



Factors Influencing Vehicle Operating Costs of Haulage Firms in a Developing Country

Christopher Adesola Wojuade (Corresponding Author)

Department of Transport Management Ladoke Akintola University of Technology, PMB 4000, Ogbomoso, Nigeria

Email: cawojuade@lautech.edu.ng

Jubril Oladosu

Department of Transport Management Ladoke Akintola University of Technology, PMB 4000, Ogbomoso, Nigeria

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Abstract

Vehicle operating cost is the cost that haulers incur in rendering freight services. This cost is influenced by operational, economic, fixed asset, and institutional factors. Haulage firms must take the right decision on these factors to minimize the vehicle operating cost and increase their profit. This study examines the factors determining the vehicle operating costs of haulage firms in Nigeria. The data for this study was obtained through the administration of structured questionnaires randomly on 337 respondents out of 2154 staff in the 8 selected registered haulage firms having their headquarters in Lagos, Nigeria. The questionnaire was used to collect information on components of truck operation influencing vehicle operating costs. The result of the OLS multiple regression model shows that all the factors were significant and predict vehicle operating costs but to a varying extent. The coefficients of significant factors were wages ($\beta = 0.324$; $p \leq 0.01$), empty running ($\beta = 0.297$; $p \leq 0.01$), fleet size ($\beta = 0.264$; $p \leq 0.01$), training ($\beta = -0.201$; $p \leq 0.01$), weight of freight ($\beta = 0.145$; $p \leq 0.01$), drivers experience ($\beta = 0.132$; $p \leq 0.01$), vehicle age ($\beta = 0.111$; $p \leq 0.05$), administrative fee ($\beta = 0.100$; $p \leq 0.05$) and maintenance ($\beta = 0.096$; $p \leq 0.05$) influence vehicle operating costs of haulage firms respectively. The study concluded that driver's wages, empty running, fleet size, and training were important factors influencing the vehicle operating costs of the haulage firms. The study recommends useful policy decisions to improve the performance of haulage businesses in the study area.

Keywords: Vehicle operating cost; Haulage firm; Freight business; Freight operator; Developing country.

1. Introduction

Transportation is an important activity that must be given adequate attention in national economic planning. An efficient transport system provides economic and social opportunities that result in better accessibility to markets, employment growth and investments (Ballou, 2004). This has also enhanced the physical distribution of commodities which has helped consumers to have unlimited access to a variety of goods and services irrespective of their locations. In the developed countries, freight operation is moderately shared between road and rail transport modes (Forckenbrock, 1994 cited in (Fernando and Wijesiri, 2014). However, road transportation remains the dominant mode of transporting passengers and freight in developing countries (Aigbe *et al.*, 2012). This is applicable to Nigeria where more than 90 per cent of goods and services are hauled on the roads on daily basis.

The cost of providing freight service is very essential in haulage business. One of the important costs considered in rendering freight transport services is the vehicle operating costs (Vladan, 2015). Vehicle operating cost is the cost that a haulage firm incurs to render freight services. The costs is associated with owning, operating and maintaining a vehicle which includes fuel consumption, tires, maintenance and repairs, oil consumption, capital depreciation, license and insurance and drivers wages (Curtis *et al.*, 1996). The viability of the organization decisions and policies on components of vehicle operating cost will determine the profitability and service quality of the freight business.

The vehicle operating cost has been a major challenge to road haulage operators due to many factors involved. The factors determining the freight operating cost are operator, economic, fixed asset and institutional (Sinha and Labi, 2007; Thoresen and Roper, 1996). The freight operators exercise certain level of control on all the factors except fixed asset. The haulage firms must take the right decision on these factors so that the vehicle operating costs will be minimized and profit margin enhanced. These factors are influenced substantially by operating efficiency employed by the haulage operators in managing them. The components that have great impact on operating costs of haulage firms are age and size of truck, engine condition, type and weight of cargo haul, distance of haul, driving style, fleet size, fuel, maintenance and repair, road surface condition, drivers experience, wages and speed (Blanchard, 2010; McMullen, 1987; Sinha and Labi, 2007).

