ECONOMIC JUSTIFICATION OF NON-MOTORIZED TRANSPORT (NMT) IN CITIES OF DEVELOPING COUNTRIES: CASE STUDY ON NON-MOTORIZED TRANSPORT SCHEME FOR KAMPALA CENTRAL BUSINESS DISTRICT

J KIGOZI

Project Management and Engineering Consultants (PROME) Limited
PO Box 249334 Kampala, Uganda; Built Environment Engineering Division
Tel: +25 67 0557 9281 / +25 67 8188 8042; Email: kgzjoseph@gmail.com

ABSTRACT

African cities have waited too long to deal with the existential threat of Climate change and thus have begun to suffer its effects. In most African cities, populations are increasing rapidly and the reliance on Non-motorized transport (NMT) is high, but dedicated NMT infrastructure remains limited. In all cities and towns across Uganda, the use of private vehicles has risen steadily over the years and has congested these cities, poisoned the air and killed NMT users at exceptionally high rates. In view of the above, The Ministry of Works and Transport developed and passed the Non-Motorized transport policy in 2012 and currently this policy is at implementation stage. Kampala Capital City Authority (KCCA) in the bid to implement this policy has undertaken a pilot project to establish Non-Motorized Transit corridors along Namirembe Road and Luwum Street which are be accessible to only pedestrians and cyclists. Further to this KCCA has undertaken designs for an extension of this pilot to cover 4.25 km of CBD streets and 15km along the existing medium gauge railway to from the CBD to Namanve. This paper presents an economic justification of the aforementioned NMT projects using the Non-Motorized Transport Project Assessment Tool (NMT PAT) to quantitatively and qualitatively analyse the expected impacts (benefits and costs). The impacts have been analysed in four categories i.e Social impacts, Economic impacts, Health impacts and Environment impacts. The results of the analysis indicate that considering a design life of 15 years Kampala city will experience reductions in emissions to the tune of 675,000 tons for Carbon dioxide, 13.81 tons of Particulate matter and 2536 tons of Nitrogen dioxide. The health benefits in terms of reduction in accidents valued at Uganda shillings 4,163,611,405,517.35 (USD 1,134,499,020) will also be realized. A general improvement in journey quality, security and liveability will also be achieved as well as a reduction in the noise levels by about 3.75 decibels. To encapsulate by implementing the proposed NMT infrastructure, a Net present Value of 14 trillion shillings (USD 3 Billion) shall be realised thus demonstrating that NMT investment is an attractive venture for developing cities.

Keywords: Non-Motorized transport, Economic Benefits.

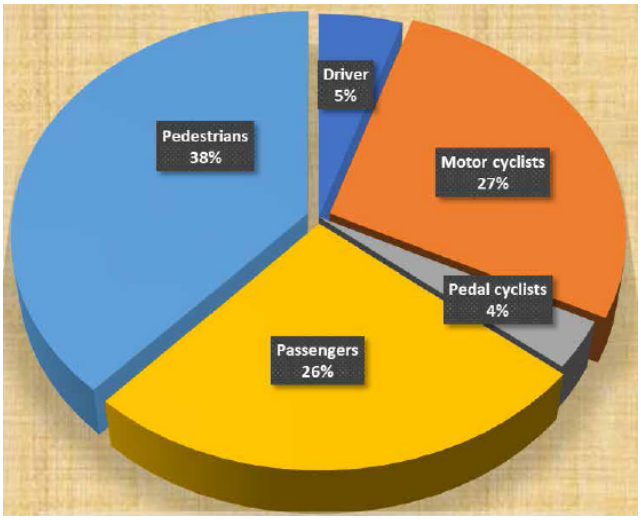
1. INTRODUCTION

In most African cities, population is increasing rapidly and the reliance on Non-Motorized transport (NMT) is high, but dedicated NMT infrastructure remains limited. Globally, road crashes have been taking a higher toll in the past years, with over 1.35 million people killed on the world's roads annually and another 20-50 million seriously injured, making road safety a public health priority.

At a national level, the use of private vehicles has risen steadily over the years and has congested most towns and cities, poisoned the air and killed NMT users at exceptionally high rates. The table below extracted from the Uganda Police Annual crime report of 2019 shows the fatalities per road user category for the years 2018 and 2019.

