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Decision Making and Truck Operating Costs on Haulage Business in Lagos, Nigeria

Christopher Adesola Wojuade[1*] and Jubril Oladosu[1]

[1]Department of Transport Management, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Author CAW designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors CAW and JO managed the analyses of the study. Author JO managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: To evaluates how managers take decisions on variable components of freight operation and its effects on truck operating costs in haulage business in Lagos, Nigeria.
Study Design: The structure of this paper is a descriptive design. It identified a gap in knowledge and employed a structured questionnaire to obtain useful information that gives a clearer understanding of the subject in a new environment. The data collected was analysed using descriptive statistics.
Place and Duration of Study: Haulage companies operating in Lagos, Nigeria between June and August 2019.
Methodology: The population study is 2154 staff drawn from the eight purposively selected registered haulage companies in Lagos, Nigeria. A structured questionnaire was randomly administered on 337 personnel involved in freight operations. The questionnaire survey was conducted to obtain information on company's expenses and policy decisions on truck operating components.

**Corresponding author: Email: cawojuade@lautech.edu.ng;*

Result: The decision to use new truck reduces fuel consumption and maintenance cost of haulage business. Furthermore, remunerating drivers in salary is cost effective, regular training of drivers improves their performance while high empty return trips leads to revenue loss. Business owners take decisions on huge financial investment while managers handled those that are directly related to daily fleet operations.

Conclusion: The study concluded that decisions on components of freight operation increases truck operating cost of the haulage companies in the study area. The study therefore recommends policy actions that will enhance productivity of haulage companies through effective decisions.

Keywords: Truck operating cost; decision-making; freight operation; Haulage company.

1. INTRODUCTION

The transport sector represents a vital component of national development and has significant impact on economic productivity [1]. Road transportation remains the most widely used transport mode in developing countries [2]. It proves to be the predominant mode for freight operation due to non-functioning of rail transport system. Road freight transportation is a critical part of the economic activity without which economies would not function [3]. Truck plays important role in the distribution of goods and services through the road networks. In Nigeria, like many developing countries, freight is almost exclusively transported by truck.

The cost of providing freight service is very essential in haulage business. Truck operating cost is the monetary value that the haulage company incurs in order to generate freight service. Truck operating cost can be categorized into fixed and variable costs [4]. Fixed cost is expenses that contain ownership of the trucks including capital for truck purchase, registration and license fees, insurance, depreciation and storage [5]. Variable cost is the expenses that are directly related to truck operation or usage such as fuel, tyre, repair and maintenance and labour costs [6]. Generally, the more the truck is used, the higher the expenses incurred, but due to the economies of scale, some of these expenses will become less per mile as the distance travelled increases.

Truck operating cost has been a major challenge to haulage operators due to many factors involved and competition both in terms of price and services and low profit margins [7]. Haulage companies must minimize their truck operating cost in order to remain in business. They have to employ strategies that can efficiently manage the operating cost to ensure profitability and service quality. Managers must take strategic decisions on the components of operating costs such as type of truck (new or used), fleet size, type of tyres, maintenance, drivers remuneration, route to ply, when and where to requisition for spare parts and government regulations [8]. This will enhance cost efficiency in procurement and operations generally if right decisions are taken. Hence, companies must keep devising modalities by which the operation continues to yield profit in spite of challenges involved. The viability of the organizations decisions and policies will determine the profitability of the haulage business.

There have been several studies conducted on truck operation. These studies focus on different aspects of commercial truck operation. The average and marginal operating cost per mile for commercial trucks in various road pavements and traffic conditions was calculated by [9,10,11,12,13] and [14] in different countries. The differences in the cost structure of large and small haulage firms was examined by [15] and [16]. Furthermore, [17] identifies the major factors influencing vehicle operating cost in haulage business while [18] and [19] predict the fuel consumption of heavy-duty truck. The studies of [20] and [7] examine how haulage companies take decisions on distribution of goods during government restriction and route choice decision making by truck drivers respectively. The existing literature reveals that decision making in haulage business has not been well researched. Specifically, how the decision making on components of truck operation affect operating cost has not receive desired attention. The operating cost and profitability of haulage business is determined predominantly by decisions on components of truck operation. This study intends to bridge the gap by evaluating how decision on components of truck operation influences operating cost in haulage business in Lagos, Nigeria.