There have been several attempts by researchers to understand issues related to vehicle operating costs. These studies focused on operating costs of commercial trucks (America Transportation Research Institute, 2018; Barnes and Langworthy, 2003; Dooley *et al.*, 1988), cost structure of small and large haulage firms (Kot, 2015), vehicle operating cost for short haul (Fernando and Wijesiri, 2014) and truck costing model (Berwick and Farooq, 2003; Hossain, 2009; Thoresen and Roper, 1996). The literature shows that studies on impact of components of truck operation on operating cost in haulage business are not readily available. There is need to understand the influence of these factors on vehicle operating costs. The knowledge gained will inform operators on decisions that enhance productivity and performance in freight operations. Hence, this study aims at examining the factors influencing vehicle operating costs in haulage business in Lagos, Nigeria.

2. Literature Review

Thoresen and Roper (1996), identified four major factors that influence the vehicle operating cost. These factors are operator, economic, fixed asset and institutional. The operator factor deals with the driving habits of drivers on the road. Driving requires certain skills, concentration and patience and these attributes vary among drivers. A safe and economical driving style and habit can reduce costs of fuel, tire, maintenance and repair work on the vehicle. According to Balogun *et al.* (2011), demographic attributes age, education, marital status and driving experience had effects on the driving attitude of truck drivers. Hence, they should be given priority in recruitment of drivers, as a wrongly recruited driver can increase operating cost or even cause damage to the fleet of truck in the organization. The major factors that influence fuel consumption in vehicle operation are speed and acceleration (Daniels, 1974; Delgado *et al.*, 2012). The speed that drivers travel depends on the road condition, weather and speed regulations. For instance, if the truck speed is slowed down due to frequent stops in a city or bad condition of road pavement, the fuel consumption will increase drastically. The increase in fuel consumption and maintenance costs would increase the operating cost of a haulage firm. There is need to improve the performance of drivers in order to reduce the operating cost in haulage business. This can be achieved through incentives that will boost their morale. Dosunmu *et al.* (2015), recommends giving monetary incentives in the form of bonuses to the best drivers for neatness, accident free, safe delivery of merchandise, efficient fuel usage and highest number of trips within a specified period of time. Also, Mercedes Benz (2009) recommends sending drivers to training courses on commercial truck driving at government approved centres so as to improve their driving skills and stimulate efficient fuel consumption and improvement on road safety. This can positively influence drivers' attitude while driving on the road and help the fleet operations to be successful. The operator characteristics are important in managing the equipment efficiently so as to achieve reasonable operating costs.

The economic factor focuses on cost components of truck operation. Vehicle operating cost is the monetary value, which the haulage firm incurred to generate the freight service. Vehicle operating cost can be categorized into fixed and variable costs (Berwick and Farooq, 2003). Fixed cost is expenses that entail the acquisition of the vehicle and are usually incurred even though the vehicle is not running (Mankiw and Taylor, 2015). This includes mortgage on the truck, license fees, insurance, sales and tax. Dooley *et al.* (1988), defined variable cost as expenses that are directly related to operating the vehicle and changes with increasing mileage run. Generally, the more the vehicle is used, the higher the cost incur, but due to the economies of scale, some of these expenses will become less per mile as the distance travel increases. Variable cost includes tire, fuel, repair and maintenance and wages. Evidence from studies has shown that the most important operating costs are fuel, wages and maintenance. For example, Levinson *et al.* (2005), found that wages account for 41 per cent while fuel account for 38 per cent of the total operating costs in Minnesota. America Transportation Research Institute (2018), reveals that wages account for 43 per cent and fuel account for 22 per cent of total operating costs in the United States. Furthermore, the operating cost in a haulage firm can also be influenced by size of the firm, type of service provided and government regulations. McMullen and Tanaka (1995), used a translog cost function to examine the differences that exist between large and small haulage firms. They found significant differences in cost structures of the haulage firms. Large firms have significant economies that are associated with increasing average load, length of haul and shipment size. However, smaller firms did not show any increase in costs due to increases in average load, shipment size and length of haul indicating they have already taken advantage of these economies. Kot (2015), appraised the cost structure of different road transport firms. The finding of the study reveals differences in cost structure relative to the firm size with domination of personnel cost in small firms and cost of fuel in larger firms. The proportion of each cost is important in calculating vehicle operating cost per kilometer driven (Burhamtoro, 2013). Barnes and Langworthy (2003), estimated operating cost for commercial trucks based on fuel, repair and maintenance, tire and depreciation cost. They estimated the total truck operating cost to be \$0.49 per kilometer. The operating costs of commercial trucks vary depending on roughness of road surface, traffic stream, engine conditions and driving style of the driver. According to Hossain (2009) the total operating cost for three-axle trailer on feeder roads in Sweden is 97.9 Krona per 10 kilometer. The average marginal cost per mile is \$1.691 for the for-hire sector of the trucking industry in the United States (America Transportation Research Institute, 2018). The expenses on vehicle ownership and operation are the major determinants of vehicle operating costs in commercial trucking.

