THE COST OF TRAFFIC CONGESTION AND ACCIDENTS TO THE ECONOMY IN TANZANIA

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1.0 INTRODUCTION

Traffic congestion is a condition on any road network as use increases, and is characterized by slower speeds, longer trip times, and increased queuing. The most common example is for physical use of roads by vehicles. When traffic demand is great enough that the interaction between vehicles slows the speed of the traffic stream congestion is incurred. As the demand approaches the capacity of a road (or of the intersections along the road), extreme traffic congestion sets in, where vehicles are fully stopped for periods of time, is colloquially known as a **traffic jam**. Dar es Salaam city is no exception, many roads in the city have very high volume/capacity ratio and many intersections are heavily affected with traffic jams. A solution is well overdue and we need to start resolving the crisis now in using both short, medium and long term measures.

There have also been some efforts in the past to address the problem. The experts' meeting was held in Dar es Salaam in July 2007 to address Dar es Salaam road traffic congestion and a number of mitigation strategies were suggested.

The recent study by the Government with the support of the Japanese International Cooperation Agency JICA in collaboration with the Dar es Salaam City Council (DCC) has prepared the Transport Master Plan for Dar es Salaam City to year 2030 and has proposed some Short term, medium term and long term solutions to transportation problems in Dar es Salaam City incorporating the BRT project to be implemented under the DART Agency.

Congestion in Dar es salaam is always changing from bad to worse, more important, it is getting worse year by year. Current official forecasts imply that congestion will be substantially worse by the end of this decade, even on the very favourable assumption that all current Government projects and policies are implemented in full, successfully, and to time. This is because road traffic is growing faster than road capacity. This is not a temporary problem: it will continue to be the case, in the absence of measures to reduce traffic, because it is infeasible to match a road programme to unrestricted trends in traffic growth. The effect, using the various method of measuring congestion, and a long established method of valuing it, would be that the annual cost would increase

significantly by 2020. Under the current social and economic frameworks, there are no feasible policies that could reduce congestion to zero in practice, or that would be worth while doing in theory. But savings worth billions of shillings a year could in principle be made by appropriate congestion mitigation measures over the whole network, of which (very approximately) half might be reflected in the prices of goods, and half in savings in individuals own time spent travelling. A good proportion of this could alternatively be secured by an appropriate package of alternative measures e.g priority lanes and signaling; switching to other modes including freight to rail and passenger movements to public transport, walking and cycling; soft policies to encourage reduced travel by car; land-use patterns which reduce unnecessary travel; and associated measures to prevent benefits from being eroded by induced travel.

In solving congestion problems using various state of the art solutions, road safety also tend to be improved significantly and thereby reducing accidents considerably.

This paper will address the economic losses due to congestion and road accidents and provide some short, medium and long term solutions to alleviate the prevailing problem.

2.0 NEGATIVE IMPACTS OF TRAFFIC CONGESTION AND ACCIDENTS

In general, traffic congestion and accidents has a number of negative effects:

- Wasting time of motorists and passengers as a non-productive activity for most people and congestion reduces regional economic health.
- Delays, which may result in late arrival for employment, meetings, and education, resulting in lost business, disciplinary action or other personal losses.
- Inability to forecast travel time accurately, leading to drivers allocating more time to travel "just in case", and less time on productive activities.
- Wasted fuel increases air pollution and carbon dioxide emissions contributing to global warming owing to increased idling, acceleration and braking. Increased fuel use may also in theory cause a rise in fuel costs.
- Wear and tear on vehicles as a result of idling in traffic and frequent acceleration and braking, leading to more frequent repairs and replacements.
- Stressed and frustrated motorists, encouraging road rage and reduced health of motorists.
- Emergencies: blocked traffic may interfere with the passage of emergency vehicles traveling to their destinations where they are urgently needed.
- Spillover effect from congested main arteries to secondary roads and side streets as alternative routes are attempted (rat running), which may affect neighborhood amenity.

- Loss of life resulting into difficulty family livelihood and loss of workforce to the country's economy.