Table 1: Annual Fatalities (Uganda Police, 2019)

Road User Category	**2019**	**2018**
Driver	194	202
Motorcyclist	1064	878
Pedal Cyclist	**136**	**160**
Passenger on motorcycle	422	380
Passenger in Light omnibus	82	93
Passenger in Medium omnibus	08	30
Passenger in Heavy Omnibus	27	48
Passengers in other vehicles	462	474
Pedestrians	**1485**	**1424**



It is apparent from the data presented in the table above that pedestrians constitute the largest percentage of fatalities and thus action needs to be taken to make the roads safer for pedestrians. The key issues that have brought about the high rate of pedestrian's fatalities is the deadly combination of high vehicle speeds, human behaviour, and lack of forgiving road infrastructure. Well-designed NMT infrastructure has the potential to reduce the probability that pedestrian and cyclist crashes occur and to reduce the severity of injury when a crash actually occurs. Implementation of NMT infrastructure is therefore one of the key actions that can make roads safer for pedestrians and cyclists in-line with the United Nations Decade of Road Safety Action 2021-2030, which aims to reduce road fatalities and injuries by 50% by 2030.

African cities have waited too long to deal with the existential threat of Climate change and thus have begun to suffer its effects. With a global car fleet predicted to triple by 2050 (over 80% of that in the developing world) we have to find a way to reconcile the need for increased mobility with an ambitious reduction in emissions along with improved air quality (UN Environment, 2019). Climate change should therefore be central we it comes to transport planning. Investment in NMT infrastructure is presenting Kampala and the Uganda at large with an opportunity to achieve the collective climate related goals and the Nationally Determined Contributions (NDCs).

The Non-motorized Transport (NMT) project in Kampala aims at transforming selected road infrastructure corridors to ensure all inclusive, safe, secure, enjoyable movement of pedestrians and cyclists to and within the Central Business District (CBD). The project scope covers a 15km NMT corridor for Pedestrians and Cyclists along the Kampala-Namanve railway reserve connecting to 4km of Pedestrianized streets within the Kampala Central Business District.

Table 2: Proposed Design

	
Existing MGR Railway Corridor	Proposed design of NMT infrastructure along the MGR Railway corridor
	
Current Typical Street within the CBD	Typical CBD Street After Re-design

2. EVALUATION FRAMEWORK AND METHODOLOGY

2.1 Overview on the Non-Motorized Transport Project Assessment Tool (NMT-PAT)

Non-Motorized transport (NMT) investments have real and quantifiable benefits for the individual users, the community, and the country at large however in Uganda currently there is not an existing, published and comprehensive method for economic appraisal of NMT infrastructure. In that regard, the Non-Motorized Transport Project Assessment Tool (NMT-PAT), developed by a joint venture between UNEP and the Centre for Transport Studies was adopted to analyze the Economic costs and benefits of the proposed NMT project in Kampala.

NMT-PAT is a Microsoft-excel based tool that is designed to evaluate the costs and benefits associated with walking and cycling. NMT PAT consists of worksheets each dedicated to a specific evaluation criterion providing input and output functionality for the user (UNEP & Centre For Transport Studies, n.d.). With NMT PAT we have been able to generate meaningful insight regarding the economic viability of NMT in the Kampala whist taking into consideration Environment, Health, Economic and Social aspects.

2.2 Regional Data

The NMT-PAT economic evaluation model requires regional data as an input. Regional economic data includes; modal split, metropolitan population, economic growth rate, average inflation rate, GDP per capita and the discount rate. The regional economic data applicable for Kampala also shown in Table 3 below was obtained from the following sources:

- The Statistical Abstract 2019 and 2021 by the Uganda Bureau of Statistics;
- Transport Note No. TRN-6 by the World Bank; and
- Smart Moving Kampala by Iganga Foundation.

Table 3: Regional Data for Kampala

Indicator		Value
Modal split	Walking	0.0%
	Cycling	0.0%
	Bus	0.5%
	BRT	0.0%
	Minibus taxi	21.0%
	LRT	0.0%
	Cars	37.0%
	Motorcycles	41.0%
	Taxi	0.0%
	Other	0.5%
Metropolitan population	2021	1,507,080
	2036	4,000,000
Economic growth rate		6.50%
Average inflation rate		2.60%
Currency		Ugandan shillings
GDP/capita		Sh 3,248,600.00
Discount rate		12%

2.3 Project Investment Costs

The estimated project implementation costs were determined through a unit rate analysis of the major cost elements of the project i.e. Equipment costs, Labour costs, Materials costs and Overheads. The anticipated project investment costs for the NMT project considering 2021 as the financial year for design and 2022 as the financial year for construction were input in to the model as shown in Table 4.

