

Unpacking Critical Operational Cost Drivers in Road Haulage Transport Operations in Nigeria

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Abstract: *This paper examines the operational cost structure of Nigeria's road haulage industry, with a particular focus on cost drivers, truck model preferences, fleet efficiency, and cost optimization strategies. Employing the Friedman Test and Principal Component Analysis (PCA), 27 operational cost drivers were ranked, revealing driver salaries, vehicle maintenance, lubricants, and regulatory compliance fees as the most critical expenditures. The analysis indicates a strong preference for Chinese-manufactured trucks (e.g., HOWO, Foton) due to affordability, while European brands (DAF, Scania, Iveco) demonstrate superior durability but incur higher maintenance costs. Results further highlight the low adoption of fleet management technologies, such as GPS tracking, fuel monitoring, and Transport Management Systems (TMS), which exacerbates operational inefficiencies. Additionally, regulatory obligations, including licensing and inspection costs (e.g., VIO papers, emblems, and stickers), significantly constrain profitability. The deteriorating road infrastructure compounds these challenges, contributing to high depreciation rates and accelerated tyre wear. To mitigate these cost pressures, the study recommends the adoption of preventive maintenance strategies, digitalized regulatory compliance, increased integration of fleet management technologies, and diversified fleet composition to achieve a balance between cost-effectiveness and durability. By establishing a structured framework for ranking cost drivers and exposing critical technology gaps, this study provides actionable insights for enhancing efficiency, reducing operational costs, and strengthening competitiveness in Nigeria's road haulage sector.*

Keywords: road haulage, cost drivers, fleet management, regulatory compliance, logistics efficiency, Nigeria.

INTRODUCTION

Because of globalisation and a longer and more complex supply chain, logistics plays a more critical role in developing a successful supply chain. Freight transportation cost has become one of the most important economic indicators of supply chain efficiency (Zeng and Rossetti 2003). Several previous studies have investigated various types of transportation costs (Odumosu & Adewale, 2020; Okeke & Ezeokafor, 2021; Adeyemi & Oladele, 2022). From past studies, three perspectives for classification of freight transport costs can be considered; (1) from the freight transport operators' Perspective, freight transport costs refer to the expenditure they incur in providing the services. These costs refer to operational costs. (2) From the freight owners' Perspective, freight transport costs refer mainly to the prices or charges they pay to freight transport operators. Some Freight owners tend to pay more for faster and more reliable shipping. These preferences create the value of time costs for freight transportation. And (3) From the national perspective, freight transport costs include costs associated with social, environmental, and economic aspects, which include financial, non-financial, tangible, and intangible components. These costs refer to external costs (Izadi, Nabipour & Titidezh, 2020).

Over the years, researchers have studied a wide range of cost factors and used a broad scope of methodologies to estimate freight transportation costs (Odumosu & Adewale, 2020; Uche & Eze, 2021; Adeniji & Alade, 2020). The different types of studies have different purposes, which affect their perspective, methodologies, and scope. Road haulage provides good conditions for economic growth and is a natural part of modern society. However, road freight transportation has negative side effects, including emissions and traffic congestion. A freight forwarder may consolidate shippers' goods in order to reduce some of the negative side effects, thus reducing emissions and/or congestion as well as operational costs. The negative side effects as well as operational costs can be further reduced if several freight forwarders cooperate and consolidate their collective goods flows. Consolidation refers to the process of merging a number of freight forwarders' shipments of goods into a single shipment. In this case, the freight forwarders are cooperating with competitors (the other freight forwarders). Fair cost allocations are important for establishing and maintaining cost-efficient cooperation among competing stakeholders. Road haulage goods bound for an urban area are consolidated at a facility located just outside the urban area.

In this paper, drivers of operational costs for distributing the goods are critical variables in efficient haulage operations. Common methods from cooperative game theory have been used for allocating the operational costs among the road hauliers and the municipality. However, there seems to be a lack of studies on the quantification of the weights of these drivers, where at least one driver differs from the other in some fundamental way. The purpose of this paper is to provide decision support for road haulage planners in the decision-making process of transportation planning to establish cost-efficient and stable operations. Some of the main outcomes of this thesis will be viable and practical methods that could be used in real-life situations to allocate costs among road haulage

firms, as well as support for decision makers who are concerned with road freight transport planning. The specific objectives are to: analyze the various types of road haulage vehicles in Nigeria and their comparative advantages; identify critical operational cost drivers in road haulage transport; quantify relative weights of these operational cost drivers in order of importance; and determine which of the operational cost drivers have more impact on road haulage operation in Nigeria.