2. LITERATURE REVIEW

Watanatada T et al. [21] categorized the components that influence the truck operating cost into characteristics of truck (weight, engine power and maintenance), local factors (speed limit, fuel price, labor cost and drivers attitude) and road characteristics (pavement roughness and road width). The major factors that influence fuel consumption in haulage operations are speed and acceleration [19]. 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. According to Deierlein B [18], drivers significantly influence fuel economy by controlling the idle time (engine running without kilometre driven), speed, brake usage, acceleration, coasting style, accessory use, shifting style and other determinants. Hence, drivers play a very significant role in the operating cost of the haulage firms. The increase in fuel consumption and maintenance costs would increase the operating cost of a haulage firm.

Empirical evidence from studies has shown that the most important operating costs in freight business are fuel, wages and maintenance. For example, Levinson DM et al. [10] found that wages account for 41 per cent while fuel account for 38 per cent of the total operating costs in Minnesota. Fernando and Wijesiri [12] indicates that fuel cost account for 64 per cent of the total operating cost in Sri Lanka. America Transportation Research Institute [13] reveals that wages accounts for 43 per cent and fuel account for 22 per cent of total operating costs in the United States.

The operating cost of commercial trucks varies in different parts of the world. In the United States, Barnes G et al. [9] calculates the operating cost for commercial trucks in Minnesota, United Sates. They estimate the total truck operating cost to be $0.49 per kilometer comprising of $0.27 operating cost and $0.22 labour cost. Levinson DM et al. [10] estimates the operating cost of 186 commercial vehicle operators in Minnesota. Cobb-Douglas model shows a perfect fit to estimate total cost from the data and the result indicates that 1 per cent increase in total truckload leads to 1.04 per cent increase in total cost. The average operating cost per kilometer for commercial trucks obtained from the survey is 69 cents and 64 cents from Cobb-Douglas model. The average cost per truckload is about $250 and $232 from the survey and model respectively. The marginal cost per truckload is $6.51 and per kilometer is 65 cents. According to America Transportation Research Institute [13] the average marginal cost per mile is $1.691 for the for-hire sector of the trucking industry of the United States of America.

Barton R. [11] calculates the operating costs of truck fleet's operation in Greater Toronto Area (GTA), Canada. The operating cost per kilometer is $3.58 for tractor trucks and $2.97 for straight trucks on congested road and $3.12 for tractor trucks and $2.53 for straight trucks on uncongested road. The result indicates that congestion increases costs of tractor-trailers by about 14.7 per cent and straight trucks by about 17.4 per cent. Hossain KS [22] develops an activity based cost model for feeder road freight transport in Sweden. He found that the total operating cost for three-axle trailer is 97.9 Krona per 10 kilometer in Sweden. Fernando and Wijesiri [12] estimate the operating cost of 50 commercial truck operators offering short haul in Sri Lanka. The operating cost per kilometre is Sri Lanka Rupee 151.37 for the trucking industry. Garg and Suman [14] estimates the total operating cost of 119 drivers in trucking industry in Fatuha, India. A Cobb - Douglas model with the best-fit shows that the average operating cost per kilometer is Rs.20 and marginal cost per kilometer is Rs.15 for Fatuha trucking industry.

McMullen B et al. [15] uses 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 S [16] appraises 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.

Sun Y [7] assesses the factors affecting truck routing among drivers in the United States. The results shows that there are significant differences in the route choice decision making process among various driver segments and

these decisions are affected by multiple factors such as travel time and cost, nature of freight transported and drivers' competency. Castrol TJ et al. [20] examines 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.

The decision on truck operation is an important determinant of operating efficiency in haulage business. The reviewed literature indicates that few studies have been conducted on decision making in haulage operation. The present study intends to conduct a research on how decisions on truck operation affects operating cost of haulage business in a developing country. This will provide necessary information and enhance our understanding of the influence of managers' decision on components of truck operation and operating cost.

