Civil and Environmental Research
ISSN 2224-5790 (Paper) ISSN 2225-0514 (Online)
Vol.7, No.10, 2015

Economic Appraisal of Highways in Ghana: A case study of the proposed dual carriageway between Accra and Kumasi

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Abstract

Roads and Highways are vital lifelines. Roads are needed for accessibility and for transporting of people, goods and services. Roads are therefore needed for socio-economic purposes. This research aims at assessing the suitability of asphalt as a suitable pavement material. The objectives of the research are as follows; to determine the initial cost of constructing the proposed road, to determine the lifecycle cost of the proposed road, to carry out investment appraisal on the proposed road project. Findings were as follows; the initial cost of the proposed road project is GH¢604,642,500.00 and the lifecycle cost is GH¢1,654,794.51/Km. Investment appraisal methods gave the following results; Simple payback period is 15 years, 11months, Discounted payback period is 40 years, Net Present value is negative GH¢481.29 million, Internal Rate of Return is 6.278%, Average Rate of Return is 6.278% and Present Worth is GH¢ 910.137 million. Hence the road project is not profitable and economically not feasible .However, the proposed road project can still be undertaken because of social and political reasons.

Keywords: Road, Highway, Economic Appraisal, Pavement.

1.0 Introduction

Road is a hard surface built for vehicles to travel on (Oxford Advance Learner's Dictionary, 2001). Road is also defined as a specially designed hard surface for cars, buses, bicycles, etc to travel on. The new Encyclopaedia Britannica (2003), defined the term street, road and highway as those travelled ways on which people, animals and wheeled vehicles have moved throughout recorded history.

The World book Encyclopaedia (1988), defined a road as a strip of land that provides routes for travel by automobiles and other wheeled vehicles.

World books Encyclopaedia (1988), roads usually connect urban areas with each other and rural areas. Roads are needed for accessibility. Farmers use them to ship their products to the markets. Trucks can carry manufactured products from one area to another. Good roads carry millions of automobiles that travel on business and pleasure.

Robinson et al (2004), most roads are built to facilitate the transport of people and goods, and so as to promote development. Road forms an important part of the social safety net facilitating the distribution of wealth through trade and employment opportunities in both rural and urban communities. Road also facilitates the movement of people, goods and services in all sectors for the economy, including tourism, mining, health, trade, education and agriculture. Roads are needed for socio-economic purposes. Economies and society depend heavily on efficient roads.

In the European Union, 44% of all goods are moved by trucks over roads and 85% of all people are transported by cars, buses or coaches on roads according to the European Commission (2007). Road transport remains one of the strategic sectors of Ghana's economy (Ghanaweb, 2013). Emmit and Gorse (2003), Stated that the principal requirements of a facility includes; shelter, safety and comfort, ease of use and operation, ease of maintenance, periodic repair and replacement, adaptability and durability, ability to recycle materials and components.

The overall goal is to achieve these goals in an economic, safe and timely fashion using he most appropriate resources available.

Most roads are constructed by Government. Government includes Central government, Local government and Government agencies. Most roads are constructed and cared for by the state. Government helps the states and agencies pay the cost of building and improving the roads. In Ghana, the Ministry of Road and Highway is the Government of Ghana ministry responsible for road construction and maintenance. The vision of the ministry is to provide and maintain and integrate, cost effective, safe and sustainable road network responsive to the need of users, supporting growth and poverty reduction.

In Ghana, roads are classified as national roads, regional roads and inter-regional roads. The roads are also classified based on the department managing them. These are Highways, Urban roads and feeder roads. Roads can also be classified as first class roads, second class roads and third class roads.

World book Encyclopaedia (1988), classified roads as surfaced and unsurfaced roads based on the type of surface. Roads are also classified as local and secondary roads and primary highways. Local roads carry traffic within a local area.

Secondary roads link small communities and connect local roads to main highways leading to distant places.

Primary highways are the most important roads. Generally, primary highways are the main roads and connect the larger communities. Other classifications of roads are free ways (super highways) and express ways. Roads within towns and cities are called streets.

