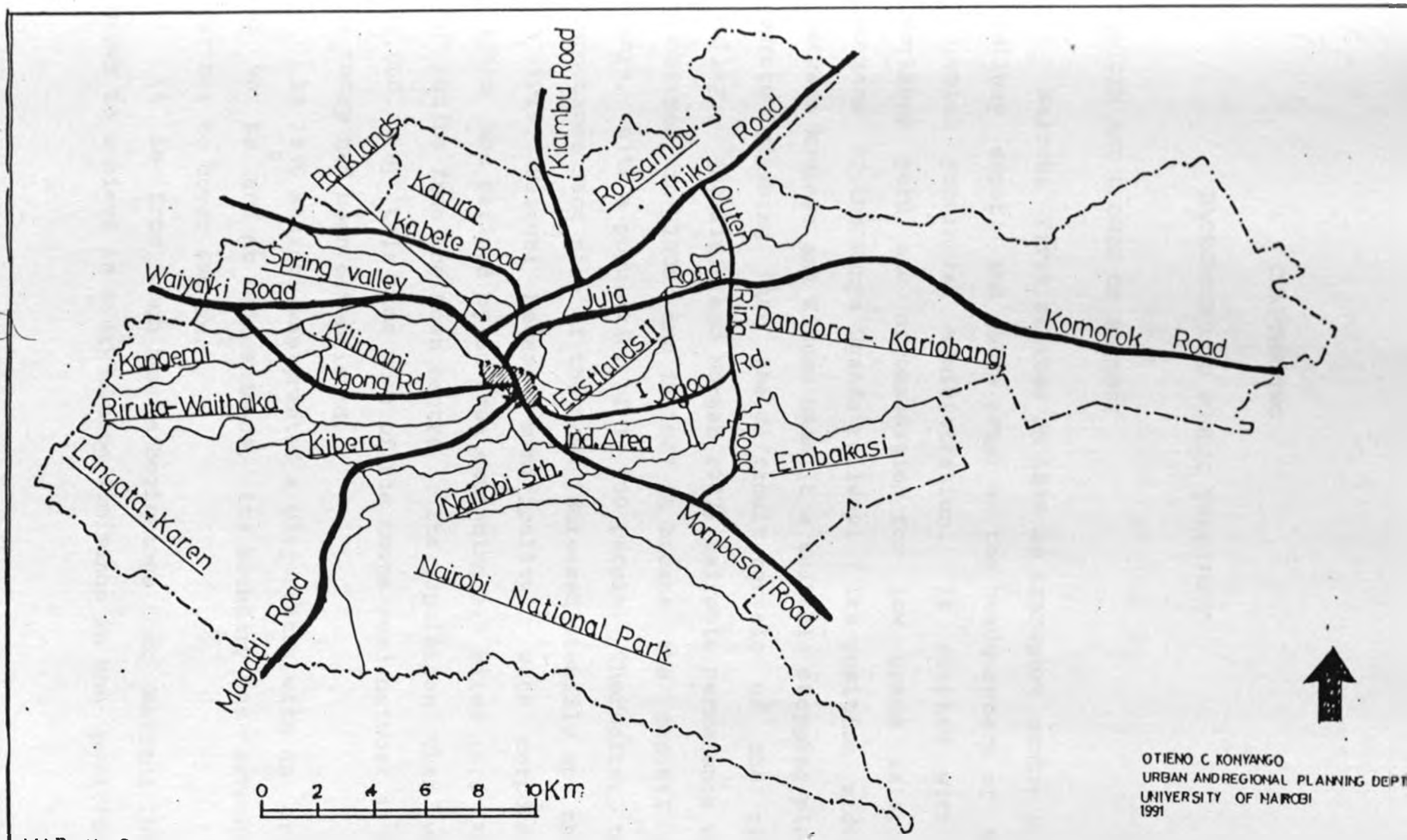
Otieno C Konyango
M A Planning II
University Of Nairobi
1991



MAP No 2

C·B·D AREA REGIONAL CONTEXT & COMMUTER ZONES

CHAPTER TWO

BACKGROUND TO PUBLIC TRANSPORT

2.0 ORIGIN AND GROWTH OF NAIROBI

Nairobi first started in 1899 as transport centre on a railway depot, and there after as the headquarters of the colonial provincial administration. It started with a workshop yard and accommodation for low grade salaried workers of the Kenya Uganda railway. Its position midway between Mombasa and Kisumu made it a suitable stopping place before climbing into the difficult terrain of the rift valley. (Halliman and Morgan 1977) Nairobis permanence was confirmed in 1905 and in 1907 it became the capital of Kenya, with a population of 10,000 people. Thereafter, the importance and size of the town increased steadily so that in 1919, Nairobi became a municipality with corporate rights and defined by an area extending 1.5 miles (3.9 Km) in radius from the town centre. Its population then was 15,000. By this time much of the towns road network as it is today had been established.

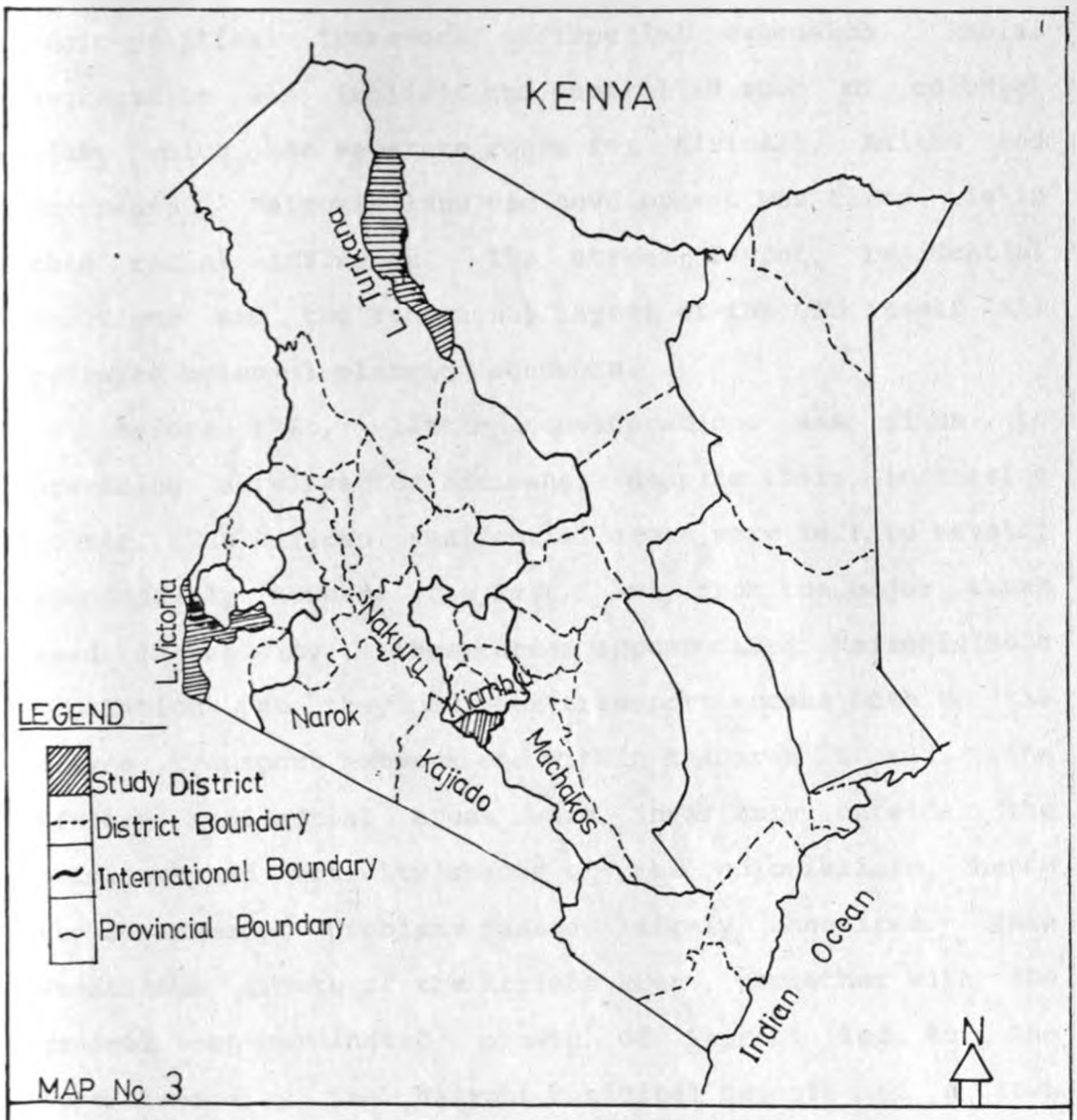
In 1950 Nairobi was granted a city status with an area of 90 Km^2 and at independence, its boundary was extended further to cover 690 Km^2.

It is from such humble beginnings that Nairobi has grown to achieve an overwhelming dominance in the political

social and economic circles both locally and internationally. Its main economic activities are concentrated within the town centre and the adjacent industrial areas which together are its main employment centres. Surrounding these two economic regions are the residential areas. Consequently, the city has taken up a concentrated trip attraction character in terms of the two centres of employment. This character tends to pull all traffic towards, a common centre irrespective of the direction and location of the residential area. Nearly all convoy of traffic are therefore heading to and from one common centre, a phenomenon that inevitably leads to congestion as one approaches the centre of attraction.

In its national location, Nairobi is well linked to nearly all parts of Kenya by four major international trunk roads. To Western Kenya via Nakuru by a trunk road and rail route, to the Coast by a rail route and an all weather road, and to Northern parts through another trunk road via Thika and to Nanyuki via Meru. Nairobi is also well linked with the neighbouring countries such as Tanzania, Uganda, Somali and Ethiopia by major international linkages. Jomo Kenyatta air port has also made it possible for it to be linked with other parts of Africa and the world at large. This good connectivity gives it a strong centrality in terms of services, commercial and industrial activities hence employment opportunities.

In terms of layout, the present size and pattern of its CBD is the result of implementation of the 1948 master plan for a colonial city which had recommended for a compact CBD with a road system that gives access to through traffic as well as into the surburbs and industrial area. Like CBD's of other nations, Nairobis CBD is the focal point of a wide range of activities namely commerce, industry, government and education, and has a projected employment potential of 190,000 jobs by the year 2000. These facts raise sufficient concern for planning for the efficient functioning of the CBD as a system. A transportation plan that maximises mobility of the level of traffic generated by the system would at best seem to offer a significant contribution towards this end.



MAP No 3

NAIROBI IN NATIONAL CONTEXT

Otieno C. Konyango
M.A Planning II
University Of Nairobi
1991

2.1 HISTORY OF PLANNING AND PUBLIC TRANSPORT IN NAIROBI

As a colonial city, Nairobi was born firmly within a socio-political framework of imperial expansion. Racial segregation was implicit and controlled much of colonial plans which had separate zones for Africans, Asians and Europeans. Nairobis land use development was fixed within this racial influence. The street layout, residential locations and the functional layout of the CBD itself all potrayed colonial planning concepts.

Before 1920, little considerations was given to providing services for Africans, despite their increasing number. The African residential areas were left to develop spontenously towards the East, away from the major trunk road in the city. These areas accommodated Nairobis bulk population yet they had poor transport access both to the city's transport network and within the area itself. The African residential areas were invariably outside the interest and activity spaces of the colonialists, hence their movement problems passed largely unnoticed. This spontenous growth of the African areas, together with the general un-cordinated growth of Nairobi led to the appointment by the Nairobi Municipal Council of a town planning consultant team in 1926 to attempt to re-order the situation.

The demand for public transport was however still low in this early period, since most of the residential areas

were located within walking distance to the CBD and industrial area. However by 1929 general traffic problems in the town had become subject of discussion by the Nairobi Municipal Council, particularly the issues of parking and overspeeding (Hake 1977 pp.22).

The need for public transport however begun to be felt as the city continued to expand in size and population. This demand was answered in 1934 with the inauguration of Nairobi town bus services, starting with two buses. This followed an agreement between Nairobi Municipal Council and the British transport company (U.T.O.) to provide urban public transport services in the town, with exclusive franchise to carry fare paying passengers in and around the Municipality. This was the origin of the present Kenya bus services.

The growth in provision of public transport was however slow and by 1950 there were only 12 buses serving mainly the Asian and European areas which were well served with good distribution of access roads both within itself and to the town centre (Stren and White 1989).

The neglect of African public transport needs led to spontenous emergence in the 1950's of an informal mode of public transport; `Matatu' which was used by Africans to transport residents within the African areas to the nearby rural villages and to carry foodstuffs from rural areas to the African residential zones. Their number grew upon

independence in 1963 with the influx of migrants into the city when colonial restrictions on Africans were repealed.

The Master plan for Nairobi Municipality, commissioned in 1948 formed the first concious plan for the city. The plan laid down guidelines for the development of Nairobi for the next twenty years. It earmarked land for residential and industrial areas, proposed further extension for the road network as well as the commercial areas of the town. The present layout of Nairobi's CBD area is as a result of the implementation of the proposals of this 1948 plan. Prior to 1948, the CBD was characterised by large open spaces which the plan proposed, to be filled up and the CBD area be prevented from spreading beyond Nairobi river in the North and the railway line in the South, thus making a compact area.

The reasons advanced then for compactness were:

(i) Amenities would be provided within easy reach of one another.

(ii) The mid-day traffic and consumption of time on homeward journeys would be somewhat lessened.

(iii) That parking problem would be brought within easy reach of solutions since one or more centralised parking places would be able to accommodate the car population as also the journey from there to work will be a short one.

The master plan proposed a road system whithin the CBD which gives freedom of through traffic as well as easy exit for traffic into the city's surburbs and industrial area. The result culminated in the present day layout of the road network in the city, where the major motor-way access to the CBD area is to the west by means of Uhuru Highway and its associated junctions on University way, City Hall way, Kenyatta Avenue, Haile Selassie Avenue, Race Course Road and Landhies road.

On the whole, while the plan was well intended, it did not give adequate means of traffic circulation around the CBD such that today a sizeable volume of vehicles have to transverse the CBD area even if they have no business there. While Kenyatta avenue, Race Course road, University way and Haile Selassie Avenue can be said to be distributory roads, the fact is that over years, they have assumed a dual purpose, serving as service roads as well as local distributor roads.

A report prepared by the planning section of NCC 1974 showed that 6.04 Km (26.6%) of the CBD area road network had a volume capacity ratio of 1.0 meaning that this proportion of the network had reached its saturation point. 29.2% had a volume capacity ratic of 0,7 to 1.0 meaning that they were approaching their saturation levels. In total therefore it can be inferred that 55.8% of the CBD area road network was congested and caused delays during peak hours to

both private and public transport commuters. According to the report, a volume capacity of 0.7 to 0.8 should be most appropriate, for the sake of efficient traffic flow. Among the most affected streets were Haile Selassie avenue, Tom Mboya Street, River Road, Kenyatta Avenue and Racecourse Road which also serve as service as well as local distributor roads. The fact that nothing has since been done on these roads in terms of expansions to cope with increasing demand means that they are now overloaded far beyond their capacity.

Far from achieving its objectives, the trend of development that followed the Master plan was therefore a complete negation to the very princples upon which it was based. By 1966, the CBD area was already characterised by a dominance of vehicles as every motorist endevoured to penetrate into the centre as much as possible. One critical problem brought about by this scenerio was that of traffic congestion and parking difficulties, forcing the Nairobi City Council to appoint a committee in that same year to make recommendations on how to resolve these problems within the CBD area.

The period after independence witnessed an increase in car ownership especially by the well to do Africans who took over the roles left by the Europeans. As a result there emerged an elitist group with values similar to those of the departing Europeans.

The situation inherited at independence therefore was that of a city destined for capitalist expansion with extreme inequalities in the level of services provided in different areas. The city grew tremendously in population especially as the African population temporarily experienced a state of Liesez faire, a situation which encouraged migration to urban centres particularly Nairobi which attracted most of the job seekers. The city boundary was also expanded from 90 Km^2 (35 square miles) to 690 Km^2 (266 squate miles). (N.U.S.G. 1973). This expansion brought a large unserviced area to be added to the already underserviced area thus worsening the problem.

The rapid population growth through migration was perhaps due to the new government's employment policies which expanded African representation in government and industry. Towards the 1970's a new population distribution begun to emerge, with low income groups who are the main users of public transport being pushed further away from near the CBD and its adjacent industrial area, which are their main working places. This followed the governments policy an facing out squater settlements sited near the CBD like Pumwani, estate and also the introduction of site and service schemes like Dandora and Kayole. Other sprawling settlements like Kibera, Soweto and quarry also begun to emerge, on the peripheries of the city. This expansion of the city was however not matched by a similar expansion in

public transport facilities and services hence the beginning of the conflict and stampede in public transport currently being witnessed in the CBD area.

The city government therefore within this first decade of independence begun to face an uphill task of providing adequate urban services induding public transport yet there was no co-ordinated plan to guide the city's growth and development. Despite also the tremendous extension of the city boundary, development control was only attempted through sectoral plans which however only gave `prima facie' solutions to the city's development problems.

The first post independence planning started in 1970 with the commissioning of Nairobi urban study group (N.U.S.G.) which culminated in the 1973 Nairobi Metropolitan growth strategy report. The group surveyed various activities in the CBD area and estimated its rate of growth at 6.7% per annum. Its projections for the year 2000 however provided for limited growth since most of its land was under utilisation and even the vaccant sites were already earmarked for future development. Any additional development would therefore have to be accommodated through re-development of existing developed sites. The obvious fact here then is that the CBD's transport demands was tipped to increase significantly.

On transport, the group identified traffic congestion and lack of parking space as the prominent problems begging for a comprehensive transport policy for the city. The major traffic generators to the CBD and its adjacent industrial area were identified as being the various high density residential areas which also accounted for most of the commuter traffic that uses public transport. It therefore proposed the decentralization of industry to the city outskirt areas like Dandora, Ruaraka and Dagoretti as a means of achieving better integration of work and housing areas and of reducing transport problems of the city in general, and the CBD in particular.

That the CBD and industrial area today remains the dominant employers in the formal sector, and that there has only been limited expansion of industries to Ruaraka, Dagoretti and Dandora areas reflect the slow pace with which this policy recommendation has been taken.

N.U.S.G. report projected the employment potential of the CBD to stand at 190,000 jobs by the year 2000. This level of employment if attained would raise significantly the percentage of journey to work movements hence transport demands. To accommodate the movement demands of such a level of employment would certainly require excessive investment in roads and their associated junctions and parking points as well as a co-ordination of public transport circulation particularly at their arrival and departure

points in the CBD. The N.U.S.G. report however did not provide a planning framework within which this fundamental issue could be addressed and programmes drawn for implementation. The report none the less recommends the use of public service vehicles especially buses, as a measure to relieve congestion on the city's road space. The city's planning should therefore be carried out in a manner that accommodates or encourages public transport.

One conspicuous omission by the N.U.S.G. group was the `Matatu' sector whose role in public transport it failed to give due consideration. It mainly emphasised the future development of buses operating on exclusive bus ways, a commuter rail transit system and the staggering of working hours in the CBD areas as steps that would help to contend with the city's transport demands and supply. By then however, `Matatu' sector was well established as a viable informal mode of public transport in a situation where formal public transport services were already in adequate. This is exemplified in the fact that in 1973 President Kenyatta issued a decree legalising the `Matatu' sector and exempting them from T.L.B. regulations (Stren and While 1989).

In implementing the N.U.S.G. recommendations, the Nairobi City Council also excluded `Matatus' from considerations in its physical planning. Consequently,

`Matatus' begun to poach into bus stops, public spaces car parks and traffic islands, some of which became their route terminals in the CBD area. The current terminal points problem in the city therefore dates back partly to these errors in planning by the city government.

In 1978, Nairobi City Council set up a transport unit within the city Engineering department with a view to control both public and private transport policy. The transport unit carried out a feasibility study the same year on bus ways with an aim of working out a programme of regulating public and private transport, parking supply and control of traffic circulation within the CBD area. Though there already existed a system of bus routes and bus lay-by, the study noted that there was need to develop them further by constructing another 27.7 Km of bus priority lanes to provide efficient transport and meet demand for a growing city. This has since not been implemented yet public transport demands has more than doubled. More over, the bus routes and facilities are now being used by other public transport modes, namely, `Matatus' and Nyayo Bus service which has put in more strain. In general however N.C.T.U.'s response to public transport needs has been too slow to meet demand.

The most recent planning response to Nairobi transport needs has been conducted by the Belgium Transurb consult

group (1984) Their investigations are still going on. The group highlighted three options to deal with the present mass transportation problems in Nairobi. The first option suggested the use of exclusive bus ways while the second option suggested the introduction of light rail transit system. The third option which seems to have cought the governments approval introduces the concept of articulated bus system.

Their 1986 provisional report gives a detailed analysis of supply and demand side of Nairobi's public transport. It gives a projection of Nairobi's population at 1,505,000 in 1990 and 2,525,000 by the year 2000, assuming a moderate growth rate of +4.5%. The report also projected the wage employment potential for Nairobi to stand at 417,400 in 1990 only 20% of these would be in the informal sector and 658,900 in the year 2000. Again only 18% of these would be in the informal sector. Which such high population and employment levels in the city the report estimated the daily passenger journeys growth rate to rise from 29.1% in the 1985-1990 period to 59.6% in the 1990-2000 period. The future demand of public transport for this period are given below.

Table 1

Projection of Public Transport Passenger Journeys per Day

Year	Passengers by Mode		
	K.B.S.	Matatu	Total
1985	372,000	304,000	676,000
1990	476,000	397,000	873,000
2000	633,000	760,000	1,393,000

Source: Transurb Report pg. 48

The market share was projected to stand at 54.6% for KBS and 45.4% for Matatu. With the introduction of NBS, these markets shares are expected to change remarkably.

The group identified three basic problems needing urgent attention. These were:

(i) The congestion phenomenon due to roads not being adapted to traffic intensity, parking obstructions and lack of staggering of peak hours.

(ii) The lack of by-passes for avoiding the CBD. Presently, much of traffic must pass through the CBD even if it is through traffic and this includes also some public transport that could easily be channelled to pass outside the CBD. The study found that about 67% of vehicles passing through the CBD was through traffic.

(iii) The parking problem in the central area as the capacity of present parking space cannot cope with demand, hence there is illegal parking causing obstruction in some streets.

The transurb group in conclusion, gave the following recommenations to the Nairobi City Commission for implementation.

(i) To cope with public transport demand, the operational speeds of public transport services be increased through the creation of protected rights of way for exclusive use of high occupancy vehicles.

(ii) Creation of bus only lanes on most congestion prone sections of streets approaching the central area.

(iii) Creation of one by pass along university way and an eastern by pass along Ngara road, and quarry road connected to Lusaka road.

(iv) Creation of Matatu terminals to curtail present situation where they poach into public parking spaces and traffic islands.

and (v) For the rest of the city, create segregated way for public transport vehicles, especially along Juja road, Jogoo road and Ngong road.

These factors therefore underline a need to develop transport system which maximise mobility and accessibility with considerable flexibility and less operational costs.