3. METHODOLOGY

This study was carried out in Lagos, located in Southwestern part of Nigeria. Lagos is the largest city in Africa with a population estimated at 21 million. The choice of Lagos for this study is based on the high concentration of industries due to the presence of seaport and airport complexes, which give avalanche of opportunities for freight business. The primary mode of transporting passengers and freight in Lagos and entire country is road. This indicate that road freight distribution is vital to the economic survival of Nigeria.

There were a total of forty-one registered road freight transport companies in Lagos. For the purpose of questionnaire survey, eight registered haulage companies were purposively selected. These selected haulage companies operate mostly flat bed semi-trailer trucks to haul dry goods such as cement, iron rod, flour, rice, sugar and other food items across the country. The study population is 2154 staff that have direct dealings with freight operations in the selected haulage companies. This study employed simple random sampling techniques to select 337 staff representing 15.6 per cent of staff in each haulage company and study population respectively. The sample size of 15.6 per cent is a good representation of the respondents because the study population is homogeneous in characteristics so fewer cases are required to yield a reliable sample. A structured questionnaire was designed and administered on the respondents that is, fleet managers, head of operations, account managers and technicians to obtain information on truck operating components of their respective companies. The questionnaire survey obtained information about company's expenses and policy on truck operating components: truck age, fleet size, drivers experience, drivers remuneration, maintenance, weight of freight carried, training and empty running.

The truck operating cost is the total cost incurred by the haulage company to provide freight services. The truck age is the production year to the date it was purchased, which is categorised as new or used. Fleet size is the number of trucks being used for freight operations in the companies. Driver's experience is measured based on years of professional driving experience. Driver's remuneration is determined based on salary or wage payments measured in Naira (₦). Maintenance cost is the amount expended on repairs and maintenance of vehicles per year measured in Naira (₦). The administrative fee is a yearly premium paid for licenses, permits and insurance premium measured in Naira (₦). The weight of freight is the size of merchandise transported by truck measured in tons. Training is the number of times drivers are trained in a year. Empty running is payload utilization of trucks that is measured based on number of empty return experienced in a year. The information obtained in this survey is operating costs of the sampled haulage companies for 2017. The survey was conducted between June and August 2019. The identity of sampled haulage companies was not disclosed due to sensitivity of the information but permission was sought from their management.

The data collected were analysed using descriptive statistics. The analysis was conducted using tabulation and cross tabulations to discuss the decision on components of operating cost in the haulage companies sampled. The findings of the survey were reported moving forward.

4. FINDINGS AND DISCUSSION

The characteristics of fleets used for transporting goods by the sampled haulage companies are reported in Table 1. The companies are contract

carriers that make arrangements with clients to transport only their shipments of goods from one point to another. The haulage companies mostly purchased used trucks for their freight operations except one that acquired new or less than 5 years old trucks. The truck age ranges between 10–15 years depending on each company's policy on truck acquisition. At this age the trucks had depreciated more than 70 per cent of its original value. The high exchange rate US$1 to ₦365 coupled with two digits interest rate charged on bank loans and cash payments was responsible for the decision not to buy new trucks. The companies differ widely in the fleet sizes they operate. Generally, larger carriers are able to develop sophisticated tools to control trucks and optimize their performance than the smaller carriers that lack administrative and financial resources to invest in such practices. The largest company owned six hundred functioning trucks followed by those that owned three hundred trucks while the smallest companies had about a hundred trucks in their fleet. The fleet size has impact on cost of operation and enjoys certain economies as the number of trucks increases. The companies mostly use 40 tons 18 wheeler semi-trailer trucks for their operations. The common manufacturers of these trucks are Mack, Iveco, Mercedes Benz, Man and Foton. The companies normally transport truckload shipments of goods from one sender to another receiver without making intermittent stops to sort the load in terminal en-route. The trucks carried average of 30 tons per trip and 973.38 tons per year. However, the quantity of freight carried by each truck varied considerably among the haulage companies. The variance is as a result of company's policy on cargo weight and type of goods being transported. For example, companies using older trucks carried more quantity of goods than those using newer trucks. This policy decision, in respect of the newer trucks was to take necessary precaution not to over labour their trucks. Thus, this variation becomes inevitable. The trucks made an average of 32 trips per year and experienced 30 per cent to 50 per cent empty returns shipment. The utilization of trucks for return shipment of goods is low among the haulage companies. The reason for this is that most of the manufactured goods and raw materials movement are northbound due to the concentration of port complexes in the southern part of the country. This result is found to be proportionate to the fleet size with company's that owned high number of trucks having higher empty return trips than those with lesser trucks. This implies that time, space, vehicle, fuel and driver were not effectively utilized thereby having negative impact on revenue generation.