3.0 Economic Considerations of Transportation

Transportation in the Socio-Economic System is always serving to achieve National and local goals. It involves Land and Natural resources development, population distribution and Connections, economic goals (growth, efficiency etc) social goals (Employment, mobility etc), National Sovereignity and political goals and people and goods movement as well as international trade, tourism and relations. In this context, the following are the main and important considerations of transportation in the Social-Economic System

I. Production and consumption of Products:

Transport is a key necessity for specialization - allowing production and consumption of products to occur at different locations.

II. Trade and Development:

Transport has throughout history been a spur to expansion; better transport allows more trade, land use development and a greater spread of people.

III. Economic Growth and Efficiency:

Economic growth and impact on economic efficiency have been always dependent on increasing the capacity and rationality of transport as well as safety. But the infrastructure and operation of transport has a great impact on the land and is the largest drainer of energy, making transport sustainability a major issue.

IV. Causes for mobility related to economic considerations:

Modern societies dictates a physical distinction between home and work, forcing people to transport themselves to places of work or study, as well as to temporarily relocate for other daily activities. These reasons are strongly connected to decisions of economic nature.

V. Additional considerations:

Passenger transport is also the essence of tourism, a major part of recreational transport. Commerce requires the transport of people to conduct business, either to allow face-to-face communication for important

decisions or to move specialists from their regular place of work to sites where they are needed

4.0 What share should transportation get from national Budget??

As mentioned earlier, Land Transportation Systems as a means to fulfill and achieve national and local values, goals and purposes deserves a significant share from the national budget taking into consideration the development of land use and natural resources and better and more efficient economy that extract more from our transportation systems. A lot of benefits always accrue from better transportation systems. In this financial year(i.e 2011/12), the Government has set aside Tshs 1,505bn (USD 875 million) for roads, railway and ports infrastructure development. This amount is 11.12% of the total National budget. ***The question is: is this amount enough?***
Taking into consideration the current requirements of transport infrastructure development, it is evident that the budget is not adequate.

5.0 Transport economic benefits

Transportation and Motorization development has its negative Side effects as well. The Major Negative Side Effects of Land Transportation include Congestion, Air Pollution, Road & Transportation Accidents.

In this regard, the Purposes and Goals of Using Economics in Optimizing Traffic Flow is to:

- Quantifying Traffic Flow Problems by Economic Terms
- Quantifying Congestion Solutions by Economic Terms
- Establishing Grounds for Evaluations and Decision Making
- Setting Quantitative Congestion Relief Goals and Programs
- Setting Optimized Priorities for Traffic Project Investments
- Allocation of Resources for Traffic Flow Improvements
- Justifying Investments in Highway and Traffic Projects
- Establishing Grounds for Evaluations and Follow-ups
- Setting Performance Standards to be Logically Evaluated

And Purposes and Goals of Using Economics in Road Safety is to:

- Quantifying Road Safety Problems by Measurable Terms
- Quantifying Safety Solutions by Measurable Terms
- Establishing Grounds for National Projects Comparisons
- Establishing Grounds for International Comparisons
- Setting National & Local Measurable Goals and Programs

• Setting Optimized Priorities for Safety Project Investments
• Allocation of Resources for Safety Improvements
• Justifying Investments in Safety Projects
• Establishing Grounds for Evaluations and Follow-ups
• Setting Standards to be Logically Evaluated

Basing on the above facts, relevant statements for economic optimization related to traffic congestion and loss reductions have been developed.