Table 4: Project Investment Costs

Project cost item	Financial year	Value		Net present value	
Construction Costs	2022	Sh	132,706,107,983.00	Sh	129,343,185,168.62
Design Costs	2021	Sh	12,970,610,798.30	Sh	12,970,610,798.30

2.4 Environmental Impacts

The mode shift from Motorized transport to Non-motorized transport contributes to the reduction in air pollution trough reduced greenhouse gas emissions, noise, road deaths and injuries resulting from motor accidents, congestion and social isolation. The Nitrogen dioxide contained in vehicle emissions increases the symptoms of the people suffering from respiratory and heart disease.

The Logic of estimating environmental benefits is that provision of NMT infrastructure creates a mode shift to zero emission NMT modes thus improving air quality and improving the flow of motorized traffic. The improvement in air quality results in a reduction in pollution induced respiratory incidents such as asthma and Chronic Obstructive Pulmonary Disease (COPD).

Three major indicators were considered using the NMT-PAT modal; Emissions, Energy use and Noise pollution. Suffice to mention that this analysis was originally adopted from the Transportation Emissions Evaluation Model for Projects (TEEMP) and incorporated into NMT-PAT. The amount of petrol and diesel used and their respective emissions were calculated by considering the total number of trips per day, dominant fuel type, average occupancy per mode and average trip length. Three types of emissions were calculated i.e., Carbon dioxide (CO_2), Nitrogen Oxides (NO_X) and Particulate matter (PM). The summary of results of the analysis are as shown in table 5 below for the with-project and business as usual scenarios.

Table 5: Estimated Emissions

Emissions (tons)	Business as usual	With project	Savings
	tons	tons	tons
CO_2	2,854,000.72	2,178,542.67	675,458.05
PM	1,567.67	1,553.86	13.81
NO_x	12,551.91	10,015.74	2,536.17

2.5 Health Impacts

Cycling and walking has potential to improve health for both individuals and society at large resulting from the increased level of physical activity and reduction in traffic accidents.

The Health Economic Assessment Tool (HEAT) developed by the World Health Organization is designed to enable users to conduct economic assessments of the health impacts of walking and cycling. HEAT estimates the value of reduced motility that results from specified amounts of walking and cycling (World Health Organization, 2014). HEAT can be used for assessments such as:

- Assessment of current or past levels of cycling and walking.
- Assessment of changes overtime i.e. before and after comparisons.
- Evaluation of new or existing projects.

The NMT PAT Model consists of a simplified version of the HEAT model. For the NMT project under assessment two indicators were considered i.e., Physical activity and Traffic accidents. The HEAT assessment calculates the monetary value associated with change

with the Relative Risk of Mortality (RRM) of a new user due to the change in physical activity putting into consideration the Value of a Statistical life. The results obtained from the HEAT assessment are shown in Table 6 below.

Table 6: Results of the Heat Assessment

Indicator	Difference in PKT (Km)	No. of new users	PKT per new user per week (Km)	Physical activity per week (minutes)	Relative risk of mortality	Net present value of physical activity
Walking	93,995.67	25,000.00	26.32	328.98	0.7846	Sh 3,811,673,251,545.58
Cycling	299,077.13	25,000.00	83.74	358.89	0.6052	Sh 6,985,757,522,832.62
Total						Sh 10,797,430,774,378.20

The Health impacts related to the reduction of traffic accidents were calculated based on the prediction of the reduction of NMT fatalities and injuries between the business and usual and with project scenarios. The results of this assessment are shown Table 7.

Table 7: Estimated Health Benefits

Indicator	Total health value of accidents		Net present value of reduced accidents
	Business as usual - 2036	With project - 2036	
NMT Fatalities	25,255,277,219,440.50	2,625,041,933,057.80	Sh 2,307,496,765,709.29
NMT Injuries	20,315,766,980,869.30	10,156,201,443,160.20	Sh 1,856,114,639,808.06
Total			Sh 4,163,611,405,517.35

2.6 Estimation of Savings on Transport Costs, Travel time savings and Decrease in Fuel Tax Revenue

2.6.1 Savings on Transport Costs

An assessment of the road user costs per kilometre for both Motorized and Non-Motorized modes within the Central business district was conducted. The assessment comprised of Key informant interviews with pedestrians and motorists along the following streets:

- Dastur Street;
- Market Square Road;
- Market Service Road; and
- Along the Railway Corridor to Namanve.

The interviewees were selected at random and the purpose of the interviews was to determine how the people have travelled to their destinations, frequency of visits, travel time, purpose of visits and the costs incurred in making the visit (spending patterns). The responses provided were analysed, summarized and an average cost of travel was determined as shown in Table 8.