LITERATURE REVIEW

Operational costs are those expenses incurred in the daily running of a business and are internal to the carriers and include both fixed and variable costs (Holguin-Veras, 2013). Fixed costs are defined as the costs of having a vehicle standing and available for work, and are not subject to frequent change and are not generally affected by the amount that the vehicle is used. Examples of fixed costs include vehicle excise duty, vehicle insurance, operator's license fee, drivers' guaranteed wages, depreciation, and overheads. Variable costs are factors whose level depends on the actual use of the vehicle. The costs of fuel, lubricants, tyres, repairs, and maintenance are examples of running or variable vehicle operating costs (Road Transport Industry Training Board, 1989). Kordnejad (2014) investigated the intermodal transport cost model and intermodal distribution in the urban environment in Europe. The study aims to model a regional rail-based intermodal transport system for a shipper of daily consumables distributing in an urban area and to evaluate it regarding cost and emissions. Findings show that the total transport cost for a combined transport chain is consistent with the total cost generated by the main haul, i.e., rail operations, the total cost for road haulage consisting of pre- and post-haulage to terminals and the total cost for terminal handling, which is derived from the cost per transferred unit associated with the type of terminal. Radhakrishnan and Anukokila (2014) studied a solid transportation problem with interval cost using a fractional goal programming approach (FGP). The purpose of developing the fuzzy goal programming model was to address the decision-maker (s)' difficulties in determining the goal value of each objective precisely, as the goal values are imprecise, vague, or uncertain. Also, they use a special type of non-linear (hyperbolic) membership function to solve the multi-objective transportation problem. It gives an optimal compromise solution.

Zofio et al. (2014) examined the general costs of freight transportation through a geographical analysis of economic and infrastructure fundamentals. As a Value Index, generalised transport costs (GTCs) can be divided into price and quantity indices for the economic – market – costs and infrastructure variables – distance and time within a network. In Zofio's article, road freight transportation in Spain between 1980 and 2007 has been surveyed at a very precise geographic level. The average GTCs weighted by trade flows have decreased by 16.3%, with infrastructure driving that reduction. Trego and Murray (2010) studied trucking operating costs. In this research, they used a survey to receive the required information. Survey questions targeted the average aggregate carrier cost per mile or cost per hour for 2008. Marginal costs are generally divided into

two groups, vehicle and driver-based as follows: **Vehicle-based cost factors:** (1) Fuel and Engine Oil; (2) Truck/Trailer Lease or Purchase Payments; (3) Repair and Maintenance; (4) Fuel Taxes; (5) Truck Insurance Premiums; (6) Tyres; (7) Licensing and Permits; (8) Tolls and; **Driver-based cost factors:** (1) Driver Wages; (2) Driver Benefits and (3) Driver Bonuses. The survey findings indicate that the average marginal cost per mile (CPM) is \$1.73 and the average cost per hour (CPH) is \$83.68. The highest costs were for diesel/oil, driver's wages, and truck/trailer rentals or purchases.

Lindsey et al. (2013) investigated modelling freight rates for trucks in spot markets using North American data mining and GIS. The research has found that factors such as distance, characteristics of the shipping lane, and the required truck type are among the most important determinants of motor carrier rates at both the shipment and lane level. Also, seasonality and overall market conditions play a major role in determining rates for truckload shipments. The data for their study comes from a U.S.-based 3PL provider operating in North America. Qiao et al. (2016) investigated a decision-making problem consisting of less-than-truckload dynamic pricing (LTLDP) under the Physical Internet (PI). PI can be seen as the interconnection of logistics networks via open PI-hubs, which can be considered as spot freight markets where LTL requests of different volumes/destinations continuously arrive over time for a shortstop. Carriers can bid for the requests by using a short-term contract. The results showed that the proposed model could optimise the carrier's bid price to maximise the expected profits and three influencing factors were investigated: the quantity of requests, the carrier's capacity, and cost.