Statement No. 1: “despite a low rate of Motorization developing countries suffer already from severe problems of congestion and economic losses especially in and around the large Cities”

Statement No 2: “Developing countries, because of low GDP and low income can not afford the economic losses caused by the severe problems of traffic congestion”

Statement No. 3: “Developing countries, can at the current rate of Motorization reduce economic losses due to congestion and save national economic resources for further development

Urbanization and Motorization Growth In Developing Countries without adequate development of road infrastructure causes high economic losses due to congestion and road accidents – example of Urban traffic in our City – Dar es Salaam

5.1 Identification, measurement and pricing of congestion costs on cross-town link roads

1**.Financial costs and welfare losses**

1.1. Value of the time lost due to reductions in traffic speed caused by current congestion
1.2. Valuation of increased depreciation of vehicles and additional fuel consumption
1.3. Comparative disadvantage for location of economic activities
1.4. Valuation of material damage arising from congestion-related Accidents

2. Environmental costs and loss of welfare

2.1. Costs and welfare losses arising from noise associated with traffic

congestion on cross-town link roads

2.2. Costs and welfare losses from emissions associated with traffic congestion on urban roads

2.3. Costs and welfare losses inherent in exposure to risks from the transportation of hazardous goods

2.4. Costs and welfare losses arising from the barrier effect caused by heavy traffic on cross town link roads

5.2 Land Transportation Systems: Costs and Benefits

Costs and Benefits are always associated to the following:

- To Society
- To the Developers, Operators and Maintainers
- To the Users
- To Non-Users

It should be noted that costs and benefits can also be divided to those quantifiable in monetary values and to those non-quantifiable in monetary values. The non-quantifiable costs and benefits must be dealt with utility theory, means to establish common grounds with the quantifiable Costs and benefits.

6.0 Traffic Congestion as a Transportation Problem of Economic Significance:

Low Level of Service (LOS), Indication of Congestion for levels E and F (worst levels) implies lot of wasted time, increased vehicle running costs, increased accidents and pollution as well as increased agravation and frustration.

Increase in Density beyond a critical value will cause speed flow reduction and development of congestion.

Suggested Cost Figures Due to Congestion

The wasted time in a given trip is evaluated relative to the time needed to make the trip at free flow:

WASTED TIME: Time taken for a given trip at congested conditions minus the time taken for the same given trip at free flow.

i). Wasted time Cost: Private Car for 1 hour :
Work: 50% of average cost for 1 labor hour, Leisure Time: 10% average cost for 1 labor hour

ii). Wasted time Cost: Truck or Bus for 1 hour: 50% of average cost of daily revenue divided by average daily vehicle operation hours

Dar es Salaam "the case study"

1. Lets assume a 100 k"m long 2 lane Urban Road entering a city with 6 hours daily congestion (6:30- 9:30, 16:30-19:30) causing 150,000 private cars and 10000 commercial vehicles (trucks, busses, vans, etc.) waste 2 hours daily each.

2. This will sum up during a year (300 active days) to 90 million wasted hours annually for private cars and 30 million wasted hours for commercial vehicles. (150,000x300x2)= 90 Mil. (10,000x300x2)= 6 Mil. 3. By computation we find that 1 average labor hour for a person in a private car is worth 4000 Ths and for a commercial vehicles 15000 Ths , hence, **saving 50% of the cost by reducing wasted time for private car hour will save 2000 shs per hour and for commercial vehicles 7500 shs per hour.**

From the above, total loss due to congestion in the year is of the tune of 360bn for private cars and 90bn for commercial vehicles.therefore total loss due to wasted time is 450bn per year.

And assuming each vehicle loose just 1 litre of fuel per day due to congestion, in a year a total of approximately 100 liters of fuel is wasted. For the price 2050 shs per liter, total loss in monetary terms is approximately 205bn Tshs per year. **The grand total loss is the estimated to be Tsh. 655bn per year.**

By providing a solution which would reduce wasted time (congestion hours) by 50% eg. Widening of the road from 2 to 4 lanes with a dividing barrier between the two carriageways or provide a grade separation (fly-over) at the critical intersections, the following benefits could be realised.

The total annual saving will be therefore:
: 90,000,000 private car hours savings hours x 0.5 x 2000shs = 90bn Tshs. And commercial vehicles hours savings: 6,000,000 hours x 0.5 x 7.5 shs =22.5bn shs
and the annual total saving due to time saving only will be:
112.5bn shs
Now, If the cost of widening the road from 2 lanes to 4 lanes sums up to 1.2 bn shs per km, the total cost will be: 1.2 bn shs x 100 km =120bn shs or in case of the simple fly over(for grade separation at an intersection) the cost cost will be aprox 35bn shs.