Road surface or pavement is the durable surface materials laid down as an area intended to sustain vehicular or foot traffic, such s a road or walkway (Wikipedia, 2015).

Pavement is the surface of a road, or a flat part at the side of a road for people to walk or any area of flat stones on the ground (Oxford Advanced Learner's Dictionary, 2001). Pavement materials include concrete, asphalt, stone such as flagstone, cobblestone, and sett, artificial stone, bricks, tile and wood (Seeley, 1993).

Seeley (1993) classified pavement into two categories, flexible pavement and rigid pavement. Paquette and Wright (1987) categorised pavements into rigid, flexible and composite.

1.1 Aim

The research aims at assessing the economic viability of the proposed Accra- Kumasi Highway.

1.2 Objectives

(i) To determine the initial cost of the proposed road project.
(ii) To determine the life cycle cost of the proposed road project.
(iii) To carry out investment appraisal on the proposed road projects.

2. Methodology

Primary and Secondary sources of data were employed. This was achieved through informal interviews with professionals at Ghana Highway Authority, Department of Feeder Roads, and Department of Urban Roads, Literature review of previous theses, journals and textbooks. Field Surveys were also done at various places along the Accra-Kumasi Highway.

As part of the data collection to determine the cost of flexible pavement (asphalt pavement), a road of length are Kilometer (1km) and width 10 meters was used as basis for the analysis. The profile of the road was based on a design. Measurement of the road was done and Bill of quantities produced. The cost of the road project is the determined from the Bill of Quantities.

2.1 Analysis

Data

i. Pavement material – asphalt
ii. Cost per kilometer of asphalt pavement = GH₵1,099,350.00
iii. Life of pavement = 20 years (with replacement)
iv. Interest rate = 30%
v. Distance between Accra and Kumasi = 275 kilometers
vi. Investment Period = 40 years
vii. Maintenance cost = 15% of initial cost per annum
viii. Number of vehicles using the road daily = 8,000

An Analysis per Kilometer

i. Initial cost - GH₵1,099,350.00/km
ii. Maintenance cost per kilometer = 15% of initial cost = $\frac{15}{100}$ x GH₵1,099,350.00

Maintenance cost per kilometer = GH₵164,902.50

iii. Present value of reconstruction cost (PV) = $\frac{\text{cost of reconstruction}}{(1.30)^{20}}$
(per kilometer)

Present value reconstruction cost (PV) = $\frac{GH₵1,099,350.00}{1.30^{20}}$ = GH₵5,784.54

iv. Summation of all present values = $\frac{1}{1.30^{1}} + \frac{1}{1.30^{2}} + \frac{1}{1.30^{3}} + \cdots + \frac{1}{1.30^{40}}$

($\sum$PV)

$\sum$PV = 3.33324

iv. Lifecycle cost = annual maintenance cost x $\sum$PV

Life cost (per kilometer) = GH₵164,902.50 x 3.33324 = GH₵549,659.00

vii. Total lifecycle cost (per kilometer) = initial cost + reconstruction cost + lifecycle cost

Total lifecycle cost (per kilometer = GH₵1,099,350.00 + GH₵5,784.54 + GH₵549,659.61

Total lifecycle cost (per kilometer) = GH₵1,654,794.51

2.2. Cost of constructing the Highway (Dual carriageway)

i. Cost of construction = 275 kilometer x 2 x GH₵1,099.350./km
Cost of construction = GH₵604,642,500.00

ii. Maintenance cost per annum = 15% of initial cost
Maintenance cost per annum = $\frac{15}{100}$ x GH₵604,642,500,00

Maintenance cost per annum = GH₵90,696,375.00

iii. Life of Asphalt pavement = 40 years (with replacement at year 20)

iv. Interest on capital = 30% per annum

2.3. Returns on investment (R)

R = Revenue per annum = number of vehicles Using the road x charge per vehicle x number of days x number of Toll Booths