A road user travelling by a 14-Seater Taxi from Namanve to Kampala CBD a distance of 15km for work spends an average of UGX 12000 or USD 3.3 per day to travel to and from work. If the road user shifts to a bicycle for the same trip a saving of USD 1200 per year is made.

Table 8: Estimated Cost of Motorized Transport means in Kampala

Mode of transportation	Average Estimated Cost per Km (UGX)	Average Estimated Cost per Km (USD)
14-seater Taxi	400	0.108
Boda Boda (motorcycle)	1500	0.407
Private car	1000	0.271
Private Taxi	2000	0.542

2.6.2 Time Savings

In addition to the anticipated savings on transport costs, the travel time that will be saved due to the implementation of the NMT project was determined by estimating the share of trips that will be affected by the project and time saving per trip for each mode. An economic value was attached to the time saved to determine the Net present value of the total time saved.

Table 9: Estimated Time Savings

Indicator	Share of trips directly affected by project	Estimated time saving due to project	Value of time	Value of time saving per day	Total amount of time saving	Net present value of time saving
	%	minutes	Sh/minute	Sh	Person years	Sh
Walking	2.0%	2.00	29.09	87,263.60	31.25	71,742,297.97
Cycling	2.0%	10.00	29.09	436,317.98	156.25	358,711,489.83
Bus	2.0%	2.00	24.75	75,583.38	31.82	62,139,607.23
BRT	5.0%	5.00	24.75	463,994.87	195.31	381,465,576.87
Minibus taxi	5.0%	-15.00	24.75	-3,842,530.09	-1,617.46	-3,159,071,469.68
LRT & rail	0.0%	0.00	24.75	-	-	-
Cars	5.0%	-10.00	29.09	-3,097,719.81	-1,109.33	-2,546,738,224.96
Motorcycles	1.0%	5.00	29.09	271,032.53	97.06	222,824,833.71
Taxi	1.0%	-10.00	20.40	-153,036.90	-78.13	-125,816,716.58
Other	0.0%	0.00	29.09	-	-	-
Total				-5,759,094.45	-2,293.22	-4,734,742,605.62

2.6.3 Decrease in Fuel Tax Revenue

It is envisaged that the implementation of the NMT project will bring about a decrease in the number of motorised trips and thus there shall be lost fuel tax revenue as road users will spend less on fuel. The money that will be saved by the users will be spent on other taxable consumables and thus there shall be an increase in Value Added Tax (VAT) revenue. This scenario has been analysed in NMT-PAT and is illustrated in Table 10 below.

Table 10: Lost Fuel Revenue and Gained VAT

Indicator	Fuel levy	Petrol price per litre	Diesel price per litre	Lost fuel tax revenue per year	Net present value of lost fuel tax revenue
	(%)	Sh	Sh	Sh	Sh
Fuel tax	28%	4,000.00	3,800.00	334,609,293,018	1,111,639,891,512

Indicator	Value Added Tax (VAT)	Money saved per person per year	Percentage of saved money spent on taxed consumables	Tax gained per year	Net present value of tax gained
	(%)	Sh	(%)	Sh	Sh
Value Added Tax	18%	1,800,000.0	20%	178,429,392,000.0	488,975,742,270.7

2.7 Conclusions

All the indicators discussed above have been monetized and a Net Present Value (NPV) for each indicator determined. The Sum of the NPVs has been calculated as the Net Present Benefit (NPB). The Net present value of the entire project has been calculated by subtracting the Net present Cost from the Net Present Benefit (See Table 11).

Table 11: Overall Economic Evaluation Indicators

Net Present Benefit (NPB)	Sh 14,333,643,288,048.30
Net Present Cost (NPC)	Sh 142,313,795,966.92
Net Present Value (NPV)	Sh 14,191,329,492,081.40
Cost-Benefit Ratio (CBR)*	100.72

It is evident from the **positive** Net Present Value (NPV) and the Benefit Cost Ratio that the NMT pilot project is Economically viable and attractive. The economic parameters obtained give us confidence that:

- The project is economically feasible;
- The project will be able to cover its operating costs in its life time;
- The project can adapt to economic fluctuations; and
- The project can be incorporated into the wider economic framework of the country.

The possibility of using the Spaces provided along the project corridor for alternative uses such as exhibitions, Sports events and Markets contributes greatly to the overall project economic attractiveness.

3. OTHER PROPOSED ESTIMATION TECHNIQUES FOR ECONOMIC BENEFITS OF NMT INFRASTRUCTURE

In addition to the technique that has been presented in Section 2 above there are other economic analysis techniques that can further be explored when conducting feasibility studies for NMT infrastructure.