Fixed asset deals with the capacity and physical characteristics of the road, which directly influence the travel experience of truck drivers. The carrying capacity of the road and its physical characteristics determine the maximum number of vehicles that would travel on a road way during a given time period. As traffic volume increases, the speed of each vehicle is influenced by the speed of other vehicles in the traffic stream. Traffic density will increase to a point that all vehicles would travel at a slow speed and this would result to congestion on the road (Fadare and Wojuade, 2007). The condition of road pavement is another factor that influences truck operation.

Pavement roughness characterized by potholes due to environmental deterioration and uses over time will restrict the capacity of the weight the road bears. This leads to dissatisfied travel experience as a result of bumpy ride and causes psychological imbalances for the driver and passenger. The traffic delay and rough road increase the journey time experience and add to vehicle operating costs. Hence, it is necessary to maintain the road pavement to ensure that they continue to provide a required level of service. The state of traffic and road roughness influences the costs of travelling on roads.

The institutional factor focuses on decision making on components of vehicle operating cost. For example, the haulage firm considers model of truck, age, type of engine, gross weight, spare parts, maintenance cost and most especially owner preference in selecting the most suitable truck for the business. Sivak and Schoettle (2012), observed that the useful life of trucks largely depend on timely and regular maintenance, which improve their functioning and lifespan. According to Goodyears (2012) the condition, inflation and quality of tire coupled with the axle configuration and wheel alignment affect the rolling resistance, which determine the fuel consumption. If the axle alignment is incorrect it will wear out the tires due to higher rolling resistance and increase fuel consumption. In making decision on truck routing, Sun (2013), observed significant differences in the route choice decision-making process among various driver segments and these decisions are affected by multiple factors such as nature of freight transported and drivers' competency. In order to ascertain the effect of travel restriction policy on distribution of goods Castrol and Kuse (2005) examined the impacts of large truck restrictions on haulage firms operations in Metro Manila. The result of the survey revealed that freight carriers cope with the large truck restriction policies by changing their delivery routes and or shifting their delivery times. They did not experience the effect of such changes in delivery route or time on cost of providing the service and business survival.

Another factor, empty running, is critical performance indicator of efficiency in freight business. Empty running is the truck-kilometer driven without goods. The success of haulage business depends on efficient decisions that lead to reduction in operating costs. However, the inability of haulage company to arrange for a return shipment lead to truck being moved empty which does not generate revenue but accumulates costs in labor, equipment wear and fuel (European Environmental Agency, 2010). The efficiency of haulage business depends on a set of utilization measures of time, space, vehicle, fuel and driver in the movement of goods (Niklas, 2011). Vehicle utilization level is a measure of how efficiently the freight sector is transporting goods. The improvement in vehicle utilization level through reduced empty running and better use of each vehicle's carrying capacity would generate revenues instead of loss.