Zhang et al. (2018) presented an optimisation of freight truck driver scheduling based on an operation cost Model for Less-than-Truckload (LTL) transportation. They introduced the new Time-Driven Activity-Based Costing (TDABC) method, TDABC-FTC for truck freight companies. Also, an artificial neural network (ANN) model is introduced to capture the relations between driving behaviour and fuel consumption rate. The results showed that the newly introduced methods presented considerable benefits of the optimal scheduling techniques. Conrad and Joseph (2018) studied the costs and challenges of log truck transportation. This study involved interviews with 18 log truck owners operating in the state of Georgia, USA. The results showed that the most important challenges were a shortage of qualified drivers and rising truck insurance premiums. Increasing per cent-loaded km, reducing turn times at mills and harvest sites, providing driver training, and adopting technologies, such as global positioning system tracking and on-board cameras, could improve transportation efficiency and safety. Hooper and Murray (2018) presented an analysis of the operational costs of trucking. They studied the American Transportation Research Institute's (ATRI's) annual motor carrier operations costs report. Average marginal costs were based on vehicle costs (fuel, insurance, permits, tolls, repair, and lease or purchase payments) and driver costs (wages, benefits). The average carrier cost per mile in 2017 was \$1.691, an approximately 6% increase from 2016 costs. The average carrier cost per hour was

\$66.65 versus \$63.66 in 2016. Driver wages and benefits represent 43% of total average marginal costs, and fuel costs represent 22%.

The previous research addressed issues of modelling in the field of road freight transportation, especially pricing that should include commodity types, shipping policy, service delivery characteristics, vehicle characteristics, and model horizons. They equally investigated the intermodal transport cost model and intermodal distribution in the urban environment in different parts of the world except Africa. They examined the general costs of freight transportation through a geographical analysis of economic and infrastructure fundamentals. Moreover, they developed models for calculating comparable combined internal and external costs of intermodal and road freight transport networks. None of these studies examined peculiar drivers of the operational cost of haulage, which this study tries to fill in. In addition, the study will attach relative weight in order of importance to operational cost drivers of road haulage operations in Nigeria. This will enable road haulage operators to identify the critical cost elements in their operation. Therefore, most studies focus on individual cost drivers, but there's a need for more research on how these drivers interact with each other and impact overall cost. Also, Nigeria's unique economic, social, and regulatory environment requires more context-specific studies to understand the cost drivers in road haulage transport and the need for more research on how inconsistent regulations across states impact cost drivers and how a unified regulatory framework can improve the industry.

METHODOLOGY

The study utilized the mixed methods approach (quantitative and qualitative), and a survey research design was adopted. The population of the study was the top and the middle managers of road haulage companies in South East Nigeria. The number was based on the response from the online Google survey document. The sample frame was constructed primarily to target relatively high-level managers, such as top/middle managers. Such high-level managers were targeted in the belief that, while they are intimately aware of the internal operational workings of their organizations, they are also well aware of their organization's operational cost strategy and the performance of such supply chain functions as logistics companies. As the focus of operations-related research shifts from the firm to the supply chain level, it becomes more difficult for researchers to identify groups within organizations that are aware of both internal and external processes and performance. Secondary data were sourced through the use of documented materials such as journals, existing transportation and distribution studies, textbooks, proceedings of seminars, other research findings, and the internet.

A comparison of the means of the descriptive variables and the scale items for the two groups was conducted using Friedman's test statistic. Principal component factor analysis was carried out to determine the critical operational cost drivers of road haulage transport. In a study ranking cost drivers in Nigerian road haulage, the Friedman test was used to compare 27 cost components (e.g.,

driver salary, fuel costs, and maintenance fees). The test identified which costs had significantly different rankings, helping prioritize cost-reduction strategies. Friedman's test is a powerful tool for ranking-based comparisons, particularly when data are not normally distributed. It is widely used in logistics, healthcare, and operational research to compare performance metrics, cost factors, and efficiency scores across multiple related groups. Principal Component Factor Analysis (PCA) is a statistical technique used to reduce the dimensionality of a dataset while preserving as much information as possible. It transforms a set of correlated variables into a smaller set of uncorrelated variables, called principal components (PCs), which explain most of the variability in the data. PCA is a powerful dimensionality reduction technique that enhances data analysis and pattern recognition. It is widely applied in logistics, finance, and engineering to simplify data, identify key influencing factors, and improve efficiency in decision-making.