Maintenance is conducted on trucks to keep them from breakdown and avoid experiencing unnecessary downtime, expenses and loss of productivity. There are three different maintenance culture adopted by the haulage companies. These are corrective, preventive and condition-based maintenance. Firstly, corrective maintenance is carried out when the truck develops fault. Secondly, preventive maintenance is carried out at predetermined intervals to reduce failure and prevent occurrence of fault. Lastly, condition-based maintenance monitors the actual condition of the trucks to determine the maintenance needed to be performed when there is sign of decreasing performance. The sampled companies mostly adopted corrective measures because it is performed less frequently 9 times per year and cost less than preventive maintenance. The companies that adopted preventive measure performed maintenance more frequently 12 times per year and spent more on maintaining their trucks than other companies. They intended to prevent occurrence of faults by performing maintenance at regular intervals due to their trucks advanced age (above 15 years) that required more servicing and repairs. The company that used condition-based measure performed the least maintenance 8 times per year and recorded the lowest maintenance cost due to the newness of their trucks. They adopted this type of maintenance in order to monitor the condition of the trucks so as to perform maintenance when indicators show signs in order to protect the high investment committed. Generally, the frequency of services and repairs has direct impact on cost of maintenance. The findings imply that decision on maintenance adopted by haulage companies has significant effect on the maintenance cost and management must adopt the best maintenance type for the company's fleet.

The freight trips are intercity involving substantial highway travel, which are mostly long trip above 500 miles. The trucks travelled an average distance of 546.93 miles per trip and consumed 0.805 litres of fuel per mile driven. The fuel consumption is high 4.7 miles per gallon compared to 6.4 miles per gallon for the same year 2017 in the United States of America [13]. This shows that operating with used trucks increases the fuel cost. Furthermore, the cost of

fuel reveals two important results. First, rate of fuel consumption is determined by age of truck. For example, the haulage company that used new trucks for freight operation incurred the lowest fuel cost. Secondly, the weight of freight transported had direct influence on fuel consumption. The companies that carried higher tons of goods incurred higher fuel cost than those that transported lower tons of goods. More power is required to propel engine when the payload is higher which increases fuel consumption. The cost incurred on tyres varied among the haulage companies. This cost depends on type and quality of tyres, alignment and wheel balancing, inflation, road condition and driving style of the driver. The companies generally recorded high tyre replacement between 14 -18 tyres for the year. The reasons for this loss are due to rough pavement that characterised most of the highways in the country and poor driving style of some drivers. The cost of repair and maintenance of truck covers engine oil, brake and transmission fluids and spare parts replacement. It is interesting to note that age and engine condition are the major factors that influences this cost. The company that used new trucks expended the lowest cost on repair and maintenance due to good working condition of the trucks. Contrary to this, companies using trucks above 10 years old expended higher cost depending on its year of production. The administrative fee is a yearly premium paid for licenses, permits and insurance premium. The license fee depends on engine size of truck while insurance premium is a percentage of truck value. The companies paid same license fee irrespective of the vehicle condition provided they're having similar engine capacity. Companies owning newer truck fleets paid higher insurance premium than those with older trucks due to higher value of their trucks. Some insurance companies give waiver on their premium to attract customers especially when the number of trucks to be insured is many. This gives companies owning more trucks advantage to negotiate a good deal thereby making them pay lower premium than companies owning fewer trucks. For example, a company owning three hundred trucks pay administrative fee of ₦637,000 while another company with one hundred trucks pay ₦735,000. The maintenance cost of truck reveals two important results. First, age of truck is a major determinant of the maintenance cost. The company that operated with new trucks incurred the least maintenance cost while those that used older trucks recorded the highest maintenance cost. Second, the maintenance type adopted influenced the maintenance cost expended by the haulage companies. Adopting preventive maintenance causes companies to spend more than other maintenance types.