From the foregoing it would seem that the government has made commendable efforts in attempt to plan for a solution to public transport problems of Nairobi. However, one thing is clear, that these planning efforts has been based on projections of supply and demand of the transport services rather than on plans which would address urban transport as a system whose component parts also need attention. The transport problem in Nairobi could broadly be defined as a deficiency of access and not just a problem of congestion. A solution offered to solve congestion must therefore also improve accessibility.

2.2 NATIONAL TRANSPORT POLICY

Kenya's overall national policy on transportation is to create and manage viable and efficient transportation system in the country as a whole. The policy objective as set out in the 1974-1978 national development plan is to facilitate a transportation network and a transportation system that would keep transport costs at the very minimum possible without compromising on safety and quality of service.

There are four major aspects of this policy which governs the development process of this transport system. First is the continuous road development process done through annual budgetary allocations set aside for specific road projects in accordance with the development plan. Classified roads are developed though this vote.

consequence of this has been the proliferation of illegal 'Matatu' parks in and around the city centre which in turn leads in obstruction of traffic, or complete blockage of some traffic lanes hence conflict in the overall traffic circulation in the city centre.

The third aspect of transport policy involves the provision of transport equipment and machinery which includes the Buses and 'Matatus' in the area of public transport. In Kenya, this area has been left as free market where any individuals, groups, co-operatives or companies can venture into so long as they comply with statutory and other legal requirements as provided in the legislative statutes. The govenment only recently (1986) involved itself with the actual acquisition, operation and management of public service vehicles, (Nyayo bus service) 85% of which operate intra-city services in Nairobi. The government also through N.C.C. owns minority shares in K.B.S., and by N.U.S.G. (1973) recommendations were supposed to be increased to a controlling level as a major step towards the eventual government ownership of the public transport system in the city.

The fourth aspect involves the institution of rules laws and other regulatory measures that seeks to ensure proper usage of highway and safe secure public service operation on the road and route terminals.

In Kenya, the registration of vehicles on the road, whether private or public is vested in the authority of

T.L.B. (Transport Licencing Board) which issues all kinds of licences to allow the operation of specific services like town or country bus services. Then there is also the traffic act which contains regulatory measures that governs the conduct of motor vehicles on the road and punishment for mis-conduct.

The following section reviews parts of this legislation that is relevant to this study especially those parts that concern the operation and control of vehicles.

2.3.1 (1) Traffic Act (Cap 403) Revised Edition 1962

Section 6 (4) requires a licencing officer not to register any commercial vehicle or trailer whose load capacity has not been declared by the manufacturers of the chassis until an inspector has determined its load capacity and such determination shall be final. Part xi section 100(1) on public service vehicles states that "The registrar shall in respect of any public service vehicle determine the maximum number of passengers whether sitting or standing and the weight of goods allowed to be carried at any time on such a vehicle."

These two clauses together are important for public service vehicles. For example K.B.S. are licenced to carry total of 105 passengers, 49 seated and 56 standing. The carrying capacity of 'Matatus' vary with body type but are generally put at 15 and 25 seater, for micro-bus and mini-

buses, respectively. Lack of adequate public transport in Nairobi has however made it difficult for traffic police to fully enforce these sections of the act hence the frequent scrambling and jostling witnessed in public transport modes as they carry in excess of their official capacity. This not only increases the incidence of accidents by such vehicles, but it also leads to delay at the bus stops and terminals as passengers struggle to get in and on the roads as the buses lower their operational speeds.

Section 95 (2) (e) part xi on public service vehicles states that no public vehicle licence (T.L.B) should be issued in respect of any motor vehicle which is intended to be used as a Taxi-cub unless such a vehicle has been registered as a Taxi-cub under any by-laws in force in a municipality or township. This section empowers the municipalities or townships through their by-laws, to control the ownership and usage of public service vehicles in their areas of jurisdiction. To regulate the number of such vehicles in a certain route or area so as to provide adequate supportive infrastructural facilities.

The operation of `Matatu' in Nairobi has not been catered for in the city's physical planning. They have had to do with traffic islands and relocated car parks as their city centre terminals. Even so the demand far outstrips supply. This resulted from the fact that `Matatus' do not fit as Taxi-cubs in this definition. They fall in a class

of their own. Since they do not conform with the existing N.C.C. by-laws governing Taxi cubs, until 1984 `Matatus' were considered illegal public transport means. Although they are now considered as an integral part of public transport in Nairobi, N.C.C.'s response towards their spatial needs has however been slow often taken only after lobbies by M.V.O.A. (now defunct).

2.3.2 (ii) Transportation Licencing Act (Cap 404.) Revised 1962

Section 4 (c) of this Act empowers the Minister for Transport to exempt some operators from obtaining such licences. In 1973 the Minister of Transport allowed any vehicle owner, private or public of any class to operate as passenger carrier provided the vehicle is 3 tons tare weight or its passenger capacity 15 seats and below **4. All that became necessary thereafter was for anyone to acquire such class of a vehicle, obtain road licence and then operate. This resulted in mushrooming of `Matatus' an incident that was not matched with supportive infrastructural facilities. Exempting them from T.L.B. regulations removed the possibility of them being scrutinised by inspectors of motor vehicles, hence the minimal chance of detecting their unroad-worthiness.

That they were also not to pay P.S.V. licences gave them operational advantage compared to buses. From the

*4 Kenya Gazette Issue No. 27 Legal Notice No. 89 June 1973.

onset then, `Matatus' were not integrated with buses, to offer complementary services in the supply of public transport in the city. The current competition on the roads between Matatus and buses on one hand and between Matatus themselves, together with the general deplorable Matatu culture can be traced back to this mismatch in our national policy.

A major policy shift occured in N.C.C. after their 1980 Nairobi passenger study report, which recommended among other things that.

(i) Matatus be made an effective part of the public transportation system in Nairobi, ensuring that they will supplement and not compete with buses in the supply of public transport in Nairobi and that their operations will continue to provide employment to the low income groups.

(ii) That there will be a continious operation of buses even after the expiry of their franchise in 1985 and that all safety factors regarding public service vehicle operations and maintenance are enhanced to maximum. *5

These are the major policy guidelines that has since then guided N.C.C. in dealing with the `Matatu' problem. One question however arises; what effect have they had in regard to providing for the needs of Matatus in N.C.C.'s

*5 Nairobi Passenger Study Report, 1980 pg 10-15 N.C.C.

physical planning? The guidelines remain broad and do not show how each one of them can be implemented. They do not emphasize the role of Matatus as part of Nairobi public transport and ignores the issue of their terminals.

Evidence from M.V.O.A News letters vol. 2 No. 3 and No.4 of 1984 shows that numerous debates concerning the desirability of `Matatu' operations has ended inconclusively or with general feeling that whatever `Matatu' can do, buses can do better, hence attempts to introduce more buses (K.B.S. and N.B.S.) to cope with increasing demand.

Arguments have been advanced for example that `Matatu' should ply along the light trafficked routes where buses operate with too low frequencies or that they should cater for short distance feeder traffic and should be excluded from the main line hauls. Whatever the controversy at the policy level, one thing is clear, that `Matatu' activities has and will continue to increase in space and numerical terms hence the need to incorporate them in the city's physical planning. The city authorities might have adopted the belief that the `Matatu' problem is transitory and will gradually disappear with increase in development but this has proved contrary.

On the whole the transport policy which has evolved overtime, both conciouly and unconciously represents an uneven fabric ill-suited to today's needs, and is itself a major contributor to the current problems as given in the problem statement. From the beginning, the national policy

that developed favoured the predominance of buses. In the process the leissez faire situation in which the 'Matatu' sub-sector found itself only helped it develop a momentum and socio-political immunity that makes it difficult to control or restrain. Again, the transportation policy making process . still vests most of the ultimate decision making authority on acts that have not changed their orientation since independence.

All these beggs for a new policy and planning approach to our public transport s ystem. In the following chapters the main study findings is presented arising from the data analysis. A summary, planning and policy recommendations is given at the end.

CHAPTER THREE

ANALYSIS AND EVALUATION OF TRAFFIC CONGESTION PROBLEM IN THE C.B.D. AREA

3.0 FACTORS RESPONSIBLE FOR CONGESTION AND CONFLICT AT CBD ROUTES & BUS STOPS

The CBD area has 11 bus stops, originally provided for use by K.B.S. 5 (five) of these however are also used by `Matatus' as their terminals. They were provided for the convenience of passengers picking up or alighting from vehicles. They were only meant to be brief stopping places along the bus routes and were consequently designed with a lay by capacity of 2 (two) stationary buses although they could take 3 with some strain, save for Hilton and Ambassadeur hotel bus stops with a capacity of 4 (four) each.

The main criteria used in the location of these bus stops were:

(a) The availability of enough space on the road reserve

(b) Minimum walking distance from the main activity zones for commuters

(c) Main traffic attraction points, so that the bus stops were strategic ones, with no `request only' bus stops.

(d) Non inteference with smooth traffic flow.

The location of bus stops in main traffic attraction zones while at the same time trying to ensure non interference with smooth traffic flow is a difficult task.

While originally, the traffic volume levels in the CBD streets could have been low, hence the location of these bus stops was such that their effect on the general traffic flow was negligible; this study shows that on the contrary, bus stops in the CBD have become trouble spots where traffic congestion and conflict is the order of the day thereby inhibiting traffic flow.

This is due to the fact that:

(a) These bus stops are located on the major traffic routes where the volume capacity ratio's are above or approaching saturation levels during the peak hour and are well above average during the off peak hours (see table 2). Any repeated stops however brief that may block the drive way innevitably leads to congestion.

(b) The bus stops are located at points of traffic convergance, often adjacent to or sandwiched in between two close junctions. 8/11 (72.7%) of these bus stops are in such locations. The example of O.T.C. and St. Peter Clevers bus stops are given below. In the event of traffic build up that fails to discharge faster, congestion situation arises that blocks the entire channel space and takes considerable time to clear. (Plate No. 2 also No. 1).

(c) Majority of the CBD bus stops (9/11) 84.8% have lay-by capacities of 2 (two) stationary buses each. This study found that the bus stops were receiving a higher

number of vehicles -(P.S.V.s) than they can accommodate at any one time of the day. They were operating well above their maximum capacity during the peak hours and at or near their maximum capacity during off peak hours. The study survey revealed that except for Hilton, Ambassadeur and Muindi Mbingu street bus stops, K.B.S. are virtually kept out of all their other bus stops whose lay-bys are always occupied by 'Matatus'. The result is that K.B.S. have to load and off load their passengers while stopping on the traffic drive way.

This information is contained in the table below:

Table 2

Table 2: Level of Usage of CBD Bus Stops (P.S.V.s Per Minute)

Bus Stop	Lay-By-Capacity	Ave. Buses Per Minute		Excess Per Minute	
		Peak	Offpeak	Peak	Offpeak
G.P.O.	2	4	2.1	2	0.1
O.T.C.	2	4.7	2.9	2.7	0.9
Moi Avenue	2	3.4	2.4	1.4	0.4
St. Peters	2	4.1	2.1	2.1	0.1
Race Course	2	3.7	2.1	1.7	0.1
Ronald Ngala	2	4.1	2.6	2.1	0.6
Kipande House	2	3.8	2.1	1.8	0.1

Source: Field Data 1991

* Matatus are converted to bus equivalent. (2.5 minibus = 1 Bus in terms of space consumption) N.C.C. & K.B.S.)

(d) The frequency of arrival of the public transport vehicles at these bus stops is not matched by their frequency of departure. This is shown in the table 3. below and demonstrated further in the case studies. The mis-match between the frquencies of arrival and departure causes significant traffic build up at these bus stops so that the lay-by space is always occupied, leaving no room for the oncoming vehicles which therefore have to load and off load within the moving traffic lanes. Consequently the bus stops become bottleneck areas in the traffic flow and the magnitude of the problem is serious during peak hours.

Table 3

Build Up Rate of P.S.V. At Bus Stops Per Minute

Bus Stop	Freq. of Bus Arrival		Freq. of Bus Departure		Buildup Rates	
	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
G.P.O.	4	2.1	3.8	2.0	0.2	0.1
O.T.C.	4.7	2.9	4.5	2.7	0.2	0.2
Moi Avenue	3.4	2.4	3.2	2.3	0.2	0.1
St. Peters	4.1	2.1	3.8	1.8	0.3	0.3
Race Course	3.7	2.1	3.5	1.9	0.2	0.2
Ronald Ngala	4.1	2.6	3.8	2.3	0.3	0.3
Kipande House	3.8	2.1	3.75	2.1	0.05	-

Source: Field Data 1991

From the table 3 above in 57.1% of the bus stops studied, the rate of traffic build up at the bus stops is 0.2 buses per minute. By implication therefore in every 10 minutes the bus stops has 2 bus equivalents occupying the lay-by space. 28.6% had a rate of traffic build up of 0.3 per minute, hence in every 10 minutes there are 3 (three) bus equivalents at the bus stop. The fact that these are times when the roads are operating at their saturation point and that they are receiving on average a higher number of P.S.V.s (3.9 per minute) that needs to stop there leads to serious congestion.

The magnitude of the problem is reduced at off peak hours, but still remains high enough to raise concern. 28.6% of the bus stops covered were found to have a traffic build up rate of 0.2 per minute and another 28.6% to have 0.3 per minute. These bus stops were also found acting as 'Matatu' terminals and are located on roads where volume capacity ratio remains above average during the off peak hours.

(e) Another factor responsible for congestion at the bus stops is due to their indiscriminate use by Matatus without regard to other road users. Because Matatus are operating under no time tables, they have a tendency to remain at the bus stops long enough to pick up 'sufficient' number of passengers before taking off. In the process of loading what they consider as 'sufficient passengers' they move forth and back in

attempt to entice passengers and also compete one another. In so doing, they not only block the lay by from other P.S.V's but also the driving lane from other road users. Their duration of stay at the bus stops range between 2 to 4 minutes and 3 to 5 minutes during the peak and off peak-hours respectively.

'Matatus' short duration of stay at bus stops during peak times can be explained by the presence of large number of passengers needing to travel at such times and the Matatus desire to make as many trips as possible while the peak time lasts. The extra passengers are usually picked up en route to the residential destination. At such times, passengers are also on the rush to get home the soonest possible.

At off peak times the volume of passengers goes down, they are not with much hurry and relatively fewer passengers are available on route. The Matatus therefore take longer times at CBD bus stops and terminals to load `sufficient passengers'.

(f) Commuters behaviour with regard to picking up the P.S.V's also cause considerable delay in the picking up and dropping off activity at the bus stops. The mode of boarding vehicles is a free for all phenomena where they crowd at the door steps of buses and scramble to get in. The buses have their rear doors designated for getting in and the front doors for alighting only. Commuters have however ignored this regulation and there is usually a

struggle to get in using both doors while others struggle to alight at the same time. As a result, considerable time is spent in the picking up and alighting activity at the bus stops. 69% of the buses surveyed spent between 60-70 seconds during peak hours while the highest amount of time spent during off peak hours was 40-49 seconds, 57.1%. The information is contained in the table below. The times spent in picking up and alighting activity during the peak hours therefore compares unfavourably with the times taken during the off peak hours when there are fewer passengers and less crowding at the doors of the buses.

Table 4

Passenger Boarding and Alighting Times in the C.B.D. Bus Stops

Time in Seconds	Peak Hours		Off Peak Hours	
	Number	%	Number	%
70-80	-	-	-	-
60-70	58	69%	-	-
50-59	12	14.3%	-	-
40-49	10	11.9%	48	57.1%
30-39	4	4.8%	21	25%
20-29	-	-	11	13.1%
10-19	-	-	4	4.8%
	84	100%	84	100%

Source: Field Data 1991

This situation does not affect the N.B.S. as they mainly pick their passengers at the depots, and queuing method is used for boarding the buses. K.B.S. did introduce the blue bird service with an intention to implement the queueing method. However the study found that the blue bird services like other K.B.S. buses are boarded through scrambling. The system has not taken off and what remains is sign post instructing passengers to form a queue for the bus yet the instruction is ignored.

Both the City Commission and K.B.S. agreed that the bus stops are not adequate enough to offer reasonable service except for Hilton and Ambassadeur bus stops which are removed from traffic flow stream. Their opinion was that the bus stops are too few in view of the rising demand so that it is not possible to distribute their usage adequately between different service routes. The convergence at such points by a large number of passengers and vehicles heading towards diverse directions at certain particular times of the day was seen to also contribute to the congestion phenomenon at the bus stops.

3.1 CASE STUDY OF SELECTED PROBLEM AREAS

The following areas are selected for detailed study of the nature and extent of the problem

3.1.1 O.T.C. AND ST. PETERS BUS STOP

These two bus stops are both located on Racecourse road

at a distance of about 100 m apart. O.T.C. bus stop is sandwiched between the junction of Race Course-Ronald Ngala road, and Racecourse-Landhies road, and is fed by both Ronald Ngala and Rececourse road. This bus stop has a capacity of 2(two) stationary buses only but currently serves as a long stop for Eastlands Matatus which waits there to fill in extra passengers. The analysis revealed that the `Matatus' take as much as 5 minutes on average during off peak, and 3. minutes during peak hours calling for extra passengers at this stop. The bus stop receives an average 2.9 bus equivalents per minute during off peak and 4.7 per minute during the peak hours. The survey revealed that there are always 2 bus equivalents at the bus stop in any time of the day, covering the whole lay by space. At the relatively high rate of arrival of P.S.V.s that need to stop there, the bus stop usually presents a chaotic situation manifested in heavy congestion that spreads backwards into Ronald Ngala street (plate No.1).

The problem here is worse in the evening peak hour when congestion at St. Peters bus stop joins up with the jam at O.T.C. bus stop and spreads into Landhies road, Racecourse road and Ronald Ngala Street. Note that St.Peters bus stop also acts as a terminal for `Matatus' numbers 8 and 46. The study revealed that there are always an average 3 bus equivalents at the bus stop in any time of the day when it has a lay-by capacity of only two stationary buses. Inevitably therefore a considerable number of P.S.V.s

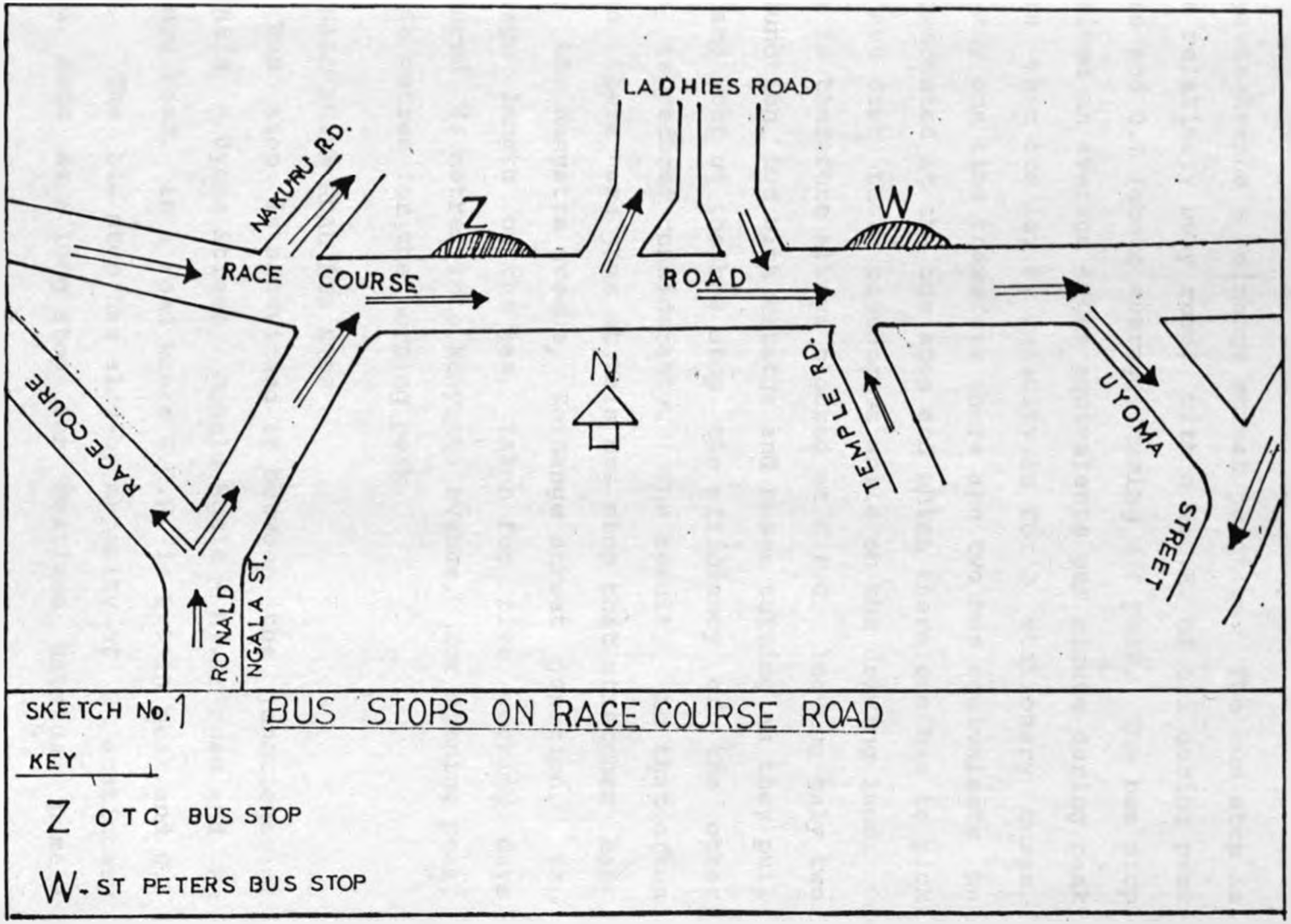
The second aspect is the government's concern for the operation of public transportation so as to facilitate ease of access to the public to enable them participate in the country's development process. It is therefore the responsibility of the public authorities, local or central to provide public transport facilities. In Nairobi, the provision of such facilities is the responsibility of N.C.C. The city authority ensures that there are enough supply to match demand, and that the supplementing facilities are adequately provided for.

The city authority also holds the power to issue or deny public service vehicle licences to those interested depending on the need and demand for such services and the supporting facilities available. Included here are K.B.S. buses, Matatus and Taxis. This gives the city authorities the power to control the public transport vehicles fleets and their operational characteristics.

Currently, this is a problem area in the city in that there is an imbalance between the designated bus parks and bus stops, and the demand for it by the public transport modes. The imbalance resulted from the fact that the city planning authorities for a long time in their spatial planning did not consider, the needs of `Matatus' which were either mis-understood or downplayed. Attempts to isolate them to separate locations in the city space has therefore always met with profound socio-political contentions. The

arriving at this bus stop has to stop on the driving lane thereby blocking the flow of traffic.

During the peak times when the volume capacity ratio of the road is approaching saturation traffic jams at this zone becomes an everyday phenomenon. The study found that at the evening peak times the jam at this section can stretch backwards for as long as 156 metres into Ronald Ngala and Racecourse road and 110 metres into Landhies road. The average length for 5 working days however was found to measure 102 metres into Ronald Ngala street, 108 metres into Racecource road and 89 metres into Landhies road. The morning peak jam was however found to be light, measuring 69 metres into Racecourse road and 52 metres into Landhies road.