The components of truck operation are important factors determining operating cost in haulage business. These components as identified in the literature include maintenance cost, vehicle age, wages, drivers experience and empty running. The knowledge of how these factors affect operating cost will enhance the understanding of freight managers in taking right decisions in truck operation. The decisions made by haulage firms on truck operations will determine the productivity and efficiency of the business.

3. Materials and Methods

The study area Lagos is located in the Southwestern part of Nigeria. Lagos is the largest city in Africa with a population estimated at 21 million. Lagos is the most densely populated city in the country with an average population density of 2,400 persons per square kilometer and annual population growth rate more than 5 per cent (Odeleye, 2011). Lagos is the economic nerve centre of the country due to the concentration of major seaports, airports, financial institutions and manufacturing activities in the city. Therefore, haulage firms are attracted to the city due to avalanche of opportunities available. The mode of transport for passenger and freight transportation in Lagos and the entire country is predominantly road.

This work adopted a case study method to conduct this research. There were 41 registered haulage firms in Lagos. This study purposively select 8 registered haulage firms for survey corresponding to 19.5 percent sample size. The choice of a haulage firm is dependent on operation of flatbed trailers and open top trailers and the head office is located in Lagos. The flatbed trailers are used to covey containers and products like steel and building materials while the open top trailers are used to transport manufactured goods and agricultural produce.

The questionnaire was designed based on analysis of literature on factors influencing freight operating costs. The study population is 2154 staff working in the 8 purposively selected haulage firms. The study designed a structured questionnaire that was randomly administered on 337 staff comprising of fleet managers, head of operations, account managers and technicians in the selected haulage firms. Questionnaire was used to collect information on components of truck operation and vehicle operating costs for the year 2017 in the sampled haulage firms. The survey was conducted between June and August 2019. The identity of the selected haulage firms surveyed in the study area was not revealed in this work. However, permission was obtained from their managements on non-disclosure of official and sensitive information. The data collected was analyzed using multiple OLS regression model to predict the factors determinants of freight vehicle operating costs in the study area. The regression model is expressed as: $y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 \dots b_nx_n + e$

Where:

Y = Vehicle operating costs

a = Slope/intercept

b_1 - b_n = Regression coefficient

X_1 - X_n = Independent variables

X_1 = Vehicle age (years)

X_2 = Fleet size (number)

- X₃ = Drivers experience (years)
- X₄ = Wages (Naira ₦)
- X₅ = Maintenance cost (Naira ₦)
- X₆ = Administrative fee (Naira ₦)
- X₇ = Weight of freight (Tons)
- X₈ = Training (Number)
- X₉ = Empty running (Number)
- e = error term or residual

The statistical package for social sciences (SPSS) 20.0 statistical software was used to analyze the data. Statistical significance was inferred at $p \leq 0.05$. The result of the survey is discussed moving forward.

4. Results and Discussion

There is no sign of multicollinearity among the independent variables because the t-ratios of the coefficients are statistically significant. The study reports the standardized regression coefficients because the variables are measured on different scales. The major determinants of vehicle operating costs in freight business in Nigeria were predicted using multiple OLS regression with the identified variables X₁ – X₉ as indicated under methods. The results of the OLS regression are reported in Table 1. In the regression model, all the variables vehicle age, fleet size, drivers experience, maintenance cost, wages, administrative fee, weight of freight, training and empty running had statistically significant relationships with vehicle operating costs. The OLS regression model is significant at $p \leq 0.01$, with F-value of 120.34 as shown in the Table. The R² value indicate that 76.9 per cent of variance in the vehicle operating costs of freight business in the study area was accounted for by the determinants variables.