The information in Table 2 focuses on driver's characteristics, remuneration and training. Driver teams operate most of the trucks for continuous movement on long haul-trips. This allows them to alternate operating the truck and supports fast delivery times. In addition, assistants are assigned to travel with driver teams. All the companies required minimum of secondary school education for effective verbal communication and minimum of five years experience in truck driving as prerequisite for employment. Most of the drivers have more than seven years experience of driving commercial trucks. The companies owning newer trucks recruit drivers with more years of experience than those owning older vehicles. This may serve as precaution to keep their trucks in good conditions for many years. Driver's remuneration is the amount drivers are paid for services rendered to the haulage companies that employed them. The drivers are not paid flat rate. Generally, medium and long-haul drivers are paid either monthly salary or wage per mile driven. Majority of the companies remunerate their drivers through the payment of salary. They remunerated them based on the type of truck driven, cargo handled and expertise of driver. The amount paid as salary is between ₦30000 - ₦60000. Drivers in the companies that adopted wages payment were paid between ₦40 - ₦60 per mile driven based on the same criteria used for salary payment. The intercity mileage chart was used to calculate the distance driven. Remunerating in salary is attractive and reduces operating costs expended by the companies. For example, all the companies that paid salary recorded lower remuneration costs compared to those on wage payment. The drivers' performance is maximized since salary is fixed irrespective of the number of trips embarked on or distance covered in a month. Contrary to this, drivers on wage tended to over speed to cover more distance and embark on more trips to increase their earnings. This attitude could encourage bad driving habit that might result in accident or unnecessary expenses. In addition to salary and wage payment, companies also pay drivers accommodation and feeding allowances for journeys that involved sleeping over the night. The total drivers remuneration is the cost of all personnel attached to a truck.

Table 1. Fleet characteristics and maintenance cost per annum

Truck age (year)	Fleet size	Weight of freight (ton)	Empty runs	Maintenance type/ no of service (year)	Cost of fuel (₦)	Tyre cost (₦)	Repair and maintenance cost (₦)	Administra-tive fee (₦)
10	600	840	15	Corrective 9	2892000	1440000	1418000	650000
15	319	1056	13	Preventive 12	3122800	1500000	1761650	637000
10	120	864	12	Corrective 9	2916800	1360000	1487400	720000
New	100	899	11	Condition 8	2631000	1280000	1074500	920000
15	335	960	10	Preventive 12	3074200	1428000	1801700	655000
10	95	1122	12	Corrective 9	2786000	1350000	1430850	750000
10	103	858	10	Corrective 9	2828000	1404000	1439360	735000
15	330	1188	14	Preventive 12	3309714	1368000	1748530	674000

Source: Author's Field Survey (2019) Note: US$1 = ₦365

Table 2. Driver's characteristics and remunerations

Drivers experience (years)	Drivers Remuneration mode	Salary/wage (₦)	Total drivers remuneration (₦)	Frequency of training per annum
7	Salary	60000	1866000	3
5	Salary	30000	1143000	3
5	Wages	50	2493440	2
10	Salary	45000	1724000	3
6	Salary	35000	1218000	3
8	Wages	60	2777400	2
8	Salary	50000	1894000	3
5	Wages	40	2027200	2

Source: Author's Field Survey (2019)

For better performance and efficiency haulage companies train the drivers. Majority of the companies conduct training exercise three times a year while others conduct it twice in a year. The regular training of drivers has potential to improve drivers driving skills and performance on the road.