LADHIES ROAD
NAKURU RD.
Z
W
RACE COURSE
ROAD
N
TEMPLE RD.
UYOMA STREET
RACE COURSE
RONALD NGALA ST.
SKETCH No. 1
BUS STOPS ON RACE COURSE ROAD
KEY
Z OTC BUS STOP
W- ST PETERS BUS STOP

3.1.2 G.P.O. BUS STOP

The bus stop is located on Kenyatta Avenue, near Kenyatta Avenue - Koinange street junction. The bus stop is on a relatively busy road, with a V.C.R. of 1.1 during peak hours and 0.7 (above average) during off peak. The bus stop received an average 4 bus equivalents per minute during peak hours when its lay by capacity is for 2 stationary buses. At any one time therefore there are two bus equivalents un accommodated at the bus stop and which therefore has to pick and set down their passengers while on the driving lane. One lane in therefore always blocked at G.P.O. leaving only two to function, but with Matatus and buses turning as they pull in and out of the bus stop the efficiency of the other lane is reduced considerably. The result, is that often times there are jams at this bus stop that stretches back into the Kenyatta avenue, Koinange street junction. The average length of the jam, taken for five working days measured 83 metres into Kenyatta avenue, for evening peak, and 46 metres for the morning peak.

3.2.3 RONALD NGALA ROAD BUS STOP

The bus stop is sandwiched in between the junctions of Ronald Ngala - Uyoma Street, Ronald Ngala - River road and Rn Ngala- Munyu road, in a road where V.C.R. is 0.9 in peak and 0.8 off peak. The bus stop has alay-by capacity of 2 stationary buses and acts as a long stop for Eastland Matatus, namely

numbers 42, and 10. and is considered a terminal by Matatus numbers 14 and 32.

The study found that the bus stop always has 3 bus equivalents both during the peak and off peak hours, implying that the bus stop is operating at a saturation point. In peak hours, it receives 2 bus equivalents per minute in excess of its lay-by capacity. The result therefore is that there is congestion at this bus stop that stretches backwards into the junction of Ronald-Ngala-Uyoma Street. Indeed the survey revealed that traffic policemen and K.A.N.U. youth wingers are always stationed at this bus stop throughout the day, to control traffic movement, 'Matatu' behaviour and to ensure that Matatus don't stay unnecessarily long at the bus stop.

The position of this bus stop is such that any serious jams there would spread backwards into Munyu road/Ronald Ngala junction and Uyoma street/Ronaly Ngala junction. This would have the effect of blocking the flow of traffic needing to get out of the city through Ronald Ngala street, through Munyu road into Ronald Ngala street, and through Uyoma street into Ronald Ngala street. It would also block traffic getting into the city centre through Uyoma street into Ronald Ngala street.

The study found however that jams in this zone was still a daily phenomenon. The average length taken for five working days measured 68 metres in the evening peak hours and 39 metres in the morning peak hours.

One common feature observed about these jams is that the morning peak hour jams eased out much faster relative to the evening peak hour jams. Perhaps this is due to the fact that there are more commuters needing to be ferried from the estates to the city centre and so the P.S.V's; the main actors in the jams at these points are also on the rush to get out. They therefore spend little time in the CBD area. In the evening peak, there is stampede and jostling of commuters, and P.S.V.s also take relatively longer times at the bus stops loading sufficient passengers. There is also a larger volume of vehicles struggling to get out of the city within that short duration of time.

The problem of congestion at bus stops cannot however be seen to happen in isolation, but has to be looked at in totality with several other factors as given below.

3.2 TRAFFIC VOLUMES

The study survey, done on the major public transport routes accross the C.B.D. showed that 4/5 of these routes have reached their saturation point in terms of traffic volume capacity ratio during the peak hours while 1/5 was above average. All were operating above average during the off peak hours. The information as contained in the table below therefore indicates that the level of vehicular volumes on the C.B.D. roads is by itself high enough to render it in efficient, in terms of facilitating the general traffic flow in the city centre. From this table, it can be

inferred therefore that the level of effectiveness of these roads in serving the CBD area is significantly poor. Any pinch point in the form of a bus stop that would cause the slightest interference with traffic flow results into a long traffic jam.

Table 5

Volume Capacity Ratio of Selected P.S.V. Routes

Road	V.C.R.	
	Peak	Off peak
Ronald Ngala Street	0.9	0.8
Tom Mboya Street	0.8	0.7
Kenyatta Avenue	1.1	0.7
Moi Avenue	1.0	0.7
Race Course Road	0.9	0.7

Source: Field Data 1991

$$\text{V.C.R.} = \frac{\text{Average Number of Vehicles/Hour}}{\text{Max Design Capacity of the Route}}$$

The study carried an enumeration to estimate the level of vehicle population in the C.B.D. space. The C.B.D. was divided into four zones A.B.C.D. and the peak hour count of car-accumulation taken.

Table 6

Vehicle Population in the C.B.D. Space by Zones

Zone	A	B	C	D	Total
Legal car parking spaces (excluding private-private)	2,256	5,133	1,530	1,420	10,339
Average Number of parked cars enumerated	3,470	8,363	2,162	2,010	16,005
Average number of illegally parked cars enumerated	1,214	3,240	632	590	5,676

Source: Field Data 1991

NB: Enumeration was done for 5 days.

The above table shows that there is a high density of vehicles in zone A and B which falls in the western part of the C.B.D. This is also the most densely developed side containing the commercial, administrative and institutional functions. The highest count of illegally parked vehicles was also recorded in these zones. That these vehicles were parked on pavements and street sides highly constricts traffic flow, both vehicular and pedestrian. The computed density of vehicles per 100 M^2 area of space in the C.B.D. was found to be 1.003 vehicles.

Further analysis on the proportion of vehicles by types in total volume shows that by and large, the majority of vehicles in the CBD streets can be classified as private vehicles. This reflects a relatively high growth rate of private vehicles in Nairobi.

Table 7

Proportion of Vehicle Types in the Total Volume by Time of the Day

Route	Peak Hour			Off peak		
	Public	Private	Others	Public	Private	Others
Kenyatta Ave.	13.1%	70.9%	15.9%	15.2%	71%	13.8%
Moi Avenue	8.8%	68.2%	23.%	10.6%	63.6%	25.7%
Race Course Rd.	21%	47.4%	29.6%	26%	47.5%	26.5%
Ronald Ngala	25.2%	55.6%	19.2%	24.8%	52%	23.2%
Tom Mboya St.	21.3%	53.9%	24.8%	20.1%	52.4%	27.5%

Source: Field Data 1991

These figures indicate that the percentage of private cars in the CBD streets is quite high throughout the day and therefore has created extra demands on the CBD's roads and parking spaces. As a result they contribute significantly to traffic congestion on the major roads, especially during peak hours. A comprehensive transportation policy for the city aimed at easing the congestion phenomenon in the CBD

must therefore begin with the issue of private vehicular access to the CBD area and their segregation from public transport modes, on other major transport routes approaching the CBD.

3.3 TRIP ORIGIN AND DESTINATION AREAS IN THE CBD

This study found that 82.1% of CBD bound trips ended within the zone to the East of Moi Avenue and 3/4 of them were concentrated around Hilton, bus stop, Ambassadeur, National Archives, Tom Mboya and Ronald Ngala streets. 77.9% of trips from the CBD were found to originate from the same zone. These findings shows that there is lack of equitable distribution of trip origin and destination points in the CBD area. That such a high level of CBD trips end or begin within one zone bears serious implications on the general traffic flow in the area. Indeed the roads in this zone were found to be the worst hit, in terms of route congestion.

NB Private here is used loosely to mean all vehicles other than P.S.V's. Lorries, Motorcycles and bicycles.

Table 8

Trip Origin and Destination Areas in the CBD

	Percentage of Vehicle trips having areas as	
	Origin	Destination
G.P.O.	22.1	17.9
Hilton & Ambassadeur	43.2	40.0
Tom Mboya & Bank Street	21.1	20.0
Bus Station	6.2	11.6
Gill House	7.4	10.5

Source: Field Data 1991

The findings also raise an important planning issue regarding which side of the CBD to locate terminal points for the public transport modes, so as to meet the operational desires of the commuters as conveniently as possible.

3.4 TRAVEL TIME SPEEDS ACROSS THE CBD

The moving time speeds across the CBD area were found to be low and closely approaching the break down point speed of 9.6 Km/hr. particularly during peak hours. Overall however, K.B.S. were found to be relatively slower, covering the journey at almost half the speeds of the other two modes; Matatus and N.B.S. Their slow speed could be accounted for by their age. K.B.S. are running relatively

older buses. Also their vehicle body size limits their efficiency in terms of manouvrebility at road junctions, traffic lights and traffic jams.

The table below gives the moving times across the C.B.D. for the different modes of transport.

Table 9

Moving Times Across the CBD in Minutes

Route	Length	Time in Minutes Spent by Modes			Mean Moving Time in Minutes
		K.B.S.	Matatu	N.B.S.	
Kipande House - O.T.C.	1.8 Km	10.6	6.2	7.8	8.2
St. Peters - G.P.O.	1.9 Km	11.6	6.4	7.7	8.6
G.P.O. - Race course	1.8 Km	10.9	6.1	7.9	8.3
Tom Mboya - Racecource	1.3 Km	-	4.2	5.4	4.8
O.T.C. - Tom Mboya	1.1 Km	-	3.6	4.8	4.2
University way - O.T.C.	2.3 Km	12.3	-	-	-
Gross Mean	-	11.3	5.3	6.7	6.8

Source: Field Data 1991

See map no. 7 pg 147 showing the routes followed.

From this table, the moving time speeds for the three modes were calculated as given in the table below:

Table 10

Moving Speeds in Km/Hr Across the C.B.D. by Modes

Route	K.B.S.	Matatu	N.B.S.	Mean Speeds
Kipande House - O.T.C.	10.1	17.4	13.8	13.8
St. Peters - G.P.O.	9.8	17.8	14.8	14.1
G.P.O. - Race course	9.9	17.7	13.7	13.8
Tom Mboya - Racecourse	-	18.5	14.4	16.5
O.T.C. - Tom Mboya	-	18.3	13.7	16.0
Gross Mean	9.9	18.7	14.1	14.8

Source: Field Data 1991

The overall analysis of information in the above table indicates a condition of high level congestion as the traffic moving speeds are fast approaching the breakdown point speeds.

This information is further subjected to student `t' test to determine whether the difference between the expected operational speeds and the observed speeds is significant enough to imply congestion. The design speed of these roads is 50 Km/hr, but the legal allowed speeds is 40 Km/hr. Considering that the breakdown point speed is 9.6 Km/hr, the mean operational speeds would therefore be reached at 25 Km/hr.

Using "t" test

Using 't' test,

$\bar{x} = 25$ where $\bar{x}$ = mean operational speeds (expected)

$\bar{y} = 14.8$ $\bar{y}$ = mean observed operational speeds

$$\Sigma(x - \bar{x}) = 0$$

$$\Sigma(y - \bar{y}) = 7.26$$

$$\hat{\sigma} = \frac{\sqrt{(= (x-\bar{x})^2 + 2(y-\bar{y})^2)}}{n_x + n_y - 2}$$

$$= \sqrt{\frac{0 + 7.26}{5 + 5-2}}$$

$$\hat{\sigma} = \sqrt{0.908} = 0.952$$

$S.E_{\bar{x}} = \hat{\sigma}/\sqrt{n_x}$ and in this case $S.E_{\bar{x}} = S.E_{\bar{y}}$ because $n_y = n_x$

$SE_{\bar{y}} = \hat{\sigma}/\sqrt{n_y}$ so $S.E_{\bar{x}} = \frac{0.952}{2.236} = 0.425$

$$SE_{(\bar{x}-\bar{y})} = \sqrt{[(S.E_{\bar{x}})^2 + (S.E_{\bar{y}})^2]} = \sqrt{(0.180 + 0.180)} = 0.601$$

$$t = \frac{\bar{x} - \bar{y}}{S.E_{(\bar{x}-\bar{y})}} = \frac{25 - 14.8}{0.601} = 16.9$$

at = 0.01 (99%) confidence level and 2 degrees of freedom

$t_c = 9.93$ Hence $t > t_c$

The difference between the observed and expected operational speeds is therefore significant enough to warrant the rejection of the null hypothesis, that there is no significant congestion in the CBD routes.

Although a road may have a lower volume capacity ratio, slower moving speeds can cause serious congestion. Idealy, a route operating efficiently should be able to allow vehicles to pass through it at any given hour without delay or restrictions on manouvrability under the operating traffic conditions.

The above information and test also shows that `place accessibility' is considerably inhibited. Place accessibility here is implied in the moving time across the CBD which measures how easy it is to get across the CBD area from various entry points using the three modes. Indeed, the study survey indicated that commuters had a tendency of alighting or picking up their vehicles in places other than bus stops or terminals, namely at traffic jams or traffic lights. The reasons given for this kind of behaviour by commuters tie up well with the problems of route congestion, slow vehicular moving speeds and hence inhibited accessibility.

N.B. The measure of accessibility here is based on analysis of public transport. Again it is important to note that accessibility can be related to more than just one factor. For example the frequency of service between the said places could equally be important.

Table 11

Reasons for Dropping in Places Other Than Bus Stops

Reasons	Response	%
1. Slow traffic movement so it is convenient to alight and walk	51	53.6%
2. Vehicles are crowded and stuffy so one drops as soon as is convenient	21	22.1%
3. Bus stops are not at convenient places in relation to destinations	15	15.9%
4. Matatus force people to alight at such places	8	8.4%
Total	95	100%

Source: Field Data 1991

By and large therefore, the congestion phenomenon in the CBD which results in slower moving speeds is the leading factor that induces commuters to alight in places other than the legally provided bus stops. This is followed by the factor of crowding in the vehicles which together with the slow moving speeds creates a tense, strainous and tiring atmosphere that prompts commuters to disembark as soon as is convenient, to also avoid going beyond their destinations due to problems of alighting.

An important point to note here is that commuters travel behaviour is conditioned by the ease or difficulty

with which the journey is taken. The average commuter is generally impatient and would not withstand the congestion situation especially when his destination is at a walking distance and even more because most of the trips taken are usually work trips, school, or business trips that are governed by time.

The ease of movement is seen in terms of time cost of moving from a point 'i' to a point 'j'. so that if a commuter has his destination at 'k' but needs to go all the way to a bus stop 'j' to alight and then walk across to 'k', the chances that he will alight at point 'i' or midway between point 'i' and 'j' soon as the opportunity presents itself then cut across to 'k' will depend on the perceived time cost of moving by the vehicle from the point 'i' to 'j' then walking across to destination 'k'. The higher the cost, the higher the likelyhood of commuters dropping to walk, depending also on the time he was at his disposal.

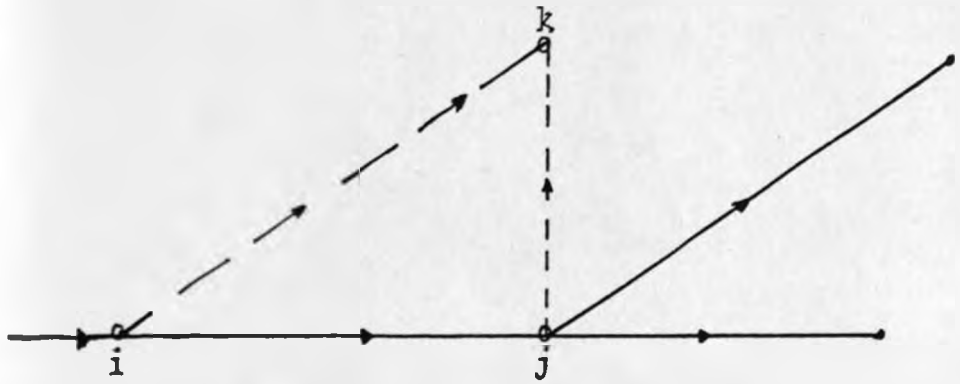


Figure 1

Probable Alighting Points for a Commuter

where

i = One point of entry into the CBD

j = The bus stop closest to the commuters destination

k = The commuter's destination in the CBD.

3.5 TRAFFIC LIGHTS

Traffic lights are on all major traffic junctions that are conceived as trouble spots in the traffic flow. The study however found that on the contrary, they cause significant and variable delay for in the journey, taking as much as 1/3 of the total journey time across the CBD area. The specific times taken by the individual vehicles at the lights however depended on the position of the bus in the queue when the cycle begins.

In conclusion, it can be said therefore that the CBD routes and bus stops are significantly congested thereby rendering in efficient, the operation of public transport system.

CHAPTER 4

ANALYSIS AND EVALUATION OF TERMINAL POINTS CRISIS IN THE CBD AREA

4.0 NATURE AND PURPOSE OF A TERMINAL FACILITY

Idealy, a terminal facility is an essential element in a transport system. It represents an interface between the transport system and the city at large, and is a place where passengers supposedly enter or leave the system.

The provision of a terminal point therefore is an accomplishment of a number of functions which include:

1. Reduction of traffic obstruction in the streets, hence it helps avoid delays arising from vehicles stopping to pick up or set down passengers at various locations, on the road. It therefore also provides a means for passengers to board or alight from vehicles.
2. A comfortable weather protected place for passengers waiting for vehicles and provides information aids to guide passengers on the use of the system. In certain circumustances, it may also provide storage place for transit vehicles not in use; for minor repairs or crews changing.

The area required for a terminal facility entirely depends on the various local circumstances which dictates the volume and frequency of traffic. The need to meet peak traffic load is one such circumstance that bears

considerable influence on a terminal. As both human and vehicular traffic increases the need for an ample site that allows for extension arises more so where like in the case of `Matatus' the mode of operation involves long waits at the terminal point to fill in `extra or sufficient passengers.

One important factor in the location of bus terminal is its relationship to the roads and generall traffic flow of the surrounding area. The concentration of the vehicles using the station must not impede normal street traffic flow or increase danger for the road users.

4.1 K.B.S. C.B.D. BUS TERMINAL

Kenya bus services is a private company owned by the United transport overseas company ltd of Britain, with Nairobi city commission holding 25% shares. The company started in 1934 and operated on a franchise agreement with N.C.C. until 1985. Since then the franchise is renewed on annual basis. This franchise made K.B.S. the sole licenced public transport mode within the city of Nairobi.

K.B.S. is provided with one C.B.D. terminal (sketch No 2) with a capacity of 35 buses and 5 more parking bays for minor servicing. Of the 35 parking bays only 15 are used for picking up and setting down passengers. Basically, K.B.S. uses the bus stops provided on major C.B.D. commuter

roads particularly at Hilton and Ambassadeur to pick up and set down their passengers. The C.B.D. bus terminal is therefore used mostly for management purposes, which includes minor servicing and fueling, and for changing crews and re-routing to reduce the dead mileage that could otherwise have to be covered to Eastleigh depot. It is therefore the contention of this study that the terminal is being under utilised. It's daily capacity is estimated below:

- The provided parking spaces = 15 lots
- Time limit for daily operation of the station = 14 hours
- Maximum time allowed per bus = 10 minutes
- In 1 hour each lot can take = 6 buses.

The current daily capacity of the station = 15x14x6

= 1260 buses per day

Given the daily operational capacity of the terminal 1,260 and the average number of buses that call at the station per day are only 784, it is evident that the daily utilised capacity of the terminal is below the available capacity (place No. 2). If another passenger waiting space were to be built on the western wing of the terminal, this operational capacity could be doubled.

The aggregate number of parking hours compared with the number of buses that call at the terminal daily may not be

so important, but the time schedules and the frequency of arrival and departure of buses from the terminal. Movement of K.B.S. is governed by time tables, but delays are frequent thus making them inefficient and unreliable. It is common phenomenon therefore to find several buses operating on the same route follow each other at a distance of 1 or 2 minutes apart hence they arrive at the terminal or bus stop almost at the same time. Such a phenomenon would threaten the efficient management of the bus station.

While K.B.S. terminal is currently operating below capacity, it would still be inadequate to meet the total daily demand if all K.B.S-C.B.D. trips were to pass there.

The K.B.S. total daily trips given below shows that demand could still be far in excess of the capacity of the terminal, hence a large number of K.B.S. C.B.D. trips would still have to depend on the bus stops especially the Hilton and Ambassadeur bus stop for picking and dropping their passengers. Other C.B.D. bus stops would also have to be used however congested they may be.

Table 12

K.B.S. Fleet and Daily Passenger Journeys

For the Last 10 Years

Year	No. of Buses	Passenger Journeys Per Day
1980	310	273,000
1981	316	282,000
1982	306	329,000
1983	322	329,000
1984	***	***
1985	424	362,000
1986	264	372,000
1987	300	431,000
1988	263	436,000
1989	247	475,000
1990	236	476,000

Source: K.B.S. & N.C.C. Transport Unit Data (unpublished)

The growth in passenger journeys between 1985-1990 rose by 29.1% and is projected ro rise to 59.6% between 1990 and 2000. According to transurb consult group (1986). The total passenger journeys by the year 2000 is expected to be 1,393,000 out of which K.B.S. is projected to take 760,000 passenger journeys per day.

This level of passenger journeys would be high enough to raise concern over the supply of public transport modes on one hand and on the other hand the supply of supporting facilities in the form of enough road space, and much more the supply of bus stops and terminals space in the C.B.D. or within its periphery at easy walking distance. The C.B.D is still poised to remain by and large their arrival and departure points in the city.

In terms of maintenance, K.B.S. has a fully staffed engineering depot at Eastleigh with 500 staff. It is therefore mandatory that each bus goes for checking every 10 days whether it has or does not have any mechanical problem. The 5 parking space for servicing at their C.B.D terminal can therefore be conceived as being adequate.

This does not mean however that K.B.S. does not suffer maintenance hardships. An average of 20 buses still break down everyday for minor mechanical problems and has to be towed to Eastleigh depot for repair. The main reasons for this rate of breakdown are given as.