Hence it can be deduced that, :

The cost of Widening the road from 2 to 4 lanes can be saved in less than 1.5 years of congestion cost savings from wasted time only : 168.75 bn tsh savings > 120 bn tsh improvement costs. The benefits and savings will accumulate during the next 20 years. The same could be for building four fly overs at critical intersection. i.e 168.75bn tsh savings > 140bn tsh for fly over construction. If saving from fuel, wear and tare and pollution are added, the cost of providing a solution (building a new road, widening of existing roads, provision of 1 fly over at an intersection) could be recovered in less than a year

7.0 Approach to Solutions and Countermeasures

Conceptual formulation to develop transportation systems to achieve socio-economic goals and reduce traffic congestion and losses include the following:

- Mobility and Congestion Problems Definition By Characteristics: time and location
- Quantification of Problems and severity by economic terms: time and location
- Checking Modes of Transport adjustments as potential solutions
- Optimal Implementation of Transport systems development and Economic Efficiency
- Development of Optimal Transportation Systems Program

The Requisites to Achieve an Optimal Transportation Systems Program includes:

a. Identification of dominant transportation needs and problems by quantity and severity and by time and location
b. Quantify the needs and problems by economic measurable terms
c. Check, define and plan for an efficient transportation systems composition
d. Adjust and develop the transportation systems programs planning

e. Set priorities for investments to implement the transport systems development

Conceptual Program Formulation to Improve Road Safety includes;

- Problems Definition By Characteristics time and location
- Quantification of Problems and severity by economic terms
- Adaptation to the Problems and Potential Prevention
- Optimal Implementation of Solutions set by Priority and Economic Efficiency
- Optimal road Safety Program

The Requisites to Achieve an Optimal Road Safety Program:

a. Identification of Dominant Problems by Quantity and Severity
b. Right Adaptation and Implementation of Solutions to Problems

c. Correct and Objective Priority Setting of Program for Optimal use of a Given Budget.

The solution to road safety Problem

The Cost Optimization Approach in Developing Road Safety Programs, What do we need?;

• Cost figures of accidents we want to prevent by given countermeasures or safety operations.
• The efficiency of the countermeasures or safety operations in preventing the relevant accidents.
• The Cost of implementing the counter measures or safety operations.
• An economic evaluation of the expected results of loss reduction relative to the safety investment.
• Setting priorities in a program for the operation and countermeasures investments

Approaches for Road Accident Costing

1. The Human Capital approach (HC)

Based on a subjective individual assessment of accident occurrence risk and its consequences and the readiness to pay to reduce or minimize this risk.

2. The Willingness to Pay approach (WTP)

Based on the future value of a persons economic production Hence, preventing and accident will lead to save the potential Economic LOSS incurred when a person is injured or killed. Property damages are added to the production loss.

3. The Insurance Company approach (IC) Based on a assessment of accident costs and compensation for body or property damages. This approach is not dealing with accident prevention but the risk of occurrence and damages caused.

The most common recommended approach is The Human Capital Approach, What does an accident cost include in general:

• Loss of future economic productivity due to death or injury in a road accident.
• Cost of medical treatment and rehabilitation in all stages during and after the accident.
• Property damage resulted by the accident to vehicles, personal property and external damages.
• Cost of services related to the accident: Insurance, emergency services, police and judicial costs, social care, etc.

• Cost representing in money terms for “grief, pain and suffering” to the persons and relatives involved.

Accident average cost by severity (all costs included):
• Fatal accident
• Severe injury accident
• Slight injury accident
• Property damage only accident

Type of accident	Cost per accidents shsx1000	Number of Accidents	Total cost tsh(x bn)
Fatal Accidents	100000	3582	358.2
Injury accident	5000	21000	105
Property damage only accident	100	15000	2.7
Total			466

Hence, it can be estimated that the Dar es salaam Total Economic Loss
Due to All Road Accidents in 2010 is Tshs 466 Billion.