Table 1: The Characteristics of Road Haulage Personnel Surveyed in the Study

Company Name	Vehicle or Truck Model	Position at the Company
Chemiroy Nigeria Limited	BDJ 60 YF	Executive Assistant
Izicrown Global Ventures	DAF 85, HOWO, Mack, and Iveco	Fleet And Maintenance Manager
MDS Logistics	Foton ETX & GTL	Technical Services Manager
Transport Services Limited	Scannia	Head of training
POG	Hohan and Mack Articulated Trailer	Driver Administrator Business performance manager (Mid-level management)
A.G. Leventis Nig. Ltd	Foton	Finance Analyst
A.G Leventis (Nigeria)Ltd	Foton	Financial Controller
A.G. Leventis Nig. Ltd	Foton	Fleet Operations Manager
Mokiz Logistics.	Howo	Driver Training Manager
Greenville LNG	Howo	Traffic Clerk
Nigerian Breweries PLC	Howo	Articulated driver
GPC Energy Limited	Howo, Across, Iveco,	

Table 1 lists various positions held by surveyed employees in logistics and transport companies in Nigeria. These positions range from executive management to technical roles and fleet administration, providing a broad representation of personnel involved in fleet and logistics management. The implications of their positions on decision-making, operational efficiency, and strategic direction are analyzed below.

The surveyed employees can be categorized into three main groups based on their job functions: (i) Senior and Mid-Level Management - Executive Assistant (Chemiroy Nigeria Limited), Business Performance Manager (A.G. Leventis Nigeria Ltd), Finance Analyst (A.G. Leventis Nigeria Ltd), and Financial Controller (A.G. Leventis Nigeria Ltd). These individuals influence strategic planning, financial oversight, and operational performance. The presence of finance professionals indicates an emphasis on cost management and budget optimization in haulage

operations. The Executive Assistant role suggests close involvement in corporate decision-making and administration.

(ii) **Technical and Fleet Management Roles:** Fleet and Maintenance Manager (Izicrown Global Ventures), Technical Services Manager (MDS Logistics), Fleet Operations Manager (Mokiz Logistics), Head of Training (Transport Services Limited), and Driver Training Manager (Greenville LNG). These roles are critical for vehicle performance, maintenance efficiency, and safety training. Fleet and maintenance managers are responsible for optimizing truck usage, reducing downtime, and improving logistics efficiency. The Head of Training and Driver Training Manager roles highlight the importance of continuous skill development to improve driver performance and safety.

(iii) **Operational and Administrative Roles:** Driver Administrator (POG), Traffic Clerk (Nigerian Breweries PLC), and Articulated Driver (GPC Energy Limited). These positions handle daily logistics operations, regulatory compliance, and driver coordination. The Traffic Clerk ensures smooth transportation planning, reducing scheduling conflicts and improving delivery timeliness. The Driver Administrator role indicates the need for efficient driver management, record-keeping, and compliance monitoring.

The surveyed positions provide a holistic view of the Nigerian haulage industry, covering executive, technical, and operational functions. The emphasis on fleet maintenance, financial oversight, and driver training indicates that companies are working to reduce costs, improve safety, and enhance operational efficiency. Moving forward, investments in technology, workforce training, and strategic financial planning will be key to optimizing haulage operations in Nigeria.

RESULTS AND DISCUSSIONS

Identification of the Key Operational Cost Drivers

Road haulage transport in Nigeria is influenced by various operational cost drivers, which vary by city and the type of commodities transported. These cost drivers significantly impact the efficiency and profitability of haulage operations. This analysis explores the key operational cost drivers in different Nigerian cities, focusing on the type of commodities carried by various truck models.

The key operational cost drivers identified in the study are:

1. Fuel Costs: Fuel is a major operational cost driver in road haulage transport in Nigeria. Variations in fuel prices and availability across different cities significantly impact haulage operations.

2. Vehicle Maintenance and Repairs: Regular maintenance and unexpected repairs contribute substantially to the operational costs. The harsh road conditions in many Nigerian cities exacerbate wear and tear on vehicles.

3. Toll Fees and Road Taxes: Toll fees and road taxes vary by region and can be a significant cost, especially on major highways connecting key cities.

4. Driver Wages and Training: The cost of hiring and training drivers is another major expense. Skilled drivers are essential for the safe and efficient operation of haulage trucks, but their wages can vary significantly across different regions.

5. Insurance Costs: Insurance is a mandatory cost that can vary based on the type of cargo, truck model, and routes taken. Higher-risk routes and valuable cargo typically lead to higher insurance premiums.