The analysis of regression coefficients reveals that driver wages would have the greatest influence on vehicle operating costs in haulage business in the study area. The result suggest that for every unit increase in driver wages, there is a significant corresponding increase of 32.4 per cent ($\beta = 0.324$; $p \leq 0.01$) in vehicle operating costs. This finding hints that driver wages is the most important component contributing to vehicle operating costs in Nigeria. Similarly, labor cost is the largest cost in commercial truck industry in the United States accounting for 43 per cent of total operating cost (America Transportation Research Institute, 2018). The labor cost can be impacted by driver experience, performance and compensation model. The labor cost is high due to increase in benefits and bonuses of drivers within the trucking industry. Also, the regression coefficients show that empty running of trucks for return trips have huge impact on vehicle operating costs in freight business in Nigeria. The result indicate that for every unit increase in empty running, there is a significant corresponding increase of 29.7 per cent ($\beta = 0.297$; $p \leq 0.01$) in vehicle operating costs. This confirms the finding by European Environmental Agency (2010), that inability of haulage firms to arrange for a return shipment of goods for trucks accumulate costs in labor, equipment wear and fuel thereby leading to loss of revenue. This situation calls for urgent policy decision to reduce empty running among the freight operators. Another variable with high influence on vehicle operating costs is the number of fleet owned and operated by the haulage firms. The result reveal that for every unit increase in fleet size, there is a significant corresponding increase of 26.4 per cent ($\beta = 0.264$; $p \leq 0.01$) in vehicle operating costs. This result is expected because as the haulage firms add to their fleet of truck the operating cost incurred on drivers, fuel, tires etc. increase as well. Furthermore, the regression coefficients of training have great influence on vehicle operating costs in freight business in the study area. The result suggests that for every unit increase in the frequency of times drivers were trained, there is a significant corresponding decrease of 20.1 per cent ($\beta = -0.201$; $p \leq 0.01$) in vehicle operating costs in Nigeria. This implies that regular training of drivers significantly improves their driving skills and performances and minimizes the vehicle operating costs. Mercedes Benz (2009), reiterate that training drivers on commercial truck driving will improve their driving skills, ensures fuel efficiency and improvement on road safety. This becomes necessary because drivers significantly influence fuel economy through their driving styles and habits on the road.

Table-1. Ordinary least squares regression coefficients of factors influencing freight vehicle operating costs

Combined			
S/N	Variables	b	β
1	Vehicle age	0.118	0.111*
2	Fleet size	0.237	0.264**
3	Drivers experience	0.116	0.132**
4	Maintenance cost	0.090	0.096*
5	Wages	0.328	0.324**
6	Administrative fee	0.089	0.100*
7	Weight of freight	0.153	0.145**
8	Training	-0.167	-0.201**
9	Empty running	0.280	0.297**
	Constant	0.075	
	F – Values	120.34**	
	R ²	0.769**	
	Adjusted R ²	0.762	

Notes: b: unstandardized regression coefficient; β: standardized regression coefficient; N = 337 * $p \leq 0.05$; ** $p \leq 0.01$
 Source: Author’s Field Survey, 2019.

The regression coefficient show that weight of freight carried by trucks has impact on vehicle operating costs in haulage business in the study area. The result indicate that for every unit increase in weight of cargo carried, there is a significant corresponding increase of 14.5 per cent ($\beta = 0.145$; $p \leq 0.01$) in vehicle operating costs. This result indicates that more power is required to propel the engine when the weight of cargo carried becomes heavier. This will result to increase in fuel consumption and vehicle operating costs. This hint that the weight of freight transported had direct influence on vehicle operating costs. This conform to the finding that type and weight of good are significant parameters determining energy consumption and operating costs of a truck (Levinson *et al.*, 2005). Another variable that influence the vehicle operating costs is the truck driver's experience. The result suggests that for every unit increase in driver's experience, there is a significant corresponding increase of 13.2 per cent ($\beta = 0.132$; $p \leq 0.01$) in vehicle operating costs of haulage business in the study area. It can be inferred from this result that preferential consideration in wages is given to drivers with high years of driving experience and performance in trucking industry. This result conforms to the findings of Balogun *et al.* (2011) that demographic attributes of age, education and driving experience had effects on the driving attitude of truck drivers. Haulage firms reward drivers for excellence, safety, safe driving and on-time delivery to retain experienced and qualified drivers. This policy adds to the vehicle operating costs of haulage firms in the study area.