The current figures indicate that, the total number of registered vehicles in the country is 964,326 excluding Governement vehicles. The insurance premiums is approximately 100,000 tsh (average) per motor vehicle to cover for accidents etc, this means that the insurance industry is worth over Tsh 100bn, How much is invested on Road Safety as compared to this investment on insurance companies?

8.0 Countermeasures investments.

It has been suggested by some stakeholders that the level of congestion that society tolerates is a rational (though not necessarily conscious) choice between the costs of improving the transportation system (in infrastructure or management) and the benefits of quicker travel. Others link it largely to subjective lifestyle choices, differentiating between car-owning and car-free households. Many solutions to the problems involve improvement of road infrastructure as described below.

8.1 Road Infrastructure improvements

- Junction improvements
  - Grade separation, using bridges (or, less often, tunnels) freeing movements from having to stop for other crossing movements
  - Reducing junctions

        - Local-express lanes, providing through lanes that bypass junction.
        - Limited-access road, roads that limit the type and amounts of driveways along their lengths
- Reversible lanes, where certain sections of highway operate in the opposite direction on different times of the day/ days of the week, to match asymmetric demand. This may be controlled by variable message signs or by movable physical separation or by traffic police.
- Separate lanes for specific user groups (usually with the goal of higher people throughput with fewer vehicles)
    - Bus lanes as part of a bus way system
    - High occupancy vehicle (HOV) lanes, for vehicles with at least three (sometimes at least two) riders, intended to encourage more people to use one car.

8.1.1. Junction Improvement:

8.1.1.1 Grade Separation using bridges

Grade separation is the method of aligning a junction of two or more transport axes at different heights (grades) so that they will not disrupt the traffic flow on other transit routes when they cross each other. The composition of such transport axes does not have to be uniform; it can consist of a mixture of roads, footpaths, railways, canals, or airport runways. Bridges, tunnels, or a combination of both can be built at a junction to achieve the needed grade separation.

In Tanzania and in Dar es Salaam in particular, at the moment we need simple grade separation bridges (see figure 1 below) for our critical intersections such as Ubungo, Tazara and Mwenge. In the future we might need complex grade separation as shown in figure 2 below depending on traffic demands, economics and the environment

Figure 1. Simple Grade Separation

Figure 2: Complex grade separation

8.1.1.2 Provision of a Fly-Over at Ubungo intersection

It is clearly understood that the volume to capacity ratio at ubungo Intersection is very high and as a result there is huge traffic Jam at the intersection since it is the major exit from Dar es salaam to up-country Cities and neighboring countries. Significant time loss is experienced at Ubungo due to this bottleneck. To solve the problem, a concerted **FAST TRACK** approach to problem solving is required.

To solve this problem and considering all modes of transport using the intersection and considering an increasing demand in future, it is proposed that construction of a mixed traffic fly over, using split design taking into account existing BRT lanes and for future BRT lanes along Morogoro road and Sam Nujoma road respectively is likely to offer most benefit in terms of intersection traffic operations. See figure 3 below