Table 2: Operational costs drivers by city and commodity hauled

S/No	City	Commodities hauled	Preferred Truck Model	Cost Drivers
1	Lagos	Consumer goods Industrial products	Mercedes-Benz Actros DAF XF	High fuel costs due to traffic congestion Significant toll fees on major expressways Higher driver wages due to the cost of living
2	Abuja	Government supplies Construction materials	Volvo FH Series MAN TGX	Moderate fuel costs with relatively less congestion Lower toll fees compared to Lagos High maintenance costs due to long-distance hauls
3	Port Harcourt	Oil and gas equipment Industrial goods	Scania R-Series Mack Trucks	High maintenance and repair costs due to heavy-duty operations Significant insurance premiums due to the high value of transported goods Moderate fuel costs
4	Kano	Agricultural products Textiles	MAN TGX Iveco Stralis	Lower fuel costs due to less congestion High maintenance costs from long-distance and rough road conditions Moderate driver wages
5	Ibadan	Perishable goods Consumer products	DAF XF Hino 700 Series	Moderate fuel costs High maintenance costs due to poor road conditions Lower toll fees compared to Lagos and Abuja

Source: Author's Compilation 2024

Operational cost drivers in Nigerian road haulage transport vary significantly by city and the type of commodities transported. Key factors include fuel costs, vehicle maintenance, toll fees, driver wages, and insurance costs. Understanding these drivers helps in optimizing haulage operations and improving cost efficiency.

Determination of relative weights of the operational cost drivers in order of importance

The Friedman Test (see Table 3) ranks the importance of 27 operational cost drivers affecting road haulage operations in Nigeria. The results reveal which factors contribute most significantly to overall logistics costs, helping stakeholders optimize cost structures and improve efficiency. The ranked operational cost drivers indicate the relative impact of each factor on haulage expenses in Nigeria.

Table 3: Ranking of the Operational Cost Drivers

S/No.	Operational Cost Drivers	Weight	Ranks
1.	Driver Salary	17.46	1st
2.	Lubricant	17.08	2nd
3.	Emblems and stickers	16.08	3rd
4.	VIO Papers	15.96	4th
5.	Maintenance and repair	15.63	5th
6.	Depreciation	15.54	6th
7.	Driver Bonuses	15.5	7th
8.	Vehicles/rolling stock	15.29	8th
9.	Tyres	15.25	9th
10.	Handling costs	14.96	10th
11.	Crew wages	14.58	11th
12.	Truck/Trailer Lease	14.29	12th
13.	Fuel Cost	14.25	13th
14.	Rent of park yard/Terminal	14.17	14th
15.	Driver Benefits	14.08	15th
16.	Offense charges	13.83	16th
17.	Overhead cost	13.83	17th
18.	Paid packing	13.04	18th
19.	Security fee at various vehicle breakdown points and trailer parks	12.92	19th
20.	Movement restriction fee	12.88	20th
21.	Vehicle Insurance	12.83	21st
22.	Technology: Tracker, Fuel monitoring, TMS-Transport Mgt System	12.67	22nd
23.	Operation License	12.21	23rd
24.	Policing costs at checkpoints	11.5	24th
25.	Tolls	11.04	25th
26.	Vehicle Licensing and Permits	10.75	26th
27.	Vehicle Excise Duty	10.38	27th

Source: Author's Computation 2024

High-Impact Cost Drivers (Top 5)**1. Driver Salary (Rank 1, Weight: 17.46)**

Labor costs are the highest contributor to operational expenses. This suggests that driver salaries in Nigeria's haulage sector are substantial, possibly due to skill shortages, high demand for experienced drivers, or unionized wage structures. Companies can explore performance-based incentives and route optimization to improve driver efficiency.

2. Lubricants (Rank 2, Weight: 17.08)

High lubricant costs indicate frequent vehicle servicing, harsh operating conditions, or poor fuel quality requiring frequent oil changes. Firms should consider bulk purchasing, supplier negotiations, or investing in high-quality synthetic lubricants that last longer.

3. Emblems and Stickers (Rank 3, Weight: 16.08)

Regulatory compliance costs (e.g., branding, licensing) are among the highest operational expenses, suggesting a costly and complex permitting process in Nigeria. Regulatory simplification and digital permit systems can help streamline compliance and reduce costs.

4. VIO Papers (Rank 4, Weight: 15.96)

The Vehicle Inspection Office (VIO) certification, mandatory for vehicle roadworthiness, is a significant expense. Costs may stem from inspection fees, compliance challenges, or unofficial levies. Firms should maintain fleet compliance proactively to avoid penalties and optimize inspection scheduling.