R = 8000 x GH₵1.00 x 365 x 13 = GH₵37,960,000.00

2.4. Investment Appraisal of the Road Project

i. Using Simple Payback method

$$\text{Number of years} = \frac{\text{Amount Invested}}{\text{Returns per annum}} = \frac{\text{GH₵604,642,500.00}}{\text{GH₵37,960,000.00}}$$

Number of years = 15.928 years = 15 years 11 months 5 days

ii. Using Discounted Payback Method

Let number of years = n i= interest rate

i=30% = 0.30

Summation of net present values (∑PV) = 3.33324

Therefore solving for n using the formula

$$\frac{1-(1+i)^{-n}}{i} = 3.33324$$

Becomes $\frac{1-(1.30)^{-n}}{0.30} = 3.33324$

$1-(1.3)^{-n} = 0.3 \times 3.33324$

$1-(1.3)^{-n} = 0999972$

$(1.3)^{-n} = 1 - 0.999972 = 0.000028$

Using logarithms

n = 40 years

Payback period (n) = 40 years

iii. Net present values (NPV)

NPV = Gross present values – Total investments

$$\text{Present value of reconstruction} = \text{GH₵}\frac{604,642500.00}{1.30^{20}}$$

Present value of construction = GH₵3,181,497.78

NPV = Cost preset values – Total investments

NPV = (GH₵3.33324) (37,960,000.00) – (604,642,500 + 3,181,497.78)

NPV = (GH₵126,529,790.40 – 607,823,997.78)

NPV = (- GH₵481,294,207.38)

v. Average rate of return (ARR)

$$ARR = \frac{\text{Average returns}}{\text{Initial investment}} \times 100\% = \frac{GH₵37,960.000 \times 100\%}{GH₵\ 604,642,500.00}$$

ARR = 6.278%

vi. Probability Index = $\frac{\sum \text{Benefits}}{\sum \text{initial investment}} = \frac{GH₵126,529,790.40}{GH₵\ 604,642,500.00}$

Probability Index = 0.20926

vii. Present worth (PW)

Total present worth (PW) = PW1 + PW2

PW1 = present worth for first 20 years

PW1 = GH₵604,642,500 + (GH₵90,696,375) (3.3156)

PW1 = GH₵604,642,500 + GH₵300,731,040.20

PW1 = GH₵905,373,540.20

PW2 = present worth of asphalt pavement and reconstruction

PW2 = GH₵905,373,540.20 (0.005261783)

PW2 = GH₵4,763,879.10

PW = PW1 + PW2 = GH₵905,373,540.20 +GH₵4,763,879.10

PW = GH₵910,137,419.30

viii. Internal rate of return in perpetuities (IRR)

$$I.RR = \frac{\text{Annual Revenue}}{\text{Initial cost of pavement}} \times 100\%$$

$$I.RR = \frac{GH₵37,960,000}{GH₵604,642,500} \times 100\% = 6.278\%$$

3.0 Findings

1. The initial cost constructing road is GH₵604,642,500.00.
2. The total lifecycle cont of the road per kilometer is GH₵1,654,383.54
3. The investment appraisal on the road project gave the following results:

i. Using simple payback method, the payback period is 15 years, 11 months.

ii. Using the discounted payback method, the payback period is 40 years.

iii. The total net present value is negative GH₵481,388,727.80

This indicates that the project will not be profitable. This may be due to the high interest rate and few numbers of vehicles using the road.

iv. The average rate of return is 6.278%. This is also very low as compared to the lending rate of 30% per annual.

v. The probability index is 0.209. This is also poor. For the project to be feasible. The probability index should be greater than or equal to one.

vi. The present worth of the road project is GH ₵901.137 million.
This high figure is due to the high maintenance costs and the cost of reconstructing the road in the twentieth year.

vii. The internal rate of return is 6.278%.

4.0 Conclusion

The road project is not economically viable since the net present value is negative GH₵481,388,727.80. In addition to this, all the other indicators like profitability index, average rate of return and the payback period are not favorable. Hence the road project is not profitable economically. However, the project can still go ahead because of social and political reasons.

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