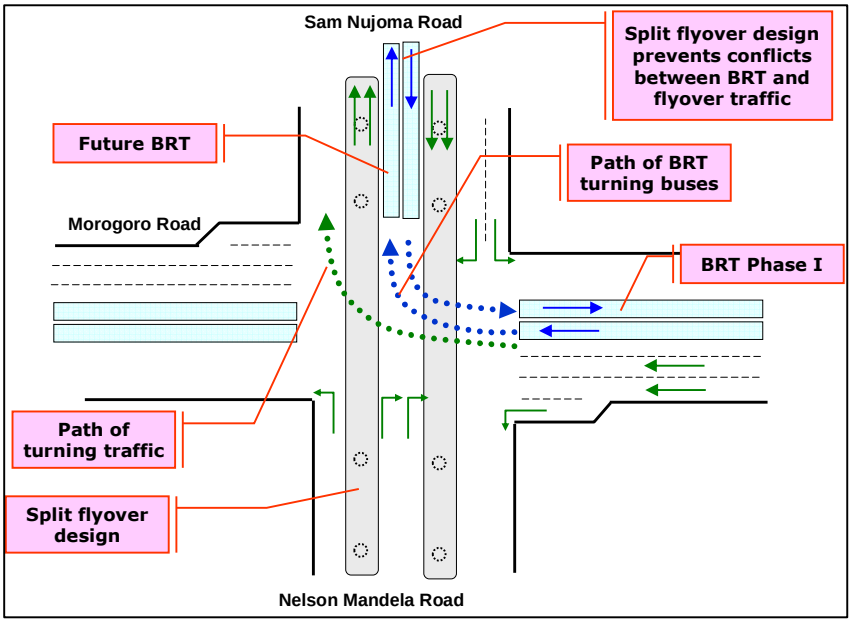

Figure 3 Schematic of Potential Mid to Longer-term Solution Split Structure Nelson Mandela Road Flyover for Mixed Traffic

Implementation Plan

DART/TANROADS shall be made responsible for the implementation of the construction works of this project.

The implementation schedule should take into account the following stages

1. Preliminary design/detailed design
2. Bidding and contract and
3. Construction schedule.

The period required for the preliminary design and detailed design stage and the bidding and contract is estimated at 12 months, while the total construction period is estimated at 24 months. The proposed implementation schedule is summarized below:

Proposed Implementation Schedule

S/N	Work Item	Duration (months)	1st year	2nd year	3rd year	4th year
			2009	2010	2011	2012
1	Preliminary design/detailed design	9				
2	Bidding and Contract awarding	3				
3	Preparatory Works+ order to commence	3				
4	Fly over(BL=300m, AL=400m, with four lanes)	21				
5	Improvement of intersection at grade separation	6				

BL=Bridge length

AL = Approach Length

Annual Disbursement Schedule

The annual disbursement schedule would be made in accordance with the project cost and the proposed implementation schedule. The total investments cost for the project could be divided by the duration of the project and thereby get an annual disbursement schedule. This shows that the cost for project is not incurred once by the client or investor. If the duration of the project is three years, then only one third(1/3) of tota project cost would be required per year.

Project Benefits

The benefits that could be expected by implementing the project include savings (cost & time, fuel, pollution etc) to road users are due to increased speed and capacity on roads.

The quantifies economic benefits of saving in vehicle operating costs and savings in time costs are defined as the difference of these costs when comparing the “with project” and “without project”. These include Net present value, EIRR and B/C ratio.

8.1.2 Reducing Junctions

At the moment, the Morogoro road from Ubungo to Chalinze Via Kimara, Mbezi, Kibaha, Mlandizi and Ruvu has Numerous junctions which causes a lot of interference with through traffic. There is a need to also provide grade separation at some critical junctions and enhance service roads to cater for non through traffic. Grade separations can be done at Kimara, Mbezi, kibaha, and Mlandizi.

As an alternative the above approach, and to leave Morogoro road from Ubungo to Chalinze as an access road, the express way from Dar es Salaam to Chalinze should be built. It can be built in phases, phase 1 being from Dar es Salaam to Mlandizi and phase 2 being from Mlandizi to Chalinze. The Public and Private Partnership (PPP) approach could be used in this undertaking under the Build, Operate and Transfer PPP type. BOTs are an effective way to bring private money into the construction of new infrastructure facilities or into the substantial renovation of existing ones. BOT agreements tend to reduce market and credit risks for the private sector because the government is the only customer, reducing the risks associated with insufficient demand and ability to pay. Private sector partners will avoid BOT arrangements where the government is unwilling to provide assurances that the private sector investment will be paid back.

In this regard, the private sector is taking over activities that would normally be carried out by the public sector. The private company bases the repayment of financing on project revenue.