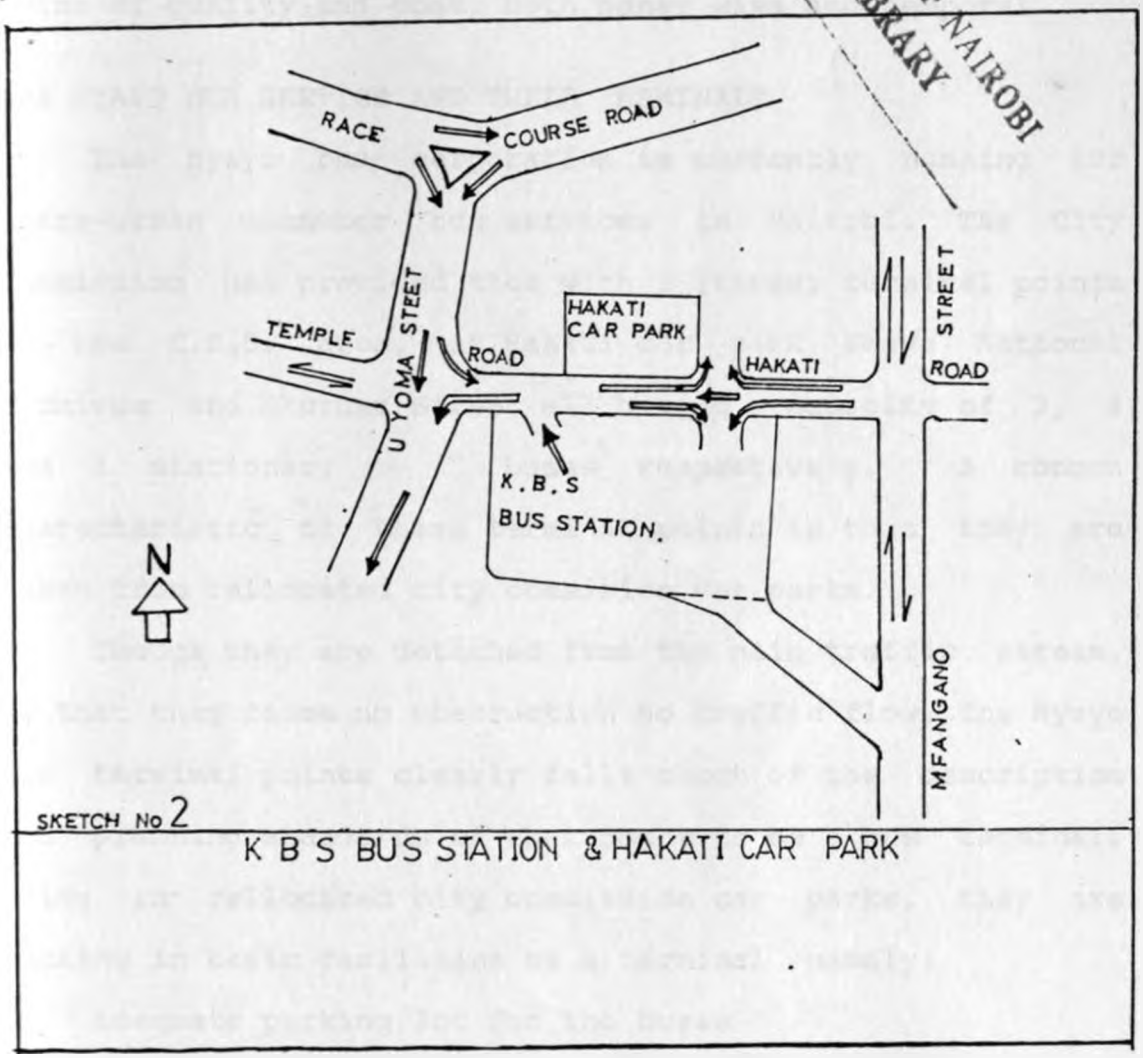
1. High competition with `Matatu' and now also with N.B.S. has reduced their profitability, resulting in difficulty for K.B.S. getting necessary financial resources to buy new buses to meet the rising passenger demand. K.B.S. is therefore running relatively older buses that are prone to frequent breakdowns.

2. Lack of subsidy from the government, despite the high operating costs.
3. High costs of spare parts.
4. Poor allocation of foreign exchange to the company by the government.
5. The problem of congestion during the peak hours hence the high rate of wear and tear of the vehicles.

Despite these problems, K.B.S. no doubt is and should continue to play a significant role in providing public transport in the city. This spells out the need to increase their efficiency and quality of service offered. To be able to do this there is need on the part of the management to work on quality side of the service, buy new buses and improve the frequency of the service.

There would be need on the part of the government to re-examine their policy regarding the allocation of foreign exchange reserves to K.B.S. so that what is allocated to them reflects their requirements. `Service rendered to K.B.S. is service rendered to the `common man' who forms the bulk of the public transport service consumer.

The City Commission on their part need to increase their shares in the company, to a dominating level so that they have a mutual responsibility in improving the efficiency and quality of service offered by K.B.S.



SKETCH No 2

K B S BUS STATION & HAKATI CAR PARK

At the planning and policy level, there is need to co-ordinate the services rendered by the three public transport modes so that they offer complementary services but within a competitive atmosphere, to the benefit of the commuter in terms of quality and cost, both money wise and temporal.

4.2 THE NYAYO BUS SERVICE AND THEIR TERMINALS

The Nyayo bus corporation is currently running 102 intra-urban commuter bus services in Nairobi. The City Commission has provided them with 3 (three) terminal points in the C.B.D. area, at Hakati car park Kenya National Archives and Nkuruma Street all having a capacity of 3, 4 and 2 stationary buses respectively. A common characteristic of these terminal points is that they are taken from rellocated city commision car parks.

Though they are detached from the main traffic stream, so that they cause no obstruction to traffic flow, the Nyayo bus terminal points clearly falls short of the description and planning standards of what ought to be a bus terminal. Being in rellocated city commission car parks, they are lacking in basic facilities of a terminal namely:

1. Adequate parking lot for the buses
2. Waiting space for passengers, so that passengers often have to crowd on pavements where they queue, of course exposed to the vagaries of weather (rain or hot sun).

The three terminal points are still used alternately with other modes. National Archives for examples is shared with Taxi cubs and private vehicles which use it during the off peak hours, Hakati car park is shared with Matatus where as Nkuruma road is shared with private vehicles. There is therefore conflict of use of space between the three different modes at these points.

As the fleet of N.B.S. intra-urban bus services continues to expand, and as the concentration of the N.B.S. vehicles using these terminal points continue to grow, they would need to be provided with a central terminal in or around the C.B.D. area, so that they are not only able to centralise their operations and enjoy economies of localization, but also meet the rising travel demand by commuters.

Currently, N.B.S. has an ambitious vision, to become the leading commuter bus service in the city, and set up standards in the public transport sector through discipline.

The table below shows the growth of N.B.S. bus fleet since 1986.

Table 13

Growth of N.B.S. Fleet 1986-1992

Year	Buses
1986	6
1987	76
1988	100
1989	142
1990	162
1992*	360*

Source: N.B.S. 1990 * Projected target

The corporation has set up a KSh.600 million worth complex at Ruaraka with a parkyard capacity of 360 buses and a capacity to fuel and service eight buses at ago. It also has a ware house capable of storing spare parts amounting to 10% of the total fleet of the buses. This would by and large remain as their depot in the city both in the near and long term future where they would park while off duty and for service. Unlike K.B.S., N.B.S. operate relatively new buses and as such suffer no large scale breakdowns. Their highest number of breakdowns was experienced in 1989 November when 25% (35) of the buses went for repair.

What N.B.S. need therefore is an ample parking site in the C.B.D. with passenger waiting bays for their commuter bus service operations in the city. Currently N.B.S. operate only peak hour sevice and have an average daily

passenger ridership of only 2000. Such a terminal space ought to be adequate enough to accommodate a full day N.B.S. operations, and their projected total fleet of 360 buses.

N.B.S. operate on almost an express service basis picking up and setting down passengers only at their depots (terminal points) in the city, save for those cross city services which use G.P.O., KENCOM, Ambassadeur and St. Peters bus stops.

In terms of their route organisation, N.B.S. management has divided Nairobi into two zones, the Eastern and Western zones, with Moi Avenue as the demarcating line. Each zone has a zone commander and is provided with a depot in the C.B.D. Kenya National Archives and Hatati car park serves the Eastern zone while Nkurumah Avenue serves the Western zone. The depots are managed by base commanders under whom are several inspectors and servicemen (women) to ensure organised queueing up and issue passengers with tickets.

Currently N.B.S. still has no definite route map, although details of the routes on which they operate were available with their base commanders. President Moi's directive is still the major factor guiding N.B.S. management on what routes to serve. Their choice of routes is therefore influenced by public opinion, based on the availability of other services on the route. Majorly, they serve the most populous areas of the city which also happen to house in the majority, the low income earners of the city.

The public write to the management about the services rendered to them, stating the current commuter facilities serving the area and current fares. A search team would be despatched to verify the information after which the respective zone commander may start a service there, depending on availability of buses. The N.B.S. also carryout independent surveys to identify new routes. Such routes must have sufficient demand. This study however found that N.B.S. are operating on 20.8% of the intra-urban routes served by K.B.S. and Matatus and they use the same route numbers as K.B.S.

The Nyayo Bus Corporation's policy on route selection and mode of service offered may only work on conditions that they continue to receive government subsidies and grants by external donors. So far the corporation has acquired their buses mainly in form of grants from Netherlands and Italy which also included spare parts worth 15% of the value of the buses. Between 1986 and January 1989 the N.B.S. was able to make a profit of 15 million; their operational costs having been covered. Conductors are however not paid because they are still serving under the auspices of National Youth Service.

With the governments subsidy withdrawn and grants no longer coming, so that N.B.S. have to buy their spare parts, their new buses and pay the full cost of their operation, they would need to be more aggressive in operation if they

have to not only make profit but also pay for the cost of operation. Their choice of routes of service would not be guided by public opinion as much as by the ability of the said route to pay the costs of service.

The study revealed that the problem is already beginning to bite hard. N.B.S. routes numbers 22 and 21 previously serving Harambee Estate, Maringo, Jericho and Jerusalem have for example been withdrawn because they were operating under capacity due to high competition from Matatus and K.B.S., so they could not pay the cost of drivers, fuel and servicing.

It would also become necessary for N.B.S. to operate full day service as opposed to their peak hour only service. The management pointed out that they are receiving complaints from commuters indicating that most routes now experience great reductions in their transport facilities after N.B.S. withdraws. This information has already been confirmed by N.B.S. research teams.

The table below gives the total daily trip demand for public transport in both the peak and off peak hours for the year 1985 to the year 2000.

Table 14

Present and Projected Passenger Journeys to and from the C.B.D.

Passenger Journeys Per Day to and From the C.B.D.			
Time/Year	Peak Hrs	Off peak hrs	Total
1985	202,800	473,200	676,000
1990	296,820	576,180	873,000
2000	417,900	975,100	1,393,000

Source: Derived from Transurb Consult Report 1986

Although peak hour passenger journeys are far less than off peak hour journeys, the peak hour problem is to be seen in view of the fact that these journeys are made within short duration of time Periods, namely 7-9 a.m. and 4.30 - 6.30 p.m. The concentration of such high levels of passenger journeys within the short time period puts strain not only on the public transport modes but also on the supporting facilities; much more the roads, bus stop and terminals. The gravity of the problem is much more clear seen in view of the fact that such trips are uni-directional. In the morning peak, the C.B.D. acts as the main trip attraction point and in the evening peak as the main trip generation point.

The off peak passenger journeys remain high enough to warrant full day operation by N.B.S. to supplement the service of 'Matatus' and K.B.S. This should also be seen from the fact that the hourly demand of passenger journeys during the off peak hours stands at 52,380. The current level of provided public transport modes can only take 41,325 at any given hour. This gives a short fall of 11,055. The result therefore is an inevitable overloading in the public transport modes even during the off peak hours. A large number of passengers have therefore to wait longer than necessary for the transport modes at the bus stops. This phenomena presents 'Matatus' operating on an aggressive profit making policy with an enticing atmosphere to resourt to over speeding as they attempt to make as many trips as possible.

The conclusion here then is that there exists a justifiable case for N.B.S. to operate off peak hour services. Their 'peak hour only' services has limited their share of the market which stands at 19.4% of the peak hour demand and only 6.6% of the total daily demand. The market share was projected to stand at 54.5% for K.B.S. and 45.5% for Matatus by 1990.

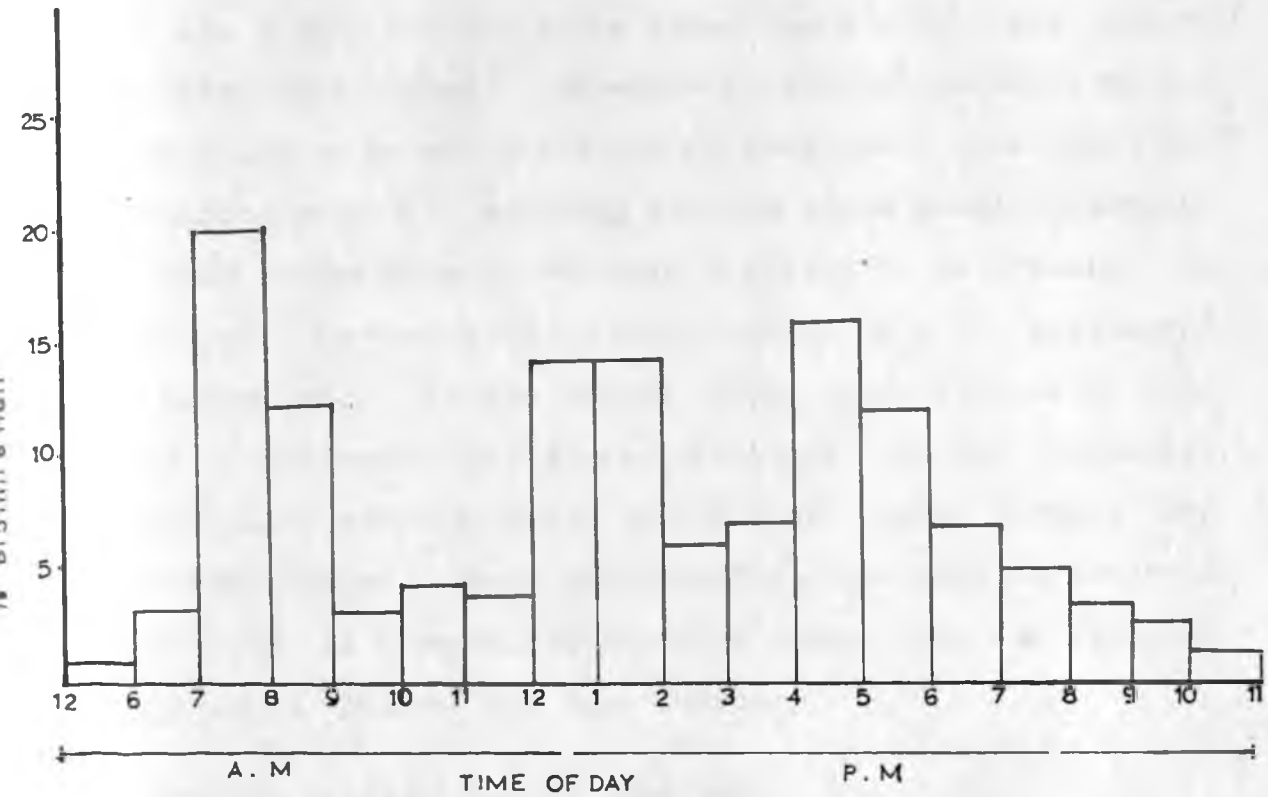


FIGURE 2

TRIP DISTRIBUTION BY TIME OF DAY

Source N.C.C D.P.U 1984

The current policy of deploying N.B.S. services to other major towns in the country side, yet they are still managed from Ruaraka (Nairobi) and brought there for repair and servicing may also not augur well for efficient management of the corporation.

If the policy of a route having to pay for itself is to be adopted then it would be appropriate to have N.B.S. operations concentrated first in Nairobi, to exhaust the excessive demand. Only then should decentralization be done and eve n then only to those towns where sufficient demand has been established. Decentralization of services should be followed by decentralization of management, so that the operations of N.B.S. services in such towns should gradually be made autonomous. For such a policy to be viable, it would also be necessary to depoliticise N.B.S. management and operations. At the moment, their operations still come under considerable political influence. During political ralies and national days, N.B.S. are used without any profitable gains. Their deployment to the district towns is also more of a political decision rather than a decision inspired by demand for such services.

4.2.1 NATIONAL ARCHIVES N.B.S. TERMINAL

The National Archives was formerly a bus stop serving K.B.S. route 26 and 36. The bus stop was later re-llocated and the space assigned parking for private vehicles. When N.B.S. started in 1986, the city commission moved out the

private vehicles and assigned the area to N.B.S. The terminal has a capacity of taking 4 buses at ago and is used during the off peak hours by Matatus route No. 46. The adjacent areas flanking the terminal is still used by Taxis and private vehicles.

The study revealed that the terminus receives 1 bus in every 4.6 minutes during the peak hour and that the buses take an average of 10.6 minutes at the terminal. During this time period, the buses are assigned a trip, depending on the longest queue at that moment which needs to be emptied. Tickets are then issued and the buses boarded. At this rate, the study found that there was always an average of 3 buses waiting to load at the terminal. At their rate of arrival at the terminal the buses form a queue often times stretching backwards to Tom Mboya street and in the process cause obstruction on traffic flow.

The study found that if tickets were issued before the arrival of the buses so that the bus would only arrive to pick up passengers and take off, then the buses take only an average of 4.3 minutes at the terminal. At this rate, the terminal could be able to cope with the demand, operating at its full capacity. Their delay and congestion at the terminal is therefore currently due to their method of operation.

The picture is demonstrated more clearly in the graph below (Figure 3). It shows that between 5.20 p.m. and 5.40 p.m. for example an average of 8 buses arrived at the

terminal, out of which only 5 departed, leaving behind 3 buses still on the queue and between 5.40 p.m. and 6.00 p.m. 5 buses arrived at the terminal, of which only two departed, again leaving 3 buses on the queue. On the whole, the rate of arrival of the buses at the terminal is not marched by the rate of departure hence there is an inevitable congestion at the terminal.

However, assuming that the rate of arrival remains constant at 1 bus in every 4.6 minutes and that each bus takes 4.3 minutes to pick up passengers and take off if it arrives to find passengers already issued with tickets, then in 20 minutes time, the number of buses arriving would be

$$\frac{20}{4.6} = 4.3 = 4 \text{ buses}$$

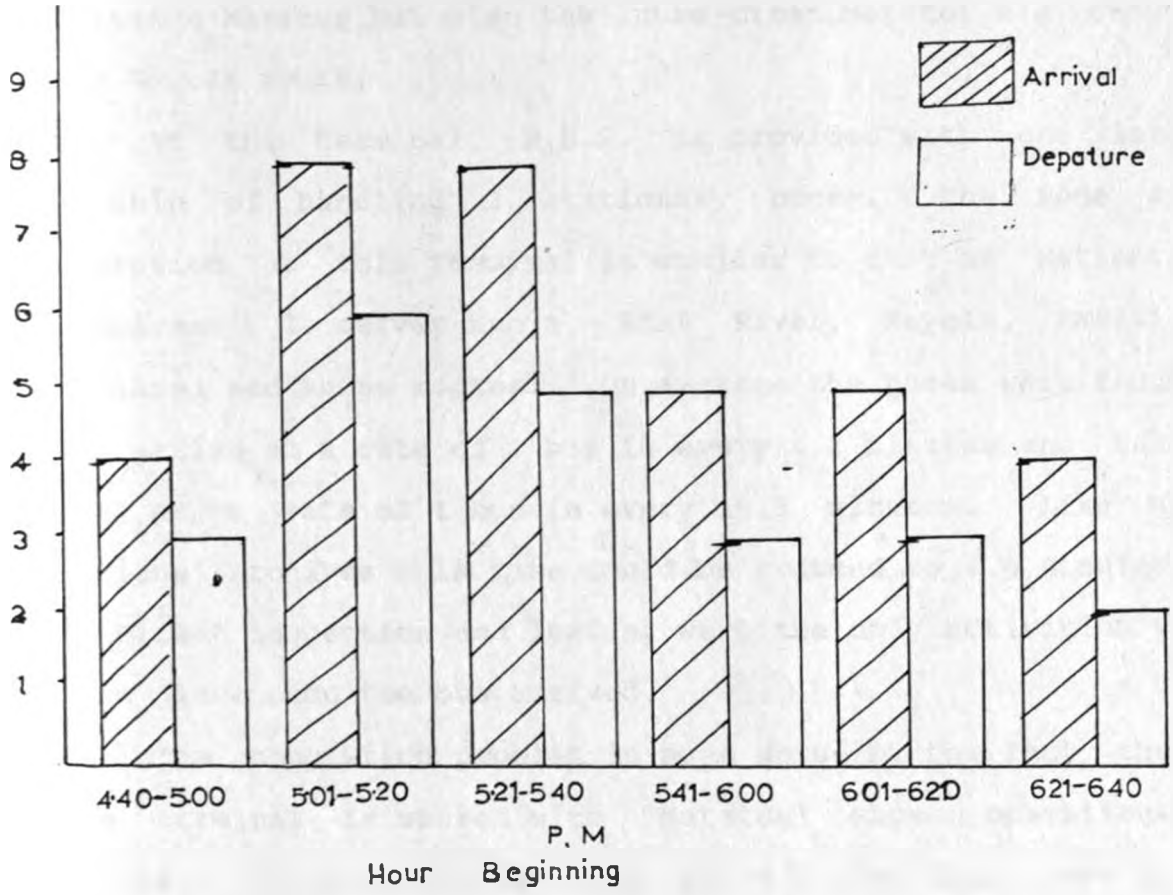
and the number of buses leaving would be

$$\frac{20}{4.3} = 4.6 \text{ or } 5 \text{ buses}$$

The rate of arrival therefore is matched by the rate of departure. If other factors are held constant, for example congestion which causes delay, leading to many buses arriving at the terminal at shorter intervals, then the above result indicates that the terminal can cope with demand, operating at its saturation point

In terms of route frequency the terminal received a higher number of buses on the Dandora route, 1 bus in every

10 minutes giving a total of six (6) buses in an hour. This was followed by Kariobangi route, 1 bus in every 15 minutes then Mathare North, 1 bus in every 20 minutes. These are important aspects that should be considered in planning so that adequate space is provided for each route within the terminal which reflects their demand, current and projected.



Field Data 1991

Figure 3

Bus arrival and departure at the terminals a comparative view.

4.2.2 HAKATI ROAD TERMINAL

Hakati road terminal is directly opposite K.B.S. bus station, (Sketch No 1). It was originally established by N.C.C. as a car park but was re-llocated and given to long distance Matatus, for example to Ongata Rongai, Athi River and Kiambu in 1983. In 1988 N.B.S. were also moved there, so that the terminal is now shared not only with the long distance Matatus but also the intra-urban Matatus e.g. Umoja and Kayole route.

At this terminal, N.B.S. is provided with one lane capable of handling 3 stationary buses. the mode of operation at this terminal is similar to that at National Archives. It serves Umoja, Athi River, Kayole, Kamiti, Embakasi and Ruiru routes. On average the buses were found to arrive at a rate of 1 bus in every 4.2 minutes and take off at a rate of 1 bus in every 10.3 minutes. Like at National Archives this time could be reduced to 4.6 minutes, if ticket inspection and loading were the only activities to take place once the bus arrived.

The congestion problem is made worse by the fact that the terminal is shared with 'Matatus' whose operational habits, as described earlier is such that they have no regard for other road users or the terminal space users. It is worth noting also that this terminal is located at the entrance of K.B.S. bus station hence, congestion here blocks the entrance leading to jams that stretches backwards into Mfangano street and also to Uyoma street.

Overall therefore the current space provided for N.B.S. can be able to cope with their demand at the present fleet levels. N.B.S. therefore only need to change their mode of operation at the terminal. Properly planned terminals are however still necessary for the future operations of N.B.S. and for the convenience of passengers.

4.3 MATATU OPERATIONS AND THEIR TERMINALS

Matatus are vehicles of smaller carrying capacities than buses usually their maximum carrying capacity does not exceed 3 metric tons and are used in the transportation of goods and passengers. There are two types of Matatus operating in Nairobi namely the micro bus with a carrying capacity of 15 passengers and the mini bus type with carrying capacity of 25 passengers.