The regression coefficient reveal that vehicle age have direct impact on vehicle operating costs in freight business in Nigeria. The result indicate that for every unit increase in age of vehicle acquired for freight operations, there is a significant corresponding increase of 11.1 per cent ($\beta = 0.111$; $p \leq 0.05$) in vehicle operating costs of the haulage firms. This result hints that as the age of truck used for transporting freight increases, the total vehicle operating costs tend to increase as well. This is normal in the operation of vehicle due to increase in oil and fuel consumption and repairs resulting from wear and tear of the engine accounted for by the old age. Newer vehicles perform better and minimize the vehicle operating costs than the older vehicles. Further finding reveal that majority of the haulage operators in the study area purchase used trucks for their freight operations, which likely account for the high operating cost. The coefficient show that administrative fee incur in the running of truck operations have influence on vehicle operating costs in haulage business in the study area. The result suggests that for every unit increase in administrative fee, there is a significant corresponding increase of 10.0 per cent ($\beta = 0.100$; $p \leq 0.05$) in vehicle operating costs of the haulage companies. This implies that as the number of vehicles in the firm's fleet increases, there will also be corresponding increase in the fee paid for permits, license and insurance premium, which add to the vehicle operating costs. Finally, the maintenance cost of vehicles used for freight operations by the haulage firms in the study area has influence on vehicle operating costs. The result indicates that for every unit increase in maintenance cost, there is a significant corresponding increase of 9.6 per cent ($\beta = 0.096$; $p \leq 0.05$) in vehicle operating costs of the freight operators. The frequency of maintenance has direct impact on vehicle operating costs of the firms. Hence, they must adopt maintenance culture that is more cost effective or acquire new trucks for their operations. Timely and regular maintenance of truck is important to avoid breakdown resulting in loss of productivity and jeopardize its useful lifespan.

5. Conclusion and Policy Implications

This study was carried out to understand the factors predicting the vehicle operating costs in haulage firms in a developing country. The contribution of identified factors influencing vehicle operating costs is clearly shown in this study. The findings indicate that all the factors had statistically significant relationships and predict the vehicle operating costs in haulage firm sampled. However, drivers wages, empty running, fleet size and training were important factors influencing the vehicle operating costs of the haulage firms. The wages is likely to continue increasing due to shortage of drivers and ageing population of the available one (America Transportation Research Institute, 2018). The result reveals that firm's inability to make optimum use of the trucks by arranging for return trips increase the vehicle operating costs. This has reduced the operational performance and revenue generated by the haulage firms. Also, the haulage firms cannot function effectively with used trucks purchased for their freight operations. The trucks are susceptible to frequent breakdown, failed deliveries, pollution and high operating costs. The high exchange rate and bank interest rate coupled with cash payment for the purchase of vehicles in the country account for the decision to adopt used vehicles by the haulage firms. The situations need to be addressed to reduce the vehicle operating costs and improve revenue generation of the haulage firms.

The knowledge acquired on determinant of factors will encourage policy decisions directed towards reducing vehicle operating costs in haulage business. First, haulage firms must improve vehicle utilization by making better use of truck carrying capacity. The operation managers must develop strategy that will ensure goods are arranged for return trips of trucks to boost revenue and reduce the vehicle operating costs. Second, government must intervene by developing policy on special intervention fund that makes loan accessible at lower interest than commercial banks to haulage firms and other transport operators in the country. This will grant them opportunity to purchase new vehicles that will enhance their operational performances. These policies are capable of reducing the prices of goods and services and improve the standard of living of the citizens.

This study could be improved upon by conducting research on other factors especially the impact of fixed asset that is the capacity and physical characteristics of road on vehicle operating costs. This will broaden our understanding of factors influencing the vehicle operating costs in freight business and equip freight managers with important information for successful freight operations in a developing country.

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