8.1.3 Separate lanes for specific user groups

The BRT project to be implemented by DART Agency is an example of the provision of segregated lanes for buses only. The project is now under construction and it si expected to operational in the year 2014. In addition, the design for Phase 2 and 3 of BRT system is ongoing and it covers Nyerere road Corridor from the Central Business District (CBD) to Gongo la Mboto area and CBD to Mbagala respectively. The BRT project is designed to cover the whole dare s Salaam city with its Trunk and feeder routes. See figure 4 below.

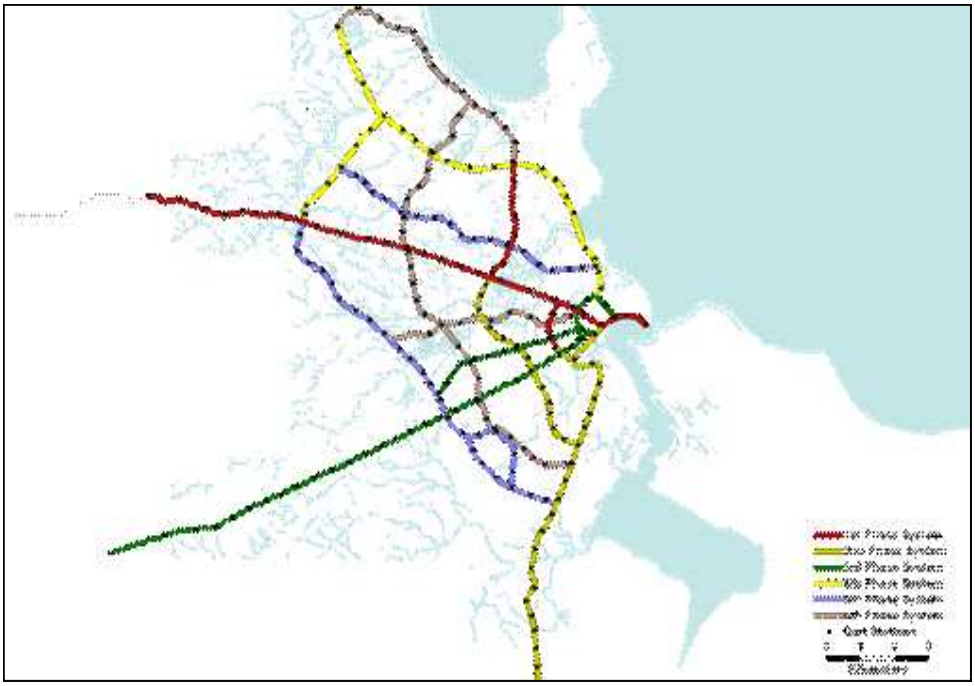

Figure 4. BRT implementation plan for Dar es Salaam City.

9. Conclusion and Recommendation

The contribution of Transportation Systems to the economy and the welfare of the society is very significant and must play a major role in the development programs of a nation and a country. Poor Transportation Systems and networks cause enormous losses due to traffic congestion and road accidents, far beyond the cost of the development of efficient systems. The use of advanced modeling and economic criteria is essential to develop optimal programs and efficient and safe transportation systems.

Looking to the Future and implementation of Knowledge and Experience in this field we can save lives, injuries and enormous economic losses in our country.

Based on the above, It is strongly recommended that the Government and all stakeholders including private sector to cooperate and take affirmative actions and implement the aforementioned projects to rescue the country from huge economic losses due to traffic congestions and accidents. Internal revenues should be solicited and taken as number 1 source of funds to finance these critical projects in order to fast truck their implementation taking into consideration the duration required to secure funds for projects from Development Partners. Donor financing should be used to augment and accelerate the ongoing projects.

In addition, local expertise should also be given a priority. The capability of local Engineers should be challenged and the Engineers Registration Board (ERB) and the Institution of Engineers in Tanzania (IET) should take the lead to provide state of the art engineering solutions to traffic congestions and Road Accident problems and all other problems in the country that needs engineering solutions.