The Matatus are generally faster than their K.B.S. counter parts. Being smaller and not restricted to any official operating policies, they can reach areas not accessible to K.B.S. vehicles. Their informal mode of operation increases their flexibility so that they can easily adapt to suit demand for example during the peak hours. The following table shows the increase in Matatu fleet in the city over the past four years.

Table 15

Intra-Urban Matatu Fleet 1987-1990

	Year			
Matatu Type	1987	1988	1989	1990
Micro Bus	786	633	612	711
Mini Bus	423	655	704	859
Total	1,209	1,288	1,316	1,570

Source: K.B.S. 1990 June.

Matatus then are the only major competitors with K.B.S. as public transporters in Nairobi. Their number has increased over the years and is projected to continue to increase significantly. With the projected increase in public transport demand it becomes clear that Matatus would be an indispensable system in the city's public transportation. They charge slightly higher fares than either K.B.S. or N.B.S. but operate largely on the same routes as K.B.S. They however don't operate within any time table.

Until 1984 N.C.C. had not seen Matatu as a constituent sector of public transport consequently no provision was made for them in the city's planning. They have been seen as uneconomical users of road space; 1 bus is equivalent to 7.5 Matatus in terms of maximum carrying capacity. However their operations has grown to a level that they constitute a gigantic problem with respect to management of the city's road traffic and transport system. Their growth seems to

have striped off the law enforcers efforts to manage their operaions in line with traffic codes of conduct. Their operational characteristics is therefore marked by over loading, overspeeding, dangerous driving, poor maintenance of vehicles, unrully drivers and conductors, chaotic parking methods and general disregard for traffic codes hence they obstruct other road users.

These operational characteristics of Matatus could largely be held responsible for the planning authorities' cold response to integrate it with other modes of public transport in the city. Consequently, the Matatu system has suffered prejudice which has resulted in severe hardships in its operation. Independent studies on `Matatus' and even researches into Matatu system by N.C.C. has largely been focused on how to streamline their operations. A study by N.C.C. transport unit 1979 for example came up with the following 4(four) recommendations:

(i) To reduce over loading in Matatus

(ii) To improve their road worthiness

(iii) To improve their quality of driving

(iv) To make Matatu operators financially responsible in case of accidents.

Any concern for Matatus by N.C.C. has since then followed along those lines. Two important areas were however neglected.

(i) Integrating Matatu into the urban transport planning framework.

(ii) With the above, planning for their terminal facilities in the C.B.D.

Interviews with City Commission and Matatu operators indicated that the places designated as Matatu terminals in the C.B.D. area have been provided either through ad-hoc planning or as a result of lobbying by the Matatu Organisation (M.V.O.A) Matatus have also taken up some places illegally and there after have to defend themselves against eviction. Such places are for example Kimathi lane and the junction of Mfangano - Ronald Ngala streets. Where such places were allocated through lobbies, a M.V.O.A. branch would identify a place and apply for permission of use.

N.C.C. would verify the space available and the number of vehicles that could be allowed to use it before granting such permission. Thus in 1989, out of 1316 intracity Matatus, only 792 were on record as having been provided with terminal spaces, leaving a balance of 524 operating without terminal space.

Records are however unavailable about the number of Matatus operating on each route and their terminal.
Such records in any case would be difficult to get, given that in the absence of any policy regulation, or regulation by their association, the Matatus do not operate on a fixed route. Also some operate long distance services during off peak hours and only return to intra-urban service in the

peak hours. Such mode of operation also makes it difficult to accommodate them within the citys transport planning framework given that they are neither here nor there. Their informal mode of operation also makes it difficult to project with concerete certainty, their growth trends and hence plan for the same. By implication therefore there is a begging need for an overhaul of the 'Matatu' system to put them under some regulation and control, if they are to operate within a co-ordinated public transport system in the city.

From the study survey, Matatu terminals appear to be areas within the central (C.B.D.) area where they have marked as their city centre starting points for trips to residential areas and destination points for trips to the city. The study investigations also established that some of the places referred to as terminals by Matatu operators can actually be described only as long stops within the duration of their trip. For example along Tom Mboya Street and Race course road, for Eastleigh and Kariobangi Matatus which operate in more or less a circular manner. O.T.C. and Ronald Ngala bus stops were also found to fit this description.

Investigations to assess the general physical environments in which Matatus collect their passengers revealed that the terminals vary in characteristics and location. They are in places formerly used as private

car parks, for example Hakati road and Gill House, on bus stops like Tom Mboya Street, traffic islands like Accra road and Lagos road or street alleys like Mfangano and Kimathi lanes.

The guiding criteria for location of these terminals was that they be in place such that they do not create traffic hazard to other users or cause obstruction. To this end, the terminals were placed under some management, originally by a route association under the auspices of M.V.O.A. These tasks has since been taken over by K.A.N.U Youth Wingers. Their tasks were found to include the following.

1. To ensure efficient entry and exit from the parking lot within the terminal space.
2. Manage the queueing system to ensure that vehicles leave in the order in which they arrive.
3. Seeing to it that Matatus adhere to terminal space regulations requiring that they park within the parking lot so that they don't cause obstruction especially where like in Tom Mboya Street they operate from a former bus stop on a busy street.

Characteristically the terminals were found to vary in size and degree of organisation. Some had small queues where as some attract longer queues. (Plate No.2) Some others looked chaotic both in location and operation. (see plate No.3) A common feature in these terminals is that

they don't have a fixed number of Matatus operating there. Some use it only during the peak hour demands while the rest of the day, they are floaters chasing after demand on other routes. 95.4% of the Matatus covered were found not to be fixed on any particular route of operation by regulation. They were found having several sign boards indicating different route numbers to be used when need arises.

The criteria for their choise of routes are given in the table below:

Table 16

Criteria for Choice of Routes by Operators

Reason	Response	%
High demand	51	60.7
Few Police checks	18	21.4
Better road conditions	11	13.1
Less traffic jams	4	4.8
Total	84	100%

Source: Field Data 1991

Further survey showed that out of the 54 intra-city K.B.S. routes 88.9% were shared with Matatus where as 11.1% are now dominated by Matatus, K.B.S. having withdrawn due to high operational costs as a result of competition from Matatus.

The queueing system, although conceived as the best method of organising Matatu operations at the terminals, was found to have serious limitations. It can only work if the

number of Matatus using the terminal space is controlled to be within the space capacity, and if their frequency of arrival is lower or equal to that of departure. Where there is a mismatch between the two, the queue would inevitably spread out to cause obstruction (plate 4). The K.A.N.U. Youth Wingers also lack any legal backing to enforce strict adherence to terminal space regulations on the operators. Consequently cases of queue jumping were found to be rampant, often times rendering the system obsolete. The resultant stampede by the `Matatus' scrambling to entice customers led to serious obstruction and nuisance to other space users.

Since it is more profitable to operate with full vehicles rather than partially full ones, the Matatus have to take longer times at their terminals, to pick up sufficient passengers before they take off. This is an important aspect of their operation that ought to have been considered in planning for their terminals so that the space provided have enough parking where they can wait.

Plate No. 2

Street Side Terminal at Tom Mboya Street

Note the Youth Wingers (red shirts) organising Matatus in a queue

Plate No. 3

Accra Road Terminal

Note the chaotic situation as Matatus spill over from the traffic island onto the road due to inadequate space.

4.4 CASE STUDIES

4.4.1 TOM MBOYA STREET: OPPOSITE RAJAB MAZIL HOUSE

This was formerly a bus stop designed only as a brief stationary point for K.B.S. and with a capacity of two standing buses. The parking space has since been extended into the adjacent private car parking lots. It is used as a terminal point by routes 23 and 32 which operate on a queue system and route 9 which operate in a circular manner and does not follow the queue system.

Since the space provided for waiting is always occupied by Matatus on the queue route 9 is forced to pick up and set down their passengers while on the traffic lane. The area presents a chaotic phenomena particularly during peak hours.

The frequency of arrival of route 9 was found to be higher than that of 32 and 23. Their rate of arrival at peak hours was 1.8 (=2) per minute while their departure rate was 1.4 (=1) per minute. Their rate of traffic build up therefore was 0.4 per minute. By implication therefore after 10 minutes there would have to be 4 Matatus waiting to pick up their passengers. That such a number of Matatus would be waiting on the traffic lane and at a time when the roads' volume capacity ratio would be approaching its saturation point (0.8) causes serious obstruction in the traffic flow. This terminal space is therefore not adequate to meet the demand.

The problem of congestion at this point is compounded by one other factor, as given below:

Directly opposite this bus stop is another stop used as terminal for Matatus route Nos. 116, 107 and No. 6 which operates in a circular manner. Matatus route No. 116 and 107 operate by the queueing system. They are long distance Matatus and the study found that they take an average 13 minutes to pick up sufficient passengers and take off. Here also the lay by space was found to be always fully occupied hence route 6 has to operate from the traffic lane. Their frequency, like that of route 9 was found to be higher, being 2.1 per minute while their rate of departure was 1.7 per minute. The rate of build up of traffic at this point therefore was 0.4 per minute implying that after 10 minutes there would be 4 Matatus at the terminal, operating from the traffic lane. That the two terminals are directly opposite each other makes this point a major bottleneck area in the traffic flow, since also the presence of such a large number of stationary Matatus on the traffic lane would cause serious traffic obstruction.

The study survey revealed that youth wingers and traffic policemen are always stationed here, helping to clear the vehicles from the traffic lane, and to control the amount of time spent at the bus stop by the Matatus, particularly route 9 and 6. which operate in a circular manner.

The table below give the information, for routes 9 and 6.

Table 17

Frequency of Matatu Arrival and Departure at the Terminal (Vehicles per Minute)

Route	Rate of Arrival		Departure Rate		Build Up Rate		lay-by Capa-city
	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	
9	1.8	1.7	1.4	1.2	0.4	0.5	2 buses
6	1.7	1.5	1.2	1.05	0.3	0.45	2 buses
Total	3.5	3.2	2.8	2.25	0.7	0.95	4 buses

Source: Field Data 1991

From the above table, it is clear therefore that if routes Number 23, 32, 107 and 116 were to be removed from this place, the terminal would be adequate to handle the traffic volume of routes number 6 and 9 operating in ther rotational manner. The total rate of traffic build up in peak hours would be 0.7 per minute meaning that after 10 minutes there would be 7 Matatus in the `terminal' an equivalent of 2.8 (=3) buses and the `terminal' capacity is 4 buses. The off peak hour build up rate would be 0.9 hence after 10 minutes there should be 9 Matatus at the terminal; an equivalence of 3.6 buses again this is still lower than the total capacity of the `terminal'.

The rates of arrival and departure of the other routes are given below for peak hours.

Route Number 23.

Rate of arrival = 1 in every 3 minutes

Rate of departure = 1 in every 6 minutes.

Thus in every 10 minutes

$$\frac{10}{3} = 3 \text{ `Matatus' will have arrived}$$

and $$\frac{10}{6} = 1.6 \text{ or } = 2 \text{ `Matatus' would have left}$$

Leaving behind 1 `Matatu' on the queue. Within the same time, 3 Matatus would have arrived on the queue, waiting to load.

Route Number 32

Rate of arrival = 1 in every 4.2 minutes

Rate of Departure = 1 in every 9 minutes

Thus in every 10 minutes,

$$\frac{10}{4.2} = 2.3 \text{ Matatus would have arrived}$$

and $$\frac{10}{9} = 1.1 \text{ Matatus would have left}$$

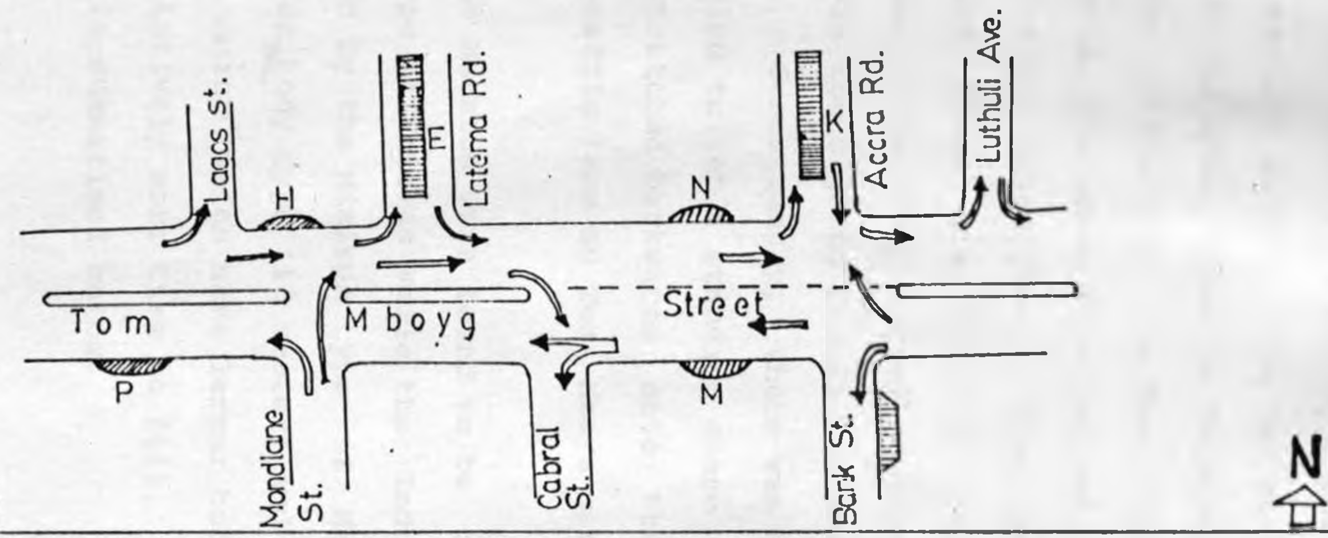
hence one `Matatu' would be left in the queue. Within the same period, 2 more `Matatus' would have arrived on the queue, waiting to load.

The result therefore is that the terminal space is always fully occupied with an average 7 Matatus on the queue

at any given moment (Plate No. 2). Any more Matatus arriving in excess has to wait on the pedestrian pavement while route 9 has to operate from the traffic lane.

This terminal point is therefore in adequate to accommodate the current levels of traffic that requires to use it, and any further increase in the traffic volume would only worsen the situation bringing traffic flow to a standstill.

SKETCH No 3



KEY

MATATU 'TERMINALS' ON TOM MBOYA STEET.

P Nation House 'Stop'
M Standard Bank Terminal
N Ebrahims Terminal
H Posta Terminal
E Latema Road Terminal
K Accra Road Terminal

4.4.2 THE GILL HOUSE TERMINAL

This terminal was formerly a bus stop and adjoined to it were metred private car parks. The car parks have since been rellocated and the space given to Matatus. It serves as the terminal for southlands, and the industrial area Matatus. On the whole, the space provided had a capacity of taking 22 Matatus at any given time. They operate by the queueing system and there are K.A.N.U. youth wingers managing the system. The study survey revealed that the vehicular volume was too high to be all accommodated within the provided space. Consequently, there was stampede, as the vehicles struggled to get a standing space (plate No.4) and the queues stretched backwards onto the pedestrian walkway or the traffic lane on Tom Mboya street. (plate No.5).

The Southlands Matatus were found to be dominated by the micro bus type of Matatus while the Industrial area route was dominated by the Minibus type of Matatus. The former have smaller body type (15 seater) and so fill up quickly than the latter which have larger body size (25 seater) and take relatively more time to fill.

The situation is summarised below:

Southlands Matatus

Rate of arrival = 1 in every 1.9 minutes

Rate of departure = 1 in every 5.2 minutes

Thus in every 10 minutes

$$\frac{10}{1.9} = 5.3 \text{ Matatus would have arrived}$$

and $$\frac{10}{5.2} = 1.9 = 2 \text{ Matatus would have left}$$

Thus within 10 minutes there would be 3 `Matatus' left on the queue while at the same time another 5 would have arrived, implying that there would be a total of 8 Matatus on the queue waiting to load.

INDUSTRIAL AREA MATATUS

Rate of arrival = 1 in every 3 minutes

Rate of departure = 1 in every 8 minutes

Thus in every 10 minutes

$$\frac{10}{3} = 3 \text{ Matatus would have arrived}$$

and only $$\frac{10}{8} = 1.3 \ (=1) \text{ Matatu would have left}$$

The result is that 2 Matatus would be left on the queue. Within the same period of time 3 more `Matatus' would have arrived on the queue, making a total of 5 industrial area Matatus on the queue.

In total therefore the terminal space would be having 13 (8+5) `Matatus' at any given moment on the queue. The space provided can only take 9 `Matatus' hence currently the terminal is operating above its capacity. The outcome of this is congestion and spill over into the pedestrian walkway and traffic lane as can be observed in plate Number 4.

The general picture that emerges from the analysis of terminals is that the current levels of demand of space at the terminals by these public transport modes far outstrips supply, hence the need for proper planning to address the issue of terminal facilities for public transport modes in the C,B.D. area.

Plate No.4

Gill House Matatu terminal

Note the queue stretches back onto Tom Mboya street as Matatus wait to get space in the terminal.

Plate 5-Nyayo Bus Terminal

Note even the road space has been converted into a parking area since the terminal is in adequate.

The Matatu terminals are simply located in areas that were formerly parking sites for motorists, side lanes of streets or traffic islands. The two major reasons given by the city planning authorities particularly with regard to Matatu is that the Industry only begun to grow tremendously in the recent past (late 1980's) and the issue of their terminals did not yet present a major planning concern. the figures supplied by transport unit of N.C.C. as given in the table below shows that as early as 1983, there were 2,600 Matatus operating within Nairobi and its satellite towns like Machakos, Ruiru, Kiambu, Ngong and Banana Hill, among others. That such a level of Matatus were operating within the city and its satellites was significant enough to raise a planning concern over their arrival and departure points in the city.

Table 18

Growth of Matatu Fleet between 1973-1983

Year	Matatu Fleet	Passenger Trips per Day
1973	375	46,000
1974	538	62,000
1975	700	72,000
1976	969	102,000
1977	1,320	104,000
1978	1,434	164,000
1979	1,567	190,000
1980	1,904	201,000
1981	1,800	223,000
1982	2,000	250,000
1983	2,600	280,000

Source: N.C.C. 1984 D.P.U.

The table shows that the number of Matatus operating in the city and its periphery increased by 600% during the 10 year period while the number of passengers per day increased by 500%. It is clear then that Matatus as a means of public transport grew significantly thus becoming an indispensable system in the city transportation.

The second reason advanced is that there is lack of land in the C.B.D. to be developed into a Matatu terminal.

The present locations of their terminal sites in the C.B.D. are considered as temporary and can be tolerated only as long as it does not pose a traffic hazard. Meanwhile discussions going on by Nairobi traffic and Road safety committee of N.C.C. is aiming at the establishment of a few large parking lots of Matatus outside the main C.B.D. area.

The issue of out of C.B.D. terminals was however not welcome to both operators and commuters. 85.3% of the commuters were against the idea and 100% of the operators interviewed opposed it. The reason advanced against out of C.B.D. terminals are given below:

A. OPERATORS

1. The strategic importance of the site is the rule of business. It should be within easy access to C.B.D. office workers, businessmen, and shoppers.
2. It should provide them with a convenient link to their routes of operation.
3. Such terminals if provided would be subject to rigid control by the city authorities. Matatu operators were found to be generally reluctant to operate from controlled points.

In general the operators feared losing business from such terminals. For them, good business entails picking up and dropping passengers at their places of convenience.

B. COMMUTERS

1. The passengers would suffer during bad weather.
2. It would be risky for commuters travelling during the night.
3. Those with heavy luggages would suffer adversely.
4. It may entail connecting with two modes where a passenger's destination is far from the terminal. This could therefore increase journey costs in terms of money and time.

Despite these contentions, it is however apparent that if the city planning authorities are to establish large terminals to accommodate the growing number of Matatus, then space for such terminals has to be sought from outside the C.B.D. area. It therefore becomes the planners task to strike a compromise between what is convenient and acceptable to commuters and operators on one hand and on the other, what is adequate in terms of planning and management of the urban public transport.

The tables below shows the amount of land occupied by various land uses in the city at large, hence the amount of land that is yet not developed.

Table 19

Existing Land Uses within Nairobi City

The urban area covers 35,800 ha. distributed as follows:

Area	%	ha
C.B.D.	1	350
Industry	4	1,600
Institutions; Airport	3	1,150
Airforce Base	1	350
Others	8	2,900
Housing	34	12,000
Mixed Resd. & Commerce	1	350
Parks and Reserve	16	5,900
Total Occupied	68%	24,500
Total Vaccant land	32%	11,300

Source: N.C.C. D.P.U. 1986

This picture presented here is that Nairobi does not yet present a case of land shortage as only 68% of its land is developed, leaving 32% yet to be developed. Two major constraints however need to be cited here:

1. The location of such vaccant land in terms of its proximity to the C.B.D. and to the existing road network so that they will be ideal terminal sites for C.B.D. bound public transport. A large proportion of these vaccant land is found in the Eastern part of the city (5,000 ha) and the rest of it is in scattered pockets throughout the city.

2. The value of such land may make it in accessible for development, given that a terminal facility like other public utilities has low rates of return which may make it an unwelcome venture.

Land uses in the C.B.D. area however shows that it is almost saturated and even what appears as vaccant land is already earmarked for development, only awaiting availability of funds. It therefore presents a case of serious land shortage. The area has 350 ha. (5,773,447.3M^2) of land. The metropolitan growth strategy (1973) projected the development growth limits of the C.B.D. at 5,000,000 M^2, but recommended that the optimal development level would be 3,000,000 M^2 at which it was hoped, the C.B.D. employment level could also be kept at 100,000 jobs by the year 2000.

As at 1970, land use in the C.B.D. were as follows:

Table 20

Land Use in the C.B.D. by 1970

Land use	Area M^2
Commerce & Industry	49,189
Residential & Hotel	81,092
Offices	224,098
Transport *	264,700
Others	8,582
Total	691,561M^2

Source: N.U.S.G. 1973 vol. 2

* Estimated.

Thus it can be inferred from above that there was still much room for development in the C.B.D., as at 1970. But twenty years later (1990) the situation is much different as can be seen in the table below:

Table 21

Land Use in C.B.D. 1990

Land Use	Area M^2
Commercial & Industry	1,179,177
Offices	2,039,937
Residential & Hotels	184,405
Transport	264,700
Total	3,668,219 M^2

Source; Field Survey

It is clear from this table that the C.B.D. has been developed beyond its optimal level even (10 years) before the projected year at which the optimal level of development was to be achieved. This implies therefore that C.B.D. development is fast approaching saturation. If the C.B.D. is divided into East and West along Moi Avenue, then the real spatial variation in density of development is as contained in the table below:

Table 22

Amount of Land Developed by Zone 1970 & 1990

Zone	1970	1990
West	324,468 M^2	3,352,804 M^2
East	38,494 M^2	50,715 M^2
Total	362,961 M^2	3,403,519 M^2

Source: Field Data 1991 & N.U.S.G Report 1973

From the above table, much of the developed land (98.5%) is in the West. Any available land can therefore only be found in the East. This land in the East is mainly found along the areas adjacent to Nairobi river. Therefore, space for terminal sites can only be sought from that direction but it has got to be at a point that is accessible or approachable from all directions of the city. This point is taken strongly in the proposals for alternative locations of terminal points.