It is also pertinent to point out that economic impact evaluation is strengthened by a before and after analysis, with a detailed baseline analysis being carried out before the investment is out in place. Base line analysis involves collecting information about every type of impact foreseen before the investment. The base line studies should also include perception studies where opinions are gathered from the intended project beneficiaries regarding the proposed infrastructure in regards to cost of travel, accessibility, safety and comfort.

3.1 Estimation Techniques for Direct Economic Impacts

Direct benefits to bicycle- or pedestrian-related businesses can be measured through business surveys, tax receipts and remittances and a count of the number and size of such businesses in a community or geographic area. However, this type of analysis requires baseline data from before the investment is put in place. Data on the number of people (through pedestrian counts) visiting a mall or shopping centres within the NMT corridor before the NMT infrastructure is put in place and after gives an indication of the potential increase in sales for the businesses in that shopping centre due to the attraction of new visitors.

To contextualize, Luwum street (see Figure 1 below) which forms part of the NMT pilot corridor thus far completed has seen a significant rise in the number if businesses (mostly informal) operating along its corridor as observed from the key informant interviews conducted along this street. Informal discussions with the business owners indicated that the number potential buyers that visit the shops has risen resulting into growth of sales. This is also attributed to the increased sense of security and comfort for the shoppers.

Before Implementation of the NMT Project

After implementation of the NMT project

Figure 1: Implementation of the NMT Pilot project along Duster and Luwum Street in Kampala

3.2 Estimation Techniques for Induced Economic Impacts

Induced Economic impacts can be determined though consumer surveys related to their travel and behaviour. Mode shifts have to be considered in this survey. Substantial data is necessary for both mode shares and consumer behaviour before and after the project is implemented.

The Estimation techniques for induced Economic impacts include:

- Improved property value which can be tracked by acquiring data on the changes in property prices, vacancy rates, rental tax Remittance and Rental income for building landlords before and after the commissioning of NMT infrastructure. Comparison between the changes in property prices and commercial rents in the Vicinity of NMT infrastructure will give an indication on the impact of the NMT investment on property value.

- Changes in the levels of Unemployment:
  Accruing to the growth in businesses there are likely changes envisaged in the level of unemployment for some occupational groups. Indication regarding changes in unemployment can be given by Tax income foregone, the cost to provide benefits to the unemployed, cost to provide family and individual credit facilities, level of exportation of labour exported by external recruitment agencies.

- Development of the Cycling industry:
  Establishment of NMT infrastructure will lead to an increase in the number of Cyclists which will increase the sales of bikes, bike parts as well as the market for bike repair and maintenance services. As such there will be newly created jobs for bike designers, trainers and mechanics this will in turn lead to growth of the cycling industry which will in turn add to the Country's GDP. Evaluation of this impact will require primary research to be carried out in the levels of sales and employment in the cycling industry before and after the implementation of infrastructure

4. REFERENCES

Iganga Foundation, 2014. Smart Moving Kampala, Design of NMT Zone in Namirembe and Luwum Street, s.l.: s.n.

Ministry of Finance Planning and Economic Development, 2019. Semi-Annual Budget Monitoring Report 2018/19, s.l.: s.n.

Ministry of Works and Transport, 2012. Non-Motorized Transport Policy, s.l.: s.n.

Rea, MS et al., 2009. Review of the Safety Benefits and Other Effects of Roadway Lighting, s.l.: s.n.

UBOS, 2014. Uganda National Household Survey 2012/2013, Kampala Uganda: UBOS.

UBOS, 2019. Statistical Abstract, s.l.: s.n.

Uganda Police, 2019. Uganda Police Annual Crime Report, s.l.: s.n.

UN Environment, 2019. Share the Road Programme Annual Report 2018, s.l.: UN Environment.

UNEP & Centre for Transport Studies, n.d. NMT Project Assesment Tool: User Guide, s.l.: s.n.

World Bank Group, 2017. The Role of City Governments in Economic Development of Greater Kampala, s.l.: s.n.

World Bank, n.d. NMT Project Assesment Tool: User Guide, s.l.: World Bank.

World Health Organization, 2014. Health economic assesment tool (HEAT). [Online]. Available at: http://www.heatwalkingcycling.org/htttp://heatwalkingcycling.org/index.php?pg=cycling&act=more1. Accessed November 2019.

World Health Organization, 2014. Health Economic assesment tools for walking and for cycling. [Online] Available at: http://www.heatwalkingcycling.org//heatwalkingcycling.org/index.php?pg+cycling&act=more1. Accessed September 2019.