The total truck operating cost comprises fuel, maintenance, driver's remuneration and training costs (see Table 3). There is variation in the total truck operating cost expended by the companies. This could be attributed to decisions on key policy issues that relate to age of truck procured for operation, maintenance type adopted, weight of freight transported, driver's remuneration and experience and training. As earlier mentioned, truck operating cost is a function of efficient decisions taken by managers on components of operation. For example, age of truck purchased for operation influences fuel consumption, with newer trucks having better fuel economy and lesser maintenance cost than the older trucks. The difference in the remuneration cost of the selected companies is determined by the mode of payment adopted. Payment of monthly salary is found to lower the cost incurred on drivers remuneration than payment in wage per miles driven. This result corroborates finding on wages and vehicle age as the factors influencing operating cost of trucks [23].

The share of total operating cost shows that fuel account for 28 per cent and wages 18 per cent. This result deviates from the finding of [13], which reveals that, wages account for 43 per cent and fuel 22 per cent of total operating cost in the United States. The wages was lower compared to the United States due to low per capita income and standard of living in the country. Also, the adoption of used trucks above 10 years by majority of the operator's accounts for higher fuel cost.

The decision making process is dependent on the components of freight operation involved. The business owners mostly determined the brand of truck purchased for the freight operation and fleet size owned by the haulage companies. These are major business decisions that involve huge financial investment that can only be taken by the owners. Apart from these, all other decisions directly related to freight operations employment, wages, training of drivers, maintenance of trucks and transportation of cargoes were taken by the managers

Table 3. Total truck operating costs per annum in the selected companies

Fuel cost (₦)	Tyre cost (₦)	Repair and maintenance cost (₦)	Administrative cost (₦)	Drivers remuneration (₦)	Total operating cost (₦)
2892000	1440000	3338000	650000	1866000	10186000
3122800	1500000	3981650	637000	1143000	10384450
2916800	1360000	3567400	720000	2493440	11057640
2631000	1280000	3074500	920000	1724000	9629500
3074200	1428000	3829700	655000	1218000	10204900
2786000	1350000	3500850	750000	2777400	11164250
2828000	1404000	3323360	735000	1894000	10184360
3309714	1368000	3836530	674000	2027200	11215444

Source: Author's Field Survey (2019)

who represent the interest of the business owners in the day-to-day operations of the companies. They use information on the market values of fuel, oil, tyre, spare parts, wages, rate charged for weight of cargo transported and distance travelled to take decision on truck operating cost. Also, managers consider factors such as prevailing operating cost in rival companies in taking decisions.

5. CONCLUSION AND RESEARCH IMPLICATIONS

This study was conducted to shed light on how managers and business owners in haulage business take decisions on truck operations in Lagos, Nigeria. The impact of decision making in truck operations and its peculiarities clearly emerges in this study. The existing situation shows that decisions on components of freight operation increases truck operating cost of the haulage companies. This is due to lack of fund to purchase new trucks, spare parts, low utilization of trucks for return trips and roughness of road pavements that contributed to high maintenance and fuel costs. This is aggravated by economic situation in the country especially high exchange rate of Naira to US Dollar, two digits interest rate charged on bank loans and outright cash payment for the purchase of trucks. This makes the cost of procuring necessary components such as trucks, tyre, oil and spare parts very exorbitant. This situation if left unchecked is capable of causing inflation in prices of goods and reduces purchasing power and standard of living of the citizens.

The understanding of this will enable policy makers and government to develop strategies aimed at reducing truck operating costs. Although, the operators are private sector dominated, they are major players in the economy. They influence prices of commodities and contribute substantially to nations gross domestic product. While government may not be able to reduce the exchange rate, they should endeavour to develop policy that will grant truck operators access to funds at lower interest rate in banks and encourage instalment payments so that they can afford the price of new truck and spare parts. The companies must also improve on vehicle utilization by reducing empty running and arrange for return shipment of goods to generate more revenues instead of loss. Managers must develop marketing strategy that will ensure more market share of southbound cargoes from northern and eastern parts of the country possibly by charging reduced fee and ensuring strategies for drivers accountability.

This study could be further enriched if an in-depth analysis of each component of truck operations is concentrated on using different methods and analytical techniques to better understand and equip managers and freight operators with first hand information on situation of truck operation in a developing economy.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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