CHAPTER 5

SUMMARY, POLICY AND PLAN RECOMMENDATIONS

5.0 SUMMARY OF RESEARCH FINDINGS

In the preceeding chapters, the problems of vehicular traffic congestion in the C.B.D. area has been dealt with broadly in so far as the vehicular traffic volume exceeds the design capacity of the roads during peak hours and the mean travelling speeds fall below the expected mean operational speeds, thereby inhibiting place accessibility and specifically as far as the C.B.D. bus stops and P.S.V. terminal points are in adequate to cope up with demand, leading to congestion and crowding by both vehicular and human traffic. The various factors contributing to this crisis has also been examined and opinion of both the user's and operators of the public transport modes sought on the general nature of public transport system and specifically on the issue of bus stops and terminal points' situation.

Upon analysis, it was found that different factors in different magnitudes contribute to the problem of congestion in the C.B.D. routes, bus stops and terminals. They include among others;

1. The locational arrangement of the bus stops and terminals. 2/3 of the bus stops were found to be located at or near road junctions, which makes them bottleneck areas in traffic flow particularly at peak times. The terminals on the other hand are picked from

private car parks and are allocated without due consideration of the demand and operational characteristics of the public transport modes. The congestion and conflict at the bus stops was found to arise as a result of lack of balance between two main aspects.

(a) The inadequate accommodation provided for traffic by the lay-by space which has hardly changed in size for decades.

and (b) The divergent, often conflicting requirements put on those bus stops by the different public transport modes. The bus stops were originally meant to serve as brief stopping points for K.B.S., operating on a time table. Matatus have either turned them into terminal points or long stops thereby subjecting them to different roles not originally foreseen. The solution to the bus stops problem therefore lies on how far an equilibrium is established between these conflicting forces, noting that Matatus by their nature, need stops that are designed for long term halt.

2 The violation of traffic rules and regulations by Matatus who cause obstruction to other road users by stopping along the roads where there are no

provisions for bus stops and through their indiscriminate use of the bus stops thereby rendering them inaccessible to other users.

(b) Traffic volumes in the C.B.D roads which are higher than the roads' design capacity together with the delay caused by the numerous traffic lights on major roads were also found to be responsible for congestion on the routes and hence the bus stops.

(c) The fact that a large number of C.B.D. trips their origin and destination points fall along one major traffic corridor is itself a significant cause of congestion. Added to the fact that the rate of public transport arrival at these bus stops and terminals is higher than they can sufficiently accommodate at any one time and that even the rate of arrival is not matched by departure, the bus stops and terminals are rendered in adequate in view of the present levels of demand.

The overall data analysis in chapters 3 and 4 together with field observations forms the basis of knowledge and information upon which the following conclusions, policy recommendations and plan proposals are made.

It was the overall objective of this study to conduct a systematic survey and inquiry which attempts to reveal the

nature and structure of the problems facing public transport modes in the C.B.D. area with respect to bus stops, routes and terminals. More specifically the study was to deal with the issues of traffic congestion at these bus stops routes and terminals which renders them inadequate in terms of providing sufficient accommodation to the public transport modes. It was also the objective of this study to suggest a system of solving the identified problems. Various policy recommendations are therefore made, highlighting the ways by which a solution to these problems could be sought.

5.1 POLICY CONFLICTS IDENTIFIED

Several policy conflicts have been identified, that surrounds the operation and management of public transport in the city which therefore needs to be resolved before an efficient public transport system for the city can be attained.

1. The gaps in our transport policy where the 'Matatus' were not catered for till 1984 are partly responsible for the current crisis. Matatus operated as an informal sector activity, working in an atmosphere of restrictions and threats, as a result of which they developed a culture unique to themselves, where by:
   (i) They isolated themselves from the formalised (large scale) modes of transport and hid

themselves from any policy or planning controls under which the other modes operated.

(ii) They competed for survival against the large scale formal modes, namely K.B.S. operating with an exclusive legal franchise in Nairobi.

This culture persisted even after the 1984 Matatu Act legalising them as public service vehicles and putting them under legal obligations to observe traffic regulations regarding P.S.V. Their persistent informal mode of operation created conflict in urban space use that came to be reflected even at spatial planning level. When their number grew, and their operations seemed to create a nuisance in the eyes of the planners, they responded by implanting their terminals into an existing urban fabric, so they were put in traffic islands and rellocated car parks, where the convenience of both the public transport mode and the users was only given low priority. Clearly then, there was lack of pragmatic approaches towards solving the problem.

In order to incorporate 'Matatus' into an integrated city public transport system there is need to understand the nature of its operations, its spatial needs and relationships to the other modes, then give it a transformation to fit into the system. This transformation should start with the provision of terminal facilities. In providing these facilities, one need not imagine that the

space lacking is necessary a site for constructing a terminal, but rather a site situated in a place where all the inputs and outputs into the Matatu activity can be optimised. Hence when Matatu operators refused proposals by the city planning authorities to be given out of C.B.D terminals, it must be seen as having arisen from their fear of the impending difficulties in such locations where their activities might not be economically viable. This is an important fact that should be considered particularly in other towns where space is still available in the urban centre and where public transport does not yet present a significant problem.

When the Matatu is seen to park anywhere on the road, or at traffic lights, and attempt to hide from planning or policy controls, it is only because the operator is trying to achieve increased demand for his services, otherwise it would not be of any economic purpose for him to operate from sites far removed from the centre of activity areas in the city when they know that commuters will pick their vehicles at their nearest points from their areas of activity.

2. The second level of conflict was identified as being due to lack of commitment among the polity. The uncertainty surrounding the role of Matatus in public transport in the city must be seen in line with the politics of the city government. Controversies at the

administrative level of N.C.C. and the central government has not worked well for the spatial management of the Matatu sector in Nairobi. In 1973 for example, Matatu operations were legalised by a Presidential decree and it appeared that the central government finally accepted the role of Matatus in providing public transport. Formal recognition of their operations however did not come untill 1984 when an act of Parliament gave them legal status. The local government on their part have been slow to incorporate Matatus within its spatial planning policies. Debates on what is to be done about them often times ended up in rivalry and with an excuse that their operations in the city remains temporary as long as K.B.S. franchise still functions. (White and Stren 1989)

In this condition of uncertainty, Matatu operators formed Associations (M.V.O.A. and K.M.O.A) through which they gained some degree of legitimacy in their operations without adhering to N.C.C. regulations. This was done by strengthening their allegience with 'powerful' leaders either at N.C.C. or central government so that any attempt to impinge on their activities in the city received strong opposition from the concerned patronage lines. It was through such system that they were also able to lobby for terminal points in the C.B.D. area.

The general conclusion therefore, for Kenya as a whole, and for Nairobi in particular is that before Matatu conflict is resolved, there must be positive political will-power which must first iron out the conflict at the policy level as to whether Matatu sector should be developed as part of the urban transport system or not. With this achieved, it would then become necessary to translate the policy to the planning level, to solve the problem.

In Nairobi C.B.D. area there is already established a compact layout of urban activity system and no more space is available. There is even little chances that the urban activities can be re-llocated or re-arranged to create a convenient space within which the Matatu activities can be conveniently accommodated. A solution to their parking problem will therefore have to be sought on the fringe C.B.D. areas, but efforts must be made to integrate such sites with the existing urban fabric.

5.2 POLICY RECOMMENDATIONS

The following broad policy recommendations are made.

1. There is need for a comprehensive bus stops policy to control the number, type, location and use of the lay-by space in the bus stops. The aim here should be to ensure that they are far removed from major points of traffic convergence. Such a policy should designate

bus stops into 'alighting only' bus stops where no waiting and boarding can be allowed at all expect for setting down and the 'general purpose' bus stops where waiting can be allowed for picking and dropping passengers. The 'alighting only' bus stops can be located in certain strategic points in the C.B.D. area where as the general purpose bus stops can be placed at certain entry points into the CBD. The alternative of designating certain bus stops for specific routes could work, but their limited number and the lack of space in the CBD may not make it feasible.

This policy must however be integrated with a policy on discipline on the part of the commuter. It is the contention of this study that commuters would be prepared to bear the strain of walking an extra distance to pick their transport, so long as the transport system is made efficient in terms of flow of traffic and frequency of service. In deed the survey found that commuters do walk to certain entry points into the C.B.D. like Serena, University way, Racecourse road or Landhies road to pick their vehicles during the evening peak hour. The main reasons given were:

1. So that they get a sitting space
2. To avoid the scrambling phenomena at the C.B.D. bus stops
3. To get buses faster since some buses get full by the time they arrive in the C.B.D. and boarding becomes difficult.

The all purpose bus stops could be used mainly during off peak times, otherwise in peak hours, commuters should be encouraged to pick the vehicles from the terminals.

2. The following factors explain the poor performance of terminals;

   (i) Except for K.B.S. terminal, `Matatus' and N.B.S. terminals are regarded by N.C.C. as temporary hence their location is not planned for in view of their operational demands. They are thus not adequate to meet the demand by these modes.

   (ii) They are located on car parks or traffic islands and are therefore frequent cause of traffic obstruction when they become congested.

In view of this terminal points crisis, the city needs a terminal points policy which is effective in making an immediate impact on the terminal points problem and should reflect the operational needs of these public transport modes, both present and future. The main objective to be pursued in light of this policy is to zone fringe C.B.D. area sites for terminals, especially for Matatus. Since it is profitable for Matatus to operate with full rather than partially full vehicles, it is necessary for them to have parking space where they can park and wait while being filled. This policy may not be welcome to Matatu operators, but it is the contention of this study that some trade offs must be borne if any feasible solution is to be reached.

Matatu operators preferred to put up with the hardships of congestion rather than have fringe C.B.D. area terminals.

3. Control of private car access to the C.B.D. area is an important prerequisite to efficient management of transport in the city centre. N.C.C. should adopt a policy of private car restraint to the C.B.D. The survey found that a higher proportion of vehicles on the C.B.D. roads were private vehicles. Towards this end, N.C.C. should immediately undertake to impose high parking charges on C.B.D. car parks, and no more free parking. No more development of private car parks in the C.B.D., and instead develop them on the fringe C.B.D. area then impose relatively cheaper parking charges whi le also ensuring maximum security of the vehicles.

5.3 TRAFFIC MANAGEMENT AT THE TERMINALS

The city authorities should control Matatu activities in the city to a level that can be accommodated within the facilities provided for them. This could be achieved through the following measures.

(i) Make it mandatory that anybody going into Matatu business should first apply for and be given a terminal space before being licensed to operate. Such an application should state among other things, the intended routes of operation. This would help to restrict their operations to specific routes, make it

easy to monitor and control their activities and plan for their spatial needs. The idea may not be popular with existing and potential operators given that it will inhibit flexibility in Matatu operation where their choice of route depends on demand at that hour. But if well managed, it can produce lucrative results.

(ii) Make it mandatory for Matatus to operate on fixed times schedules like K.B.S. In this way, it will be possible to integrate them with the other modes, and help reduce the wasteful competition among themselves and with the other modes as well as overspeeding and reckless driving.

(iii) Give Matatus separate terminals. This would help to eliminate the conflicts in use of space, as each mode has different space requirements, given their organisation and mode of operation.

(iv) Adopt the queueing method for their operation at the terminals, where by vehicles would only be allowed to fill and leave in the order in which they arrive. A Matatu Association should be responsible for management of the terminals and oversee the working of the queueing system. The terminals should therefore be leased out or rented to the Matatu Association on monthly payment.

In conclusion, the city government should undertake to ensure that efficient traffic circulation in and around the C.B.D. remains its cardinal urban transport policy that must be realised through the provision of the requisite physical facilities and policy regulations. Towards this end it should also establish standards, stating the maximum number of bus stops that can be located within a city route of a given length and size and with what spatial distance apart.

Over all, the city government should explore low cost solutions to the general urban transport problems rather than get into heavy capital investments that yields no immediate impact on the problem.

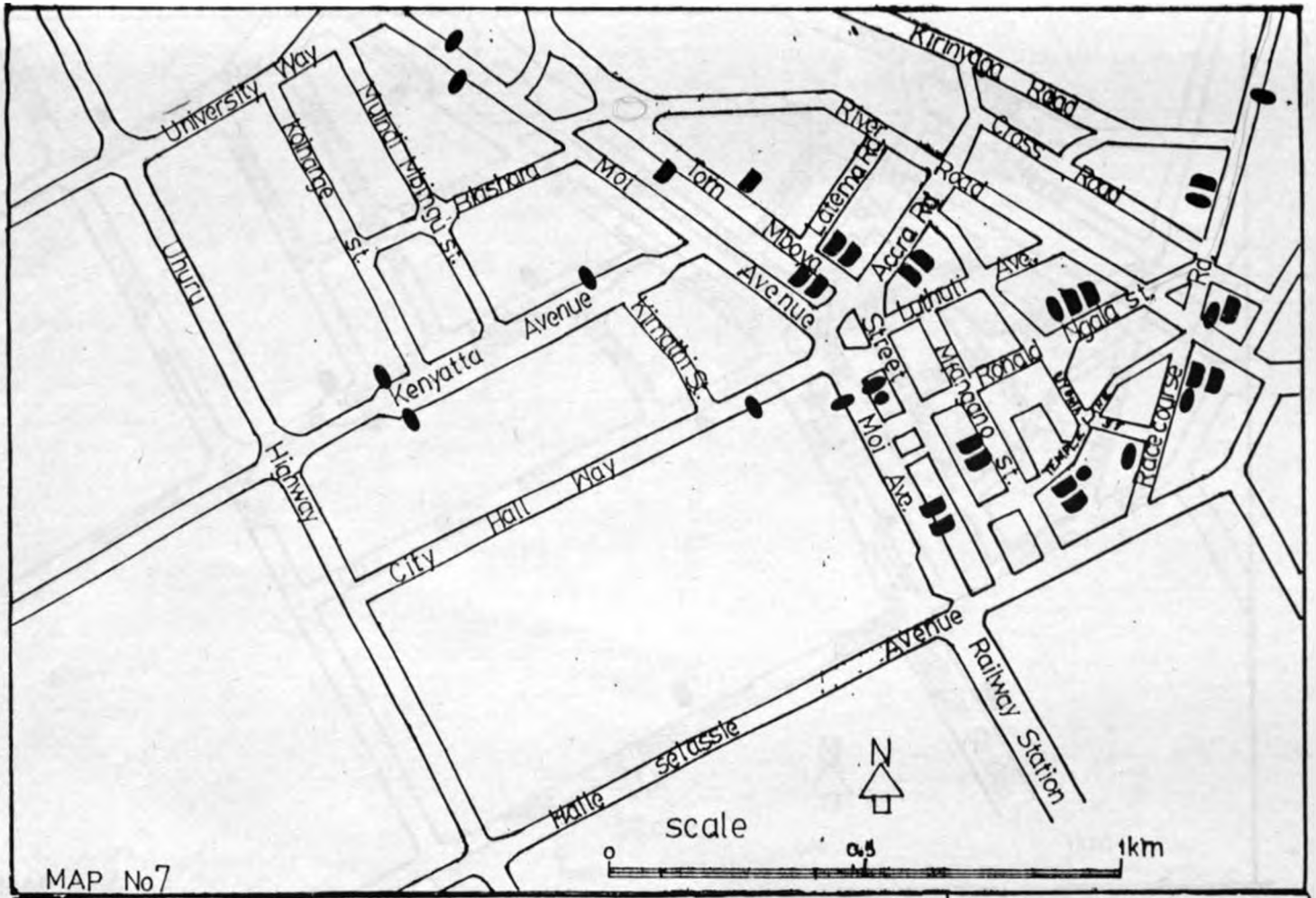
5.4 PLANNING PROPOSALS

It was part of the objectives of this study to suggest ways by which the identified problems could be solved. The planning proposals given in this section provides a framework for implementation in which the policy recommendations could be realised.

5.4.1 PROPOSAL I: PUBLIC TRANSPORT CIRCULATION SYSTEM IN THE C.B.D

The map 4 gives the suggested traffic circulation system for public transport modes in the C.B.D. area. The basic suggestion here is that `Bus-only' lanes for exclusive use of high occupancy vehicles be reserved on the following road sections.

1. Moi Avenue, from Univesity way to Railway station round about.
2. Kenyatta Avenue from Uhuru highway to Moi Avenue.
3. Haile-Selassie Avenue from Landhies road junction to Uhuru highway.
4. Ronald Ngala road from Tom Mboya Street, down to Racecourse round about for out of C.B.D. bound buses only.

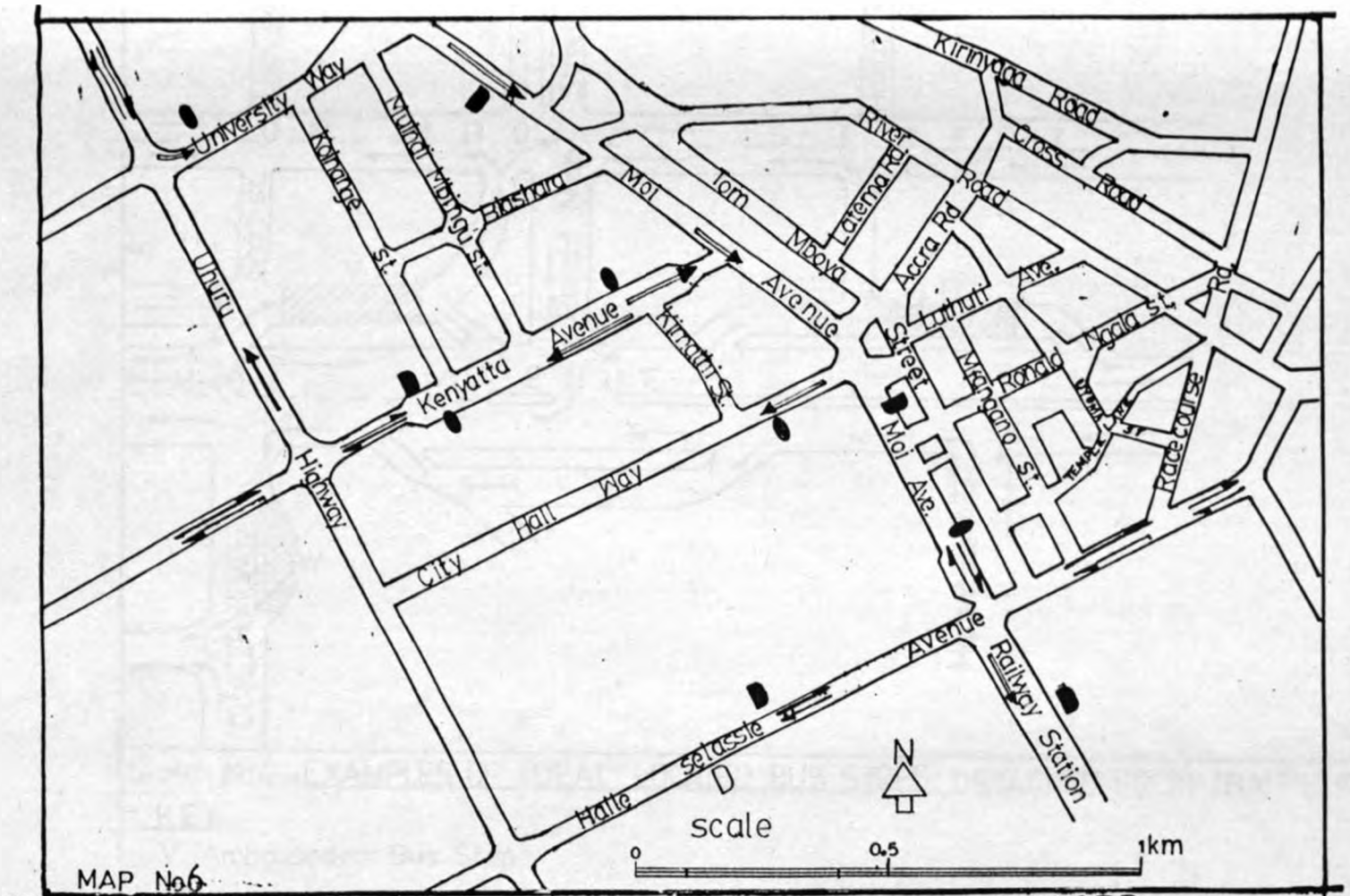


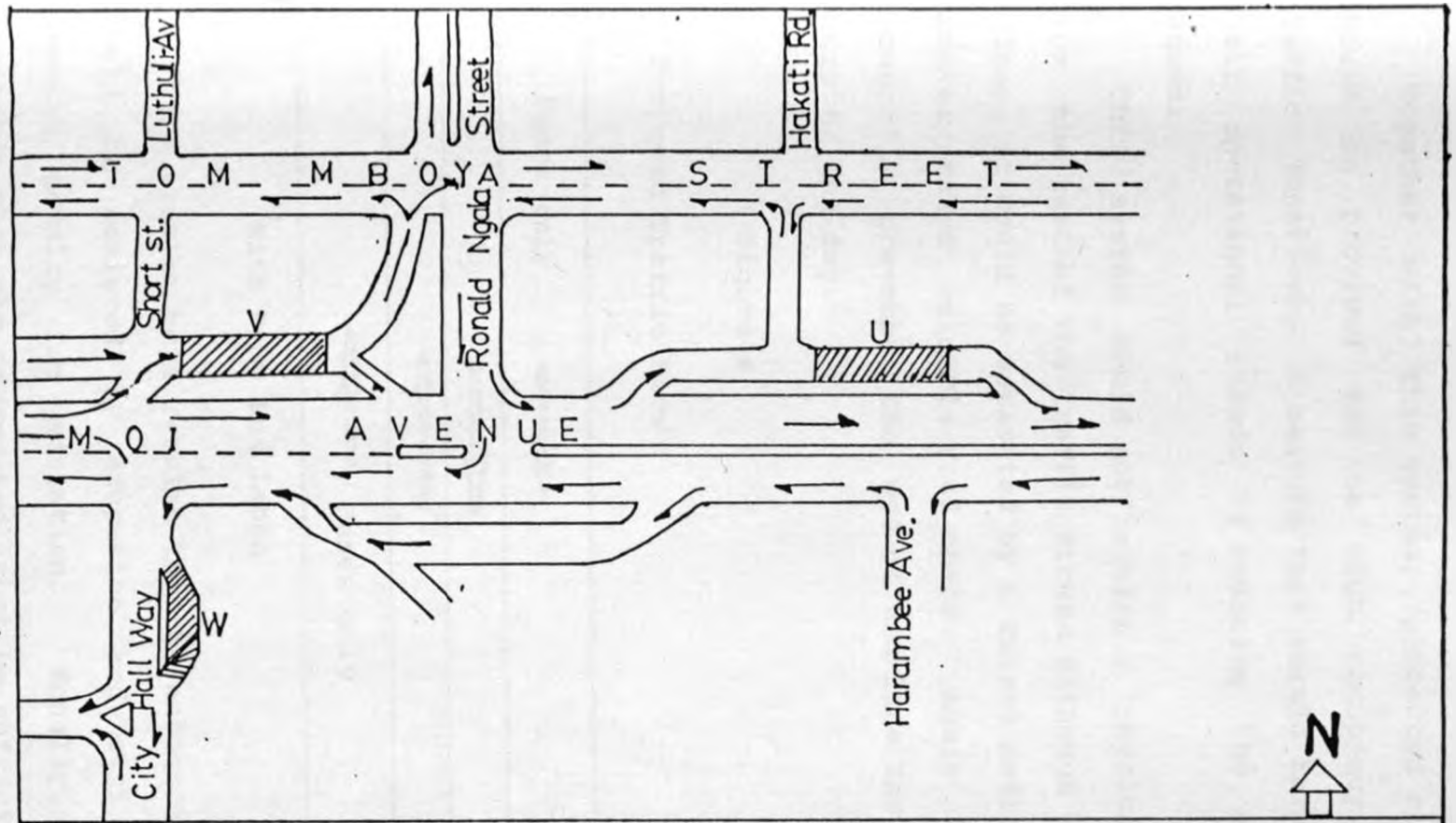
MAP No7

EXISTING BUS STOPS AND TERMINALS IN THE CBD

OTIENO C KONYANGO
URBAN AND REGIONAL PLANNING DEPT.
UNIVERSITY OF NAIROBI
M A 1991

- MATATU TERMINAL
- LONG STOP FOR MATATU
- BUS STOP
- NBS TERMINAL


University Way
Kolonge St.
Muindi Mbingu St.
Biashara
Mol
Tom Mboya
Lateina Rd.
River
Kirinyaga Road
Cross Road
Accra Rd
Ave.
Luthuli
Ngala St.
Rd
Uhuru
Kenyatta Avenue
Kimathi St.
Avenue
Street
Mol Ave.
Moi Ave.
Mfangano St.
Ronald
Ngala
Race course
Highway
City Hall Way
Haile Selassie Avenue
Railway Station
N
scale
0
0.5
1km
MAP No.6
PROPOSED PUBLIC TRANSPORT CIRCULATION SYSTEM IN THE C.B.D
OTTENO C KONYANGO
URBAN AND REGIONAL PLANNING DEPT
URBUN AND REGIONAL PLANNING
UNIVERSITY OF NAIROBI
MA 1991
ALIGHTING ONLY BUS STOPS
ALL PURPOSE BUS STOPS
One way flow
Dual flow



Sketch No4 : EXAMPLES OF IDEAL LOCATED BUS STOPS: DETACHED FROM TRAFFIC FLOW

KEY

V Ambassadeur Bus Stop

U Gill House Bus Stop

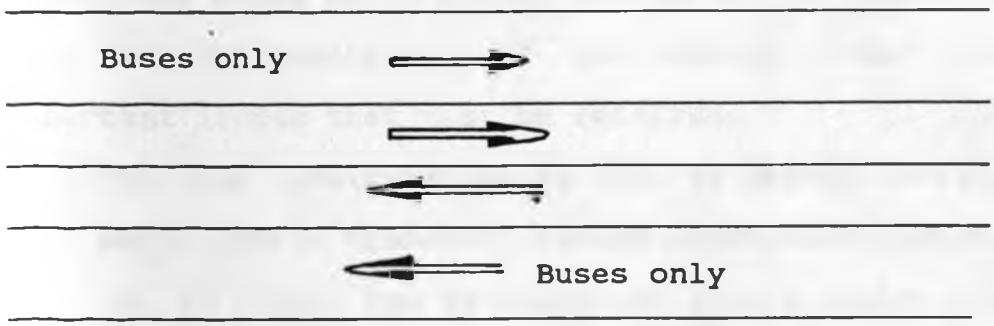
W Kencom Bus Stop

Together with this system, protected rights of way should be provided for the high occupancy vehicles at traffic junctions, a measure that should help to increase their operational speeds by reducing the average delay caused.

This system would not require a physical separation from the rest of the traffic stream although where the need arises, it could be separated by a raised median strip which however takes valuable road space. Again it would not necesarily pre-empt the use of the lane for the full 24 hours of the day.

Figure 4

Proposed Traffic Flow



With Flow Bus Lanes

The problem here remains that of enforcement, but this could be achieved by education and strict regulations bearing penalty for violation. Equally, it would be desirable that the segregated lanes be sufficiently utilised

to warrant their up keep. Although this segregation could by itself cause congestion to other road users, on the restricted road width, a deliberate bias towards public transport is nonetheless necessary in favour of the 73% of the city's population who use public transport. The implementation of this scheme should be accompanied with an increase in the rate of supply of public transport modes both in terms of flow and fleet number.

The system would have the following advantages.

1. It is low cost, and capable of early implementation.
2. It would ease the flow of traffic while it also gives ample penetration to the C.B.D. area where there are `a lighting-only' bus stops.
3. It ensures that less time is spent in the C.B.D. by these modes and a better utilisation of the bus stops.

The implementation of this system would raise two important issues that must be resolved.

1. The City Commission would need to improve efficiency on major public transport routes approaching the C.B.D. so as to limit the frequency of delays which interfere with bus schedules causing many of them to arrive at the stops at the same time.
2. Matatus must be organised into some light bus company with a central management system in the form of a co-operative society or Association responsible for their

operations. They should then operate according to schedules, and adhere to all traffic regulations covering public transport. In this case they would also play a complementary role rather than the wasteful competition currently witnessed.

One other traffic management option could be considered as a complementary to the above.

Across City Bus Services

To be operated by all the three modes; Buses having their routes begin from estates and pass through some designated fringe C.B.D.'s all purpose bus stops collecting passengers, and avoiding the C.B.D. area by using inner ring roads and the 'alighting-only' bus stops to end their journeys in residential estates on the other end of the city.

Nairobi already has a main road system that allows through traffic to bypass the central area on tangential routes such as the Uhuru Highway, University way and Haile Selassie Avenue. These routes could be used by the cross city bus services. K.B.S. is already operating such services, but they pass through the C.B.D. area. The only problem with this system is that it requires that there be sufficient demand on either side of the line. The system should be augmented

further by posting bus schedules at bus stops and terminals so that the cost of time waiting at bus stops is reduced as commuters schedule their time to fit with the bus operational schedules. The advantages of cross-city services is that it would;

(i) Help to ease the would be congestion at the terminals.

(ii) Avoid the C.B.D. area as much as possible, hence the congestion there in,

(iii) ensure that as little time as possible is spent at the bus stops.

Mean while, all town bound buses should terminate their journeys at the provided terminals during such hours. The Government ministries and parastatals should also explore the possibility of starting transport services to their employees at some fee, to be deducted from their salaries at the end of the month. This would help reduce congestion in the public transport modes, the bus stops and terminals.

5.4.2 OFF PEAK ACCESS TO THE C.B.D.

This could be another alternative where by the vehicles are allowed off peak access to a limited number of all purpose bus stops in the C.B.D. area to pick and drop extra passengers after checking in their terminals. This would ensure that those on shopping trips and with luggages do not have to walk to fringe C.B.D. terminals for their transport.

The basic support for this proposal stems from the fact that given two modes, one located in the C.B.D. and another on the fringe C.B.D. area; and since fringe C.B.D. location is away from the main concentration of activities, commuters would prefer closer picking points and so the fringe C.B.D. sites may not create reasonable demand. A public transport mode that maintains a fixed location there the whole day may make only minimal returns though slightly more during peak hours. It is reasonable therefore to give them access to the C.B.D. during the low demand hours in the day and after the evening peak from 8.00 p.m.

The city government should also consider promoting area specific bus services where P.S.V's operate from certain residential zones to working districts outside the C.B.D. like industrial area, westlands and community centre. Such services need not come to the C.B.D. area, and the city commission should provide parking places in such areas.

.5 PROPOSAL 2: PROPOSED SITES FOR NEW TERMINALS

Two alternative sites are hereby proposed for possible location of Matatu terminals.

.5.1 RACECOURSE ROAD TERMINAL SITE

1. This site is located in the down town edge of the city. 2/3 of it is owned by the city commission while the rest is owned by private individuals who have put up motor garages. The site is good because:

(i) It is defined by an already existing road network

on all sides. These roads can help to integrate it into the urban fabric.

(ii) It is on Racecourse road, which already has a high concentration of pedestrian flow since it is the main link between C.B.D. area and down town areas like Kariokor market.

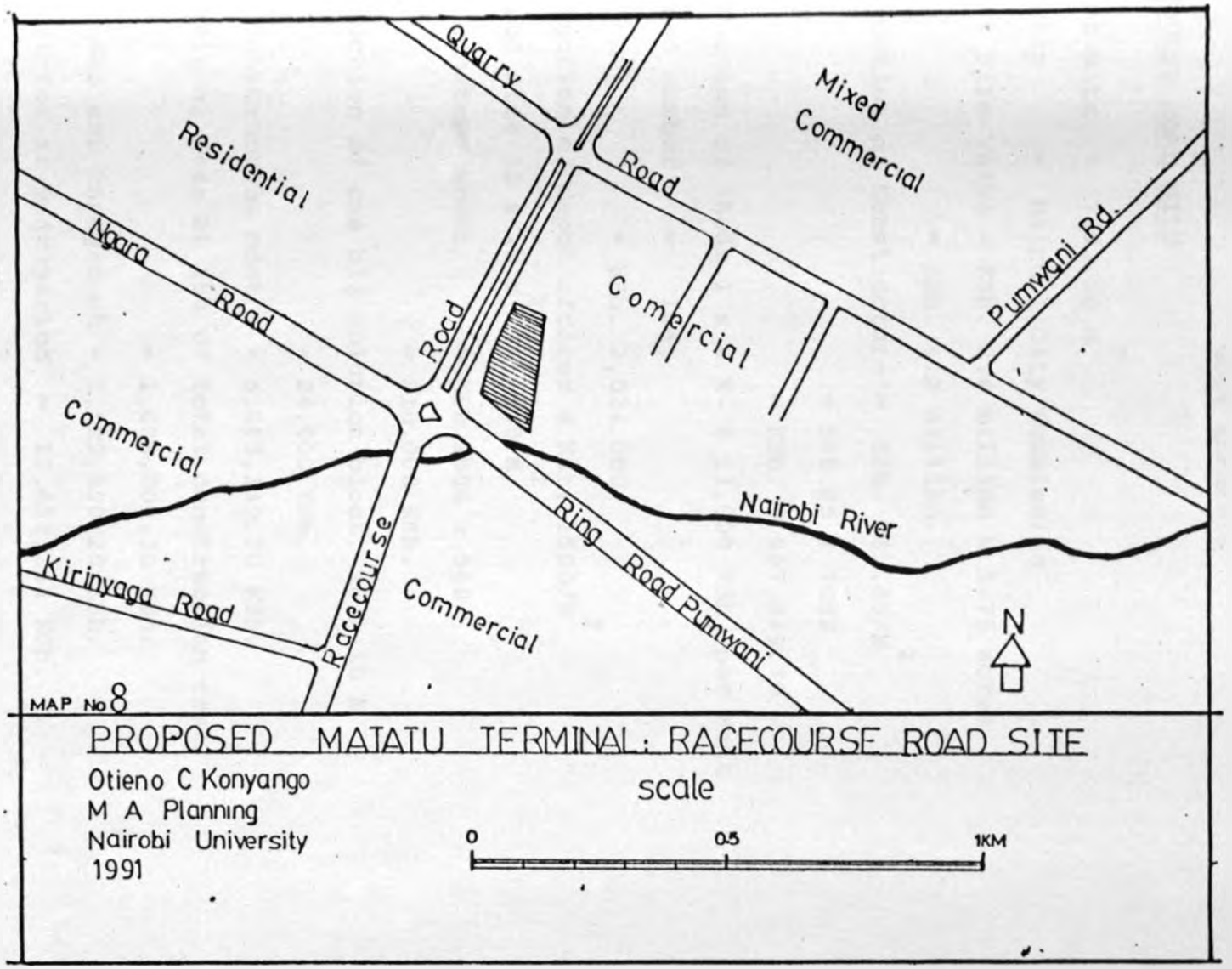
(iii) It is on a major vehicular highway (Racecourse road and New ring road Pumwani) which links the C.B.D. area with the Eastern residential estates; the most populous in Nairobi.

(iv) It is a walking distance from the C.B.D. and it borders the eastern by-pass which is also recommended as a main public transport route.

(v) It has a police station nearby (Kamukunji) for security reasons.

This site is large enough and could be partitioned for use by both intra-and inter urban Matatus especially those currently using C.B.D. sites for their terminals. It is considered in this study that only 60% ofthe site area need to be developed for parking lots and passenger waiting sheds. 40% should be left for vehicular circulation and terminal offices.

In this case only 4249 M^2 of the site would be developed for parking lots and passenger sheds. The average parking area demanded by Matatus was found to be 4 x 5 M^2 (20 M^2) (Based on field measurements). The number of parking lots proposed for this terminal therefore is 232 parking lots.


Quarry
Residential
Mixed
Commercial
Road
Ngara
Road
Road
Comercial
Pumwani Rd.
Commercial
Nairobi River
Racecourse
Ring Road Pumwani
Kirinyaga Road
Commercial
N
MAP No 8
PROPOSED MATATU TERMINAL: RACECOURSE ROAD SITE
Otieno C Konyango
M A Planning
Nairobi University
1991
scale
0
0.5
1KM

COST ELEMENTS

RACECOURSE ROAD SITE

Area of site = 7082.00 M^2

Ownership = Nairobi City Commission

Current Site Value = KSh. 2.4 million x 1.75 acres

= KSh. 4.2 million.

Construction of Substructure = KSh. 565.85/M^2

= 565.85 x 7082

= KSh. 4,007,349.70

Construction of Sheds 1 x 4 M @ 11,000 KSh. per unit

Proposed number = 184

Total cost = KSh. 2,024,000

Construction of depot offices @ KSh. 1500/M^2

proposed size 30 x 18 M^2 = 540 M^2

Hence construction cost = KSh.1500 x 540

= 810,000 KSh.

Construction of one big ablution block, 18 x 10 M

= 24,000 KSh.

Total construction cost = 6,865,349.70 KSh.

Professional fees at 15% of total construction cost

= 1,029,802.30 KSh.

Operations and Management = 1,029,980.20 KSh.

Interest for 20 year period = 12,632,241 KSh.

Overall cost of development = 21,557,372 KSh.

If current site value is included then the development cost would stand at KSh.21,557,372.20 + 4,200,000 = 25,757,372.20 KSh.

CAPITAL REDEMPTION

$$\text{Calculated daily charges} = \frac{\text{Development cost}}{\text{Recovery period x parking capacity x 365}}$$

$$= \frac{21,557,372.20}{20 \times 230 \times 365}$$

= 12 KSh. per vehicle per day

Assuming the city commission continue charging at the rate of KSh. 1/= per hour.

The average parking demand per vehicle = 5 hours per day hence the charges would be 5/- per vehicle per day

The economic feasibility of the project

$$\text{E.F.P.} = \frac{\text{NET ANNUAL INCOME} \times 100}{\text{DEVELOPMENT COST}}$$

$$= \frac{2,865250 \times 100}{21,557,372.20}$$

= 13.9%

This figure shows that N.C.C. providing this facility as an amenity rather than an economic venture is feasible.

But at 12 KSh. per vehicle per day

$$\text{E.F.P.} = \frac{6,876,600 \times 100}{21,557,372.20}$$

= 31.9%

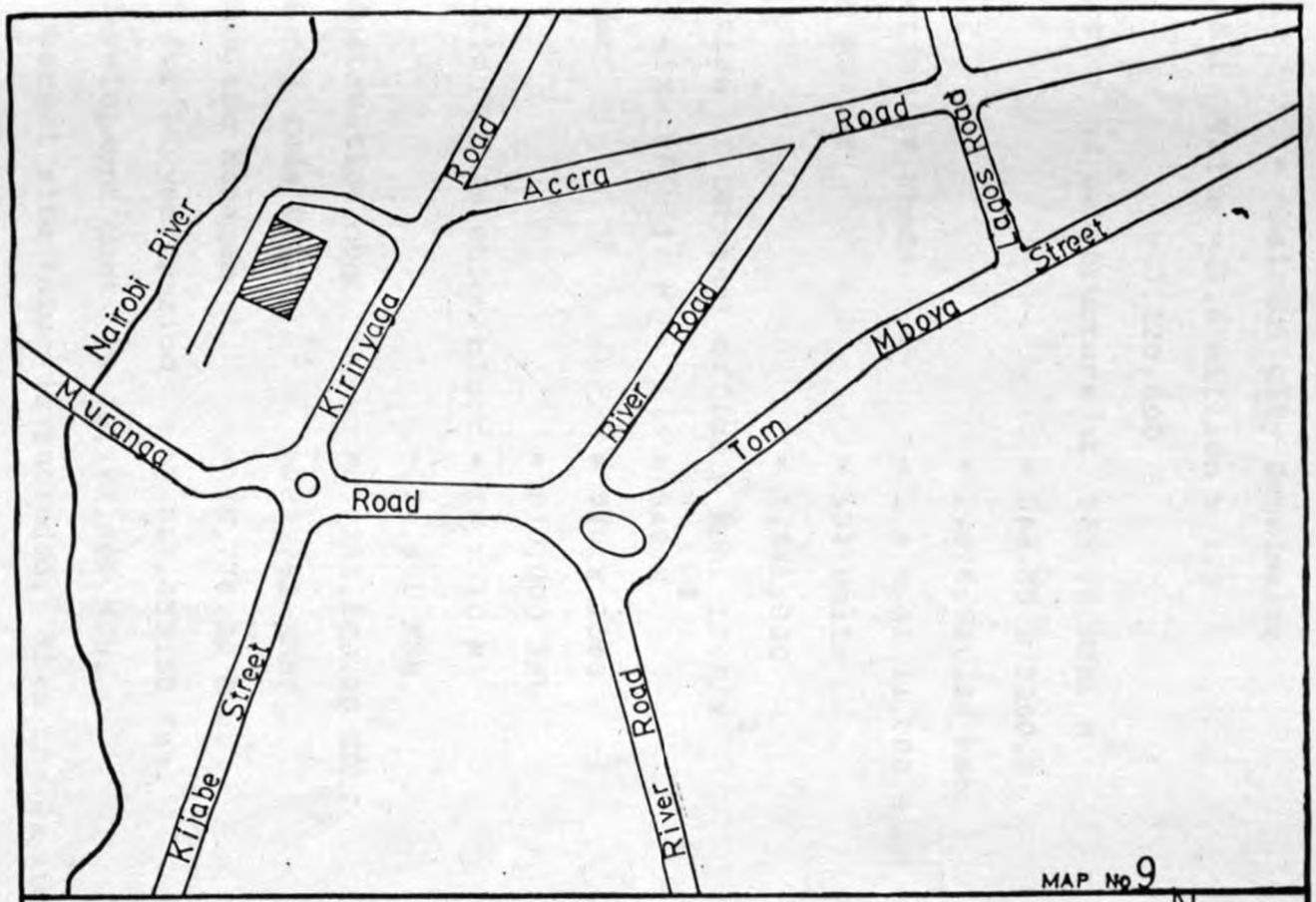
Hence the project could be an economic venture since the economic feasiblity exceeds the current interest rates, and the annual rate of return exceeds the rate of borrowing.

The project undertaking will break even at KSh.7 per vehicle per day at which rate the E.F.P. = 17.3%

5.5.2 GROGAN SITE

This is an ideal alternative site for Matatu terminals. Formerly, a squatter residence, the site is in the immediate down town area of the C.B.D. and is therefore within sufficient proximity to the C.B.D commuters. The area has recently been improved by the city commission through the construction of a circulation road network and concrete reinforcement of the Nairobi river banks, to avoid errosion. It is easily approachable from the East and West, and is easily accessible to the North through University way. The land belongs to the city commission and although part of it has been earmarked for commercial development, the remaining 1.3 acres could be developed to accommodate intra-urban Matatus and a considerable number of inter-urban routes.

Based on the same proposal that only 60% of the site area be developed for parking lots and passenger sheds, the number of parking lots to be provided at this site are 157.


Nairobi River
Road
Accra
Road
Lagos Road
Kirinyaga
River Road
Mboya
Street
Tom
Muranga
Road
Kijabe Street
River Road
MAP No 9
PROPOSED MATATU TERMINAL SITE: GROGAN
Otieno C Konyango
M A II Planning
Nairobi University
1991
scale
0
0.5
1KM.

GROGAN SITE

COST ELEMENTS

Area of site = 5260.9 M^2

Ownership = Nairobi City Commission

Current Site Value = 2.4 million x 1.3

= 3,120,000

Construction of substructure at 565.85 KSh. M^2

= 565.85 x 5260.9

= 2,976,880.20 KSh.

Construction of Sheds = 1 x 4 at 11,000 each

Proposed number = 132 units

= 1,441,000

Construction of terminal office @ KSh. 1500/M^2

Proposed size 30 x 18 M = 540 M^2

Hence cost = 540 x 1500

= 810,000 KSh

Construction of Ablution block = 18 x 10 M

= 24,000 KSh.

Total Construction cost = 5,251,880.20 KSh.

Proffesional fees @ 15% =787,782 KSh.

Operations and Management = 78,778.20 KSh.

Interest for 20 year period =9,663,459.50 Ksh.

Overal development cost = 15,781,899 KSh.

If the current site value is included, then the development cost should be KSh. 15,781,899 + 3,120,000

= 18,901,899 KSh.

CAPITAL REDEMPTION

Calculated daily charges = $\frac{\text{Development Cost}}{\text{recovery period x capacity x 365}}$

$= \frac{15,781,899}{20 \times 132 \times 365}$

= 16 Sh. per vehicle per day

Economic feasibility of the project at 5 Sh. per vehicle

$$E.F.P = \frac{2,865,250 \times 100}{15,781,899}$$

= 18%

At this rate the project would be feasible, only if N.C.C. were to provide it as a public amenity.

At 16 KSh. per vehicle per day

$$E.F.P. = \frac{9,168,800 \times 100}{15,781,899}$$

= 58%

At this rate the N.C.C. can take the project as an economic venture since the annual rate of return would be far higher than the annual rate of borrowing.

5.6 K.B.S. TERMINAL

The K.B.S. central area station should be upgraded to its maximum capacity and be used comprehensively to limit K.B.S. need to use C.B.D. bus stops. As revealed in the study, the bus station is currently operating under capacity. In addition to this, K.B.S. would need to improve on their efficiency in terms of operational schedules and increase their cross city services to evade the would be congestion at bus station.

Upgrading of K.B.S. terminal would entail construction of another lot of passenger waiting sheds, since the parking bays are already in place.

Number of sheds proposed = 8 @ 11,000 each
cost = 88,000 KSh
Professional fees = 13,200 KSh.
O & M = 1,320 KSh.
Total cost = 102,520 KSh.

5.8 N.B.S. TERMINAL

For N.B.S. the Kipande House site could be developed for their use. This area is already popular with N.B.S. since the President has always been launching new fleet of N.B.S. from there. The site is suitable in that it is easily accessible to the city core, and is approachable both from the west, and southlands of Nairobi. The site is owned by city commission and is bound on all sides by Kenyatta

Avenue, Uhuru Highway, Loita and Utalii street. It is considered in this study that 55% of the site area be developed for parking lots and passenger waiting sheds and that 45% of the site area be reserved for circulation.

The average parking demand for the bus was found to be $5 \times 9\ M^2 = 45\ M^2$.

The number of parking lots to be provided are 64.

Area of site = $4856\ M^2$

Ownership = city commission

Current site value = 20,000, 040 KSh.

Construction of substructure @ 565.85/M

= 565.85 x 4856

= 2,747,767.60 KSh.

Construction of shed 1 x 4 M @ 11,000 KSh each

Number proposed = 47 sheds

Hence cost = 11,000 x 47

= 517,000

Depot offices @ KSh. 1500/M^2

Proposed size 30 x 18M = $540\ M^2$

= 540 x 1500

= 810,000 KSh

Ablution block of 18 x 10 M

= 24,000 KSh.

Professional fees at 15%

= 614,815 KSh.

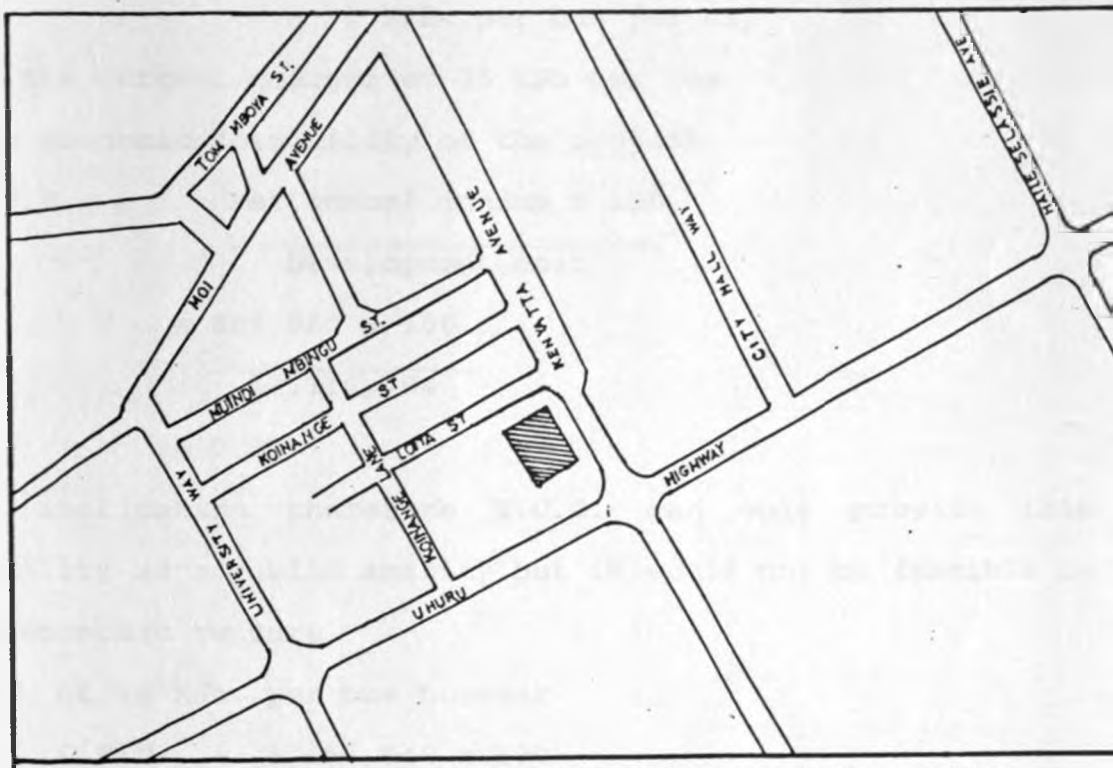
Total construction cost = 4,098,767 KSh.

Operations and Management = 61,481.50 KSh.

Interest for 20 year period = 7,541,731 KSh.

Overall cost of development = 12,316,794 KSh.

If the cost of land is included then the overall cost of development would stand at KSh. 32,316,834.


TOM MBOYA ST.
AVENUE
MOI
KENYATTA AVENUE
CITY HALL WAY
HAILE SELASSIE AVE
MUINDI MBINGU ST.
KOINANGE ST
LOITA ST
KOINANGE
UNIVERSITY WAY
UHURU
HIGHWAY
PROPOSED N.B.S TERMINAL: KIPANDE HOUSE SITE
OTIENO C KONYANGO
URBAN AND REGIONAL PLANNING DEPT
UNIVERSITY OF NAIROBI
MA 1991
0
0.5
1KM
scale
N
MAP · No 10

CAPITAL REDEMPTION

$$\text{Calculated daily charges} = \frac{\text{Development cost}}{\text{Recovery period} \times \text{capacity} \times 365}$$

$$= \frac{12,316,794}{20 \times 59 \times 365}$$

= 28 KSh. per bus per day

At the current charges of 15 KSh per bus

The economic feasibility of the project

$$\text{E.F.P.} = \frac{\text{Net annual income} \times 100}{\text{Development cost}}$$

$$= \frac{886,950 \times 100}{12,316,794}$$

= 7.2%

By implication therefore N.C.C. can only provide this facility as a public amenity but it would not be feasible as an economic venture.

At 28 KSh. per bus however

$$\text{E.F.P.} = \frac{1,655,640 \times 100}{12,316,794}$$

= 13.5%

It is therefore advisable that N.C.C. charge at 28 KSh per bus. However even at this rate the facility can only be provided as a public amenity rather than an economic venture, since the annual rate of return falls below the borrowing rate. Some government subsidy on its operation

and maintenance would also be necessary. The project breaks even at 35/-. Per bus at which rate the E.F.P. = 16.8%.

The above recommendation, plan proposals and their cost elements are made with the knowledge that one of the major constraints limiting the implementation of the city governments projects has been lack of finance. It is the contention of this study however that since the city commission now receives revenue from service charge, estimated at 60 million shillings monthly, proper financial management together with a little financial aid from the central government and other donor agencies should enable the city authority to implement a significant percentage of these proposals in their next two financial years.

5.8 CONCLUSION

The concern raised by the facts of this study rests on how to organise and manage the public transport system in a way that saves time, reduces strain and leads to more efficiency in movement and frequency of service. This means developing a transport system that will maximise mobility of the levels of journeys generated. The findings of this study therefore offers a significant contribution towards finding a solution to the public transport crisis.

It was the overall objective of this study to suggest ways of solving the congestion problem both at the terminals, bus stops and public transport routes in the

C.B.D. The conducted field survey, personal observation and interviews formed the basis of indepth knowledge of the problem. It is only at this point then that sound policy recommendations and planning proposals has been made thereby satisfying the overall objective of the study.

The transport crisis as has been demonstrated in the study is largely an economic and policy problem rather than a technical difficulty in the way of releaving the conditions of congestion and inadequacy of teminals.

It is an economic one in the sense that given sufficient supply of land, capital and materials, all the capacity needed should be provided. That the planning authorities have been slow to provide these facilities owes to the fact that the requisite resources are expensive. The basic snag is that where as heavy costs must be incurred and commitments entered into, the opportunities for recovering sufficient resources to cover such costs are not lucrative. Yet the financial limits within which these facilities are provided require that the services must pay for itself.

It is a policy one in the sense that planning responses to policy issues regarding public transport has been slow to arrest the impending crisis, and that the city government operates like many dualistic economies where urban land use activities are classified as high or low income and therefore receiving development priorities according to their class.

Throughout this study, with due regard to the factors analysed, it has been found that the solution to the transport crisis lies in traffic management options which would make the best use of the existing urban transport facilities and improve their performance capacity as well as integrate them into a working organism with each part supplementing the other in their joint efforts to meet the urban transport demands.

It is hoped that the policy recommendations and the planning proposals contained here will go along way in solving the public transport crisis in Nairobi.

APPENDIX A

OPERATIONAL DEFINITIONS

THE CITY: Nairobi Metropolitan area as defined by the city boundary.

TERMINUS: Any point in the city area where either buses or Matatus begin or terminate their journeys such points could be official or un official.

STOPS: Any point in the C.B.D. where public service vehicles can pick or drop their passengers. Such areas allow for minimal vehicle movements so that passengers can board. They are defined by lay-bys.

C.B.D.: Central area of the city as defined by the area bound by Haile-Selassie avenue, Uhuru Highway, University way and Nairobi river.

PUBLIC TRANSPORT: That aspect of tranportation seen as an organised means of travel intended for the general public use. It can be provided by private, public or corporate bodies, the central government or local authorities.

Intra-urban public transport - Deals with movement and circulation of people, goods and services between and within the various activity zones within the limits of the urban area boundary.

Matatu - The informal mode of public transport. Usually they are micro-buses Nissans, or Mini-buses operating along bus routes for passenger hire.

APPENDIX B

ABBREVIATIONS

N.C.C.	-	Nairobi City Commission (Formerly Nairobi City Council)
V.C.R.	-	Volume Capacity Ratio
M.V.O.A.	-	Matatu Vehicle Owners Association
K.M.V.A.	-	Kenya Matatu Vehicle Assocation
N.B.S.	-	Nyayo Bus Services
K.B.S.	-	Kenya Bus Services
O.T.C.	-	Overseas Transport Company
G.P.O.	-	General Post Office
C.B.D.	-	Central Business District
D.P.U.	-	Development Planning Unit
P.S.V.s	-	Public Service Vehicles
N.U.S.G.	-	Nairobi Urban Study Group
T.L.B.	-	Transport Licencing Board
N.T.U.	-	Nairobi Transport Unit
K.I.A.	-	Kenya Institute of Administration
U.T.O.	-	United Transport Overseas

APPENDIX C

COST ELEMENTS

SUBSTRUCTURE

ITEMS		COST KSH.
Excavation of top soil	1 M^3 @ 20	20.00
Normal Excavation	0.775 M^3 @ 50	38.75
Load Cart away	0.775 M^3 @ 35	27.10
Grade bottom	1 M^3 @ 20	20.00
Hard Core fill	0.5 M^3 @ 200	100.00
Murram blinding	1 M^3 @ 30	30.00
Concrete 1:1/2:3	1 M^3 @ 220	220.00
B.R.C. Reinforcement	1 M^3 @ 60	60.00
Miscellaneous Items-joints, drains, formwork etc.		50.00
		565.85

Cost per M^3 of substructure is 565.85

SUPERSTRUCTURE:

SHADE:

Concrete 1:2:4	9 M^3 @ 220	1,980.00
B.R.C	9 M^2 @ 60	540.00
150x50x3 MM R.H.S	14M x 320	4,480.00
26 Gange G.C.I.	16 M x 175	2,800.00
Formwork	15 M x 80	1,200.00
		11,000.00

Operations and Management cost is calculated at 1.1/2% of the construction cost and is to be invested in a sinking fund.

Construction rate is 11,000 per one 1 x 4.

Source: Valuation Section, M.L.H. & P.P. 1990 values

Sikuku Wafula (courtesy)

APPENDIX D

DEPARTMENT OF URBAN AND REGIONAL PLANNING

UNIVERSITY OF NARIOBI

QUESTIONNAIRE NUMBER _____

INTERVIEWERS NAME _____

DATE _____

PLACE OF INTERVIEW _____

QUESTIONNAIRE FOR MATATU OPERATORS

BACKGROUND INFORMATION

1. Your Name _____ Age _____

2. Level of Education _____

3. Marital Status _____

EMPLOYMENT

4. In What capacity do you work in this Matatu?

   (a) Conductor (b) Driver (c) Owner

5. How long have you worked in this Matatu? _____

6. How are you paid? (a) Monthly (b) Weekly (c) Daily.

7. What are the rates of payment per day/month _____

MATATU OPERATION

8. Is this matatu restricted to certain routes/service zones?

   Specify _____

9. What was the criteria for your choice of this route

   (a) Less jams (b) Few police

   (c) Better roads (d) High demand

10. Is this the same route followed by K.B.S.? _____

11. What other routes do you operate on?_____

_____

12. Is this Matatu provided with a terminal space in the C.B.D.?

State where _____

13. How many trips does this Matatu make per day? _____

14. Are these trips only intra-urban? _____

15. Do you think K.B.S. and Matatus should have

1. Separate terminals
2. Separate routes
3. Separate bus stops

16. Give reasons for your answer above

1. _____
2. _____
3. _____
4. _____
5. _____

17. Should 'Matatus' operating in the city be made to follow a fixed time table? _____

(b) Why? _____

_____

_____

18. List the main problems you face in the C.B.D. with regard to

(i) Terminals _____

_____

_____

_____

(ii) Bus stops _____

_____

_____

_____

(iii) P.S.V. Routes _____

_____

_____

_____

19. Should anybody going into matatu business first apply for allocation of a terminal space in the C.B.D. area?

_____

(b) Why? _____

_____

20. Would you accept out of C.B.D. terminals

Why? _____

DEPARTMENT OF URBAN AND REGIONAL PLANNING

UNIVERSITY OF NAIROBI

QUESTIONNAIRE FOR COMMUTERS

Questionnaire Number _____

Date _____

Respondents Name _____

Sex _____

Place of Residence _____

Place of work _____

1. Do you travel to the city centre daily?_____
2. What are your reasons for travelling? _____

   _____

   _____

   _____
3. What mode of transport do you use? _____
4. What are your reasons for the choice of this mode?

   _____

   _____

   _____
5. At what place do your C.B.D. trips end? _____
6. Where in the C.B.D. do your trips begin? _____
7. Grade the following problems in order of how they affect you most.

   (a) Long walking distance from C.B.D. bus stop/terminal to your final destination

(b) Long waiting hours at the C.B.D. bus stops and terminals

(c) Heavy traffic jams at peak hours

(d) Crowding in the buses and Matatus

8. Supposing that terminals are located outside the C.B.D. area is this a good idea? _____

(b) Why? _____

_____

_____

9. Are the present locations of bus stops in the C.B.D. convenient in terms of dropping you at the right places?

_____

Explain _____

_____

_____

10. Do you consider the present location of bus stops in the C.B.D. a hindrance to traffic flow?

Explain _____

_____

_____

11. Of the following reasons, which one do you think makes commuters to drop in places other than bus stops?

(a) The slow moving traffic makes it convenient to drop and walk, to avoid being late.

(b) Vehicles are crowded and stuffy so it is a relief to drop and walk soon as is convenient.

(c) Bus stops are not placed in ideal places in relation to destinations.

(d) Matatus force people to drop in such places.

12. Which one of these reasons makes people to pick vehicles in places other than bus stops.

(a) To get a sitting space

(b) To avoid the scramble and stampede at C.B.D. bus stops

(c) Buses are full and difficult to enter by the time they reach C.B.D. bus stops.

DEPARTMENT OF URBAN AND REGIONAL PLANNING

UNIVERSITY OF NAIROBI

INTERVIEW GUIDE

TOPIC: THE PROVISION OF TERMINAL FACILITIES FOR INTRA-URBAN PUBLIC TRANSPORT MODES

Questions Specific to N.C.C.

1. What was the criteria used in allocation of present Matatu and N.B.S. terminals in the C.B.D.?

2. What criteria was used in the location of bus stops in the C.B.D.?

3. What was conceived to be their functions?

4. What justification do you give for separate terminals for K.B.S., N.B.S. and Matatus?

5. Matatu mode of transport was authorised by Presidential Degree in 1973 and followed by a legislation in 1984. Why have they not been planned for in the city?

6. Why do you think passengers like picking/dropping at traffic lights or road junction instead of bus stops?

7. A number of studies has been done on transport, e.g. Situma 1977 which recommended out of C.B.D. terminals for extra urban transport and in C.B.D. terminals for intra-urban transport. What are some of the bottlenecks that has hindered the implementation of such report?

8. What are the growth trends of Matatus, K.B.S. and N.B.S. in the city of Nairobi.

9. What is your opinion about a policy that every Matatu should not be registered unless it is provided with a terminal facility in the C.B.D.

10. Do you think Matatus by their mode of operations need bus stops?

12. How many authorised terminals are there for Matatus? How many unauthorised ones?

13. Distribution of land-use within the C.B.D.

Land Use	Area (M^2)
Commercial	
Industrial	
Residential	
Transport	
Others	

PART II

QUESTIONS TO K.B.S. AND N.B.S.

A. GENERAL QUESTIONS

1. Do you consider the present bus stops as being adequate for the public transport modes in terms of
   (a) Their capacity in view of demand
   (b) Their number and distribution
   (c) Facilitating efficient traffic flow in C.B.D.

2. If the three modes of public transport were made to operate under the same regulations with an independent co-ordinating body, would this be feasible? and would they supplement rather than compete each other.

3. Whats your opinion about express bus routes during peak times to eliminate intermediate bus stops in the C.B.D.

4. What other management methods do you think would make traffic circulation in the C.B.D. better.

5. Outline the major problems you face with regard to the general operations and management of your fleet.

6. In congestion situation, the big buses cannot keep up with competition because of their low ability to manouvre. Have you considered having more smaller buses of the N.B.S. Iveco type.

7. What methods do you use in managing traffic at your C.B.D. terminals

8. Do you think the terminals are sufficient for your fleet?

   Explain _____

   _____

   _____

9. What solutions do you suggest to problems faced in managing traffic at these terminals.

10. Whats your opinion about traffic management systems that puts P.S.V.s terminals outside of the C.B.D.

11. Would you prefer seperate or shared terminals for these modes in the C.B.D.

    Explain _____

    _____

    _____

TRAFFIC MOVING TIME SURVEYS

Time of Survey _____to _____

Date _____

Survey taken between _____and _____ bust stops

Type of vehicle _____

Arrival time _____

Departure time _____

Time spent at each bus stop _____

(i) _____

(ii) _____

(iii) _____

(iv) _____

(v) _____

Time spent at traffic lights

(i) _____

(ii) _____

(iii) _____

(iv) _____

(v) _____

Time of arrival at control point _____

Observation of other intervening factors _____

_____

_____

_____

TRAFFIC CENSUS SURVEY

Time _____ to _____

Date _____

Census point at _____

NUMBER OF VEHICLES BY TYPES

Matatus	K.B.S.	N.B.S.	Private	Others

TRAFFIC BUILD UP RATES AT BUS STOPS AND TERMINALS

Time of Survey _____ to _____

Type of vehicles surveyed _____

Terminal/Bus stop _____

VEHICLE ARRIVALS & DEPARTURE EVERY 10 MINUTES

Time	No. Arrival	No. Departure	No. Left Behind

VEHICLE BOARDING AND A LIGHTING TIMES

Census Point at _____ Bus stop/terminal _____

Time of Survey _____ to _____

Date _____

Route No.	Arrival time	Departure	Activity	Duration

BIBILIOGRAPHY

1. BARKE, M. Trade and Transport; Conceptual Frameworks in Geography. Oliver & Boyd 1986.
2. BARWEL, I. The Matatu Public Transport Sector in Nairobi Unpublished Report, 1979.
3. BLACK, J. Urban Transport Planning Croon Helm Ltd. 1981.
4. BEREGE, E.H. Promotion of Efficiency and Effective Urban Public Transport System in Dar-es-Salaam. A Case Study of U.D.A. M.A. Thesis Planning. UON 1976.
5. BEESLEY, M. Urban Transport; Studies in Economic Policy. Butterworth and Co. Ltd. 1973.
6. BUCHANAN, C.M. Whither Transport Planning In Built Environment Vol 3 No. 7 1974.
7. CRESSWELL, R. Urban Planning and Public Transport. The Construction Press, 1979.
8. CRESSWELL, R. Passenger Transport and the Environment Leonart Hill 1977.
9. DAILY NATION 3rd November 1986. Nairobis Urban Growth.
10. DAILY NATION 22nd June 1987. Its the Down March to Work.
11. FRANK, J.K. Urban Transport; Politics Planning and People In Urban Problems and Public Policy. Lexington Books 1975.
12. GODWIN, G. Traffic Transportation and Urban Planning George Godwin 1981.

13. HOVEL, P.J. The Management of Urban Public Transport. Lexington Books, 1975.

14. HERBERT, H. Urban Transportion Systems in Developing Countries. In Existics Vol.51 No.306 1984.

15. KAPILA, et al The Matatu Mode of Public Transport in Metropolitan Nairobi. Mazingira Institute 1982.

16. MANGAT, H.S. Urban Traffic Problems in Nairobi City. N.C.C. Unpublished 1976.

17. MAINA, B.R. Road Safety in Nairobi. An Analysis of Road Accidents in Nairobi Road Network
M.A. Thesis, UON 1978.

18. MENEZES & PARTNERS. Nairobi 77; A Proposal for Comprehensive Development. Menezes 1973.

19. MWENJA, S.N. Car Parking; An Interim Report
City Engineering Department 1972.

20. MEYER, J.R. The Urban Transportation Problem
Havard University Press 1979.

21. MEYER J.R. The Urban Transport Planning.
Havard University Press 1965.

22. MURIUKI. J.N. A Study of Transport Modes into Nairobi and their Implications to Planning
A Case Study of External Bus Transportation in Nairobi
M.A. Thesis U.N. 1976.

23. M.V.O.A Newsletter Vol. 2 April 1984.

24. _____ Newsletter Vol. 3 August 1984.

25. N.C.C. Nairobi Project; Urban Planning Practices Development Planning Unit 1983-1984.

26. N.C.C. Development Plan 1984-1988 City Hall Nairobi.

27. N.C.C. Nairobi Project; Urban Planning Practice. Development Planning Unit 1985-1986.

28. N.U.S.G. Nairobi Metropolitan Growth Strategy Vol. 1 82 N.C.C. 1973 Town Planning Section.

29. ONYIRO, G.O. The Problems of Pedestrian Movement in the Central Area of Nairobi. M.A. Thesis UON 1977.

30. PETER, H.J. Transport and Communications; In Urban Planning Problems. Gordon E. Chery; Leonard Hill 1976.

31. REPUBLIC OF KENYA. Urban Transport Management Seminar K.I.A. 1987.

32. _____ Traffic Act - Cap 403 Revised Edition 1962; Laws of Kenya Vol. Viii. Government Printer, Nairobi.

33. _____ Transportation Licensing Act Cap 404 Revised 1962 Laws of Kenya Vol.Viii Government Printer, Nairobi.

34. _____ Transport Technology for Developing Regions A Study of Road Transport in Venezuela. M.I.T. Press 1966.

35. STARKIE, J. Transportation Planning, Policy and Analysis Pergamon Press 1976.

36. STREN, R. The Matatu Mode of Transport in Nairobi In African Cities in Crisis. Westview 1989.

37. SMERK. G.M. Readings in Urban Transportation - Indiana University Press 1968.

38. THOMAS MCGREEN Urban Transportation Technology - Lexington Books - London 1976.

39. TIWARI. R.C. Origin, Growth and Functional Structure of Nairobi C.B.D. The Urbanisation and Development in Kenya - Kenya Literature Bureau 1981.

40. TRANSURB CONSULT LTD. A Study of Transport Needs of Nairobi. Final Report 1986. Transurb Consult Ltd, Belgium.

41. U.N.C.H. Transportation Strategy for Developing Countries Habitat 1984

42. WAMBUA K.B.S. Ltd. Unpublished Paper and Personal Communications. K.B.S. 1988

43. WORLD BANK Urban Transport; Policies and Priorities In Urban Edge Vol. 10 No. 5 1986.

44. WELLS, G.R. Comprehensive Transport Planning Charles Griffin and Company Ltd. 1975.

45. WALMSLEY, R. The Geography of New City. Nairobi E.A.L.S. No. 1957.

46. WHITE, L.W.T. Nairobi Master Plan for Colonial Capital London H.M.S.O. 1948.