5. Maintenance and Repair (Rank 5, Weight: 15.63)

Poor road infrastructure and aging fleets likely contribute to high maintenance expenses. Frequent repairs increase downtime, reduce efficiency, and raise operating costs. Adoption of preventive maintenance strategies, fleet modernization, and route analysis to avoid bad roads can mitigate this issue.

Moderate-Impact Cost Drivers (Ranks 6-15)

1. Depreciation (15.54, 6th) – Fleet age and wear-and-tear significantly affect overall costs. Investing in newer, fuel-efficient trucks could lower depreciation rates.
2. Driver Bonuses (15.50, 7th) – Performance incentives add to costs but can improve retention and efficiency.
3. Vehicles/Rolling Stock (15.29, 8th) – Acquisition of new trucks is a major investment, suggesting high capital expenditure burdens.
4. Tyres (15.25, 9th) – High tyre costs reflect poor road conditions, rapid wear, and inflationary pressures on imports.
5. Handling Costs (14.96, 10th) – Loading, offloading, and warehouse handling contribute to operational expenses.
6. Crew Wages (14.58, 11th) – Additional labor wages beyond driver salaries add to costs.
7. Truck/Trailer Lease (14.29, 12th) – Leasing costs are high, indicating demand for fleet expansion.
8. Fuel Costs (14.25, 13th) – Although ranked lower than expected, rising diesel prices and fuel inefficiency still significantly impact overall costs.
9. Rent of Park Yard/Terminal (14.17, 14th) – Expensive terminal spaces raise operational overheads.
10. Driver Benefits (14.08, 15th) – Insurance, allowances, and incentives for drivers further increase labor costs.

Lower-Impact Cost Drivers (Ranks 16-27)

1. Offense Charges (13.83, 16th) – Fines and penalties for regulatory breaches contribute to expenses.
2. Overhead Costs (13.83, 17th) – General business administration expenses remain significant.

3. Paid Parking (13.04, 18th) – Parking fees at terminals and offloading zones add to costs.
4. Security Fees at Breakdown Points (12.92, 19th) – Roadside assistance and security expenses remain moderate.
5. Movement Restriction Fee (12.88, 20th) – Cost implications of restricted haulage hours or zonal regulations.
6. Vehicle Insurance (12.83, 21st) – While necessary, insurance premiums are relatively lower compared to other costs.
7. Technology (12.67, 22nd) – Adoption of tracking and fuel monitoring is not a major cost concern, possibly due to low penetration rates in Nigeria.
8. Operation License (12.21, 23rd) – Licensing costs are lower than expected, suggesting that once obtained, renewal fees are manageable.
9. Policing Cost at Checkpoints (11.50, 24th) – While still a factor, extortion and security levies at police checkpoints are lower in cost ranking.
10. Tolls (11.04, 25th) – Road toll costs contribute minimally to total expenses.
11. Vehicle Licensing and Permits (10.75, 26th) – A relatively low-cost component compared to other regulatory expenses.
12. Vehicle Excise Duty (10.38, 27th) – The least significant cost driver, suggesting minimal import duties or tax burdens on fleet acquisition.

Implications for Road Haulage Operations in Nigeria

The results provide critical insights into Nigeria's road transport cost structure, highlighting inefficiencies and areas for improvement.

(a) **High Labor and Compliance Costs:** Driver salary, bonuses, and benefits rank among the highest costs. Regulatory costs (e.g., VIO papers, stickers, offense charges) are significant. Simplifying licensing, reducing regulatory bottlenecks, and promoting digital permit issuance can lower costs.

(b) **Maintenance and Depreciation as a Major Concern:** Frequent repairs due to poor road infrastructure escalate costs. Fleet modernization and better road maintenance policies are urgent needs. Preventive maintenance programs can reduce repair frequency.

(c) **Impact of Fuel and Tyre Costs:** Although fuel is not the top-ranked expense, rising diesel prices remain a risk. Tyre wear is high, indicating the need for better roads and higher-quality tyre imports. Energy-efficient trucks and route optimization can improve fuel economy.

(d) **Need for Technology Adoption:** Tracking, fuel monitoring, and Transport Management Systems (TMS) rank low. Indicates low technology adoption among Nigerian haulage firms. Investing in fleet management software and GPS tracking can optimize logistics efficiency.

(e) **Security and Road Checkpoints:** Despite concerns about police extortion, checkpoint policing costs are ranked 24th. Security challenges remain, but they are not the most significant expense. Investing in cargo insurance and route security can minimize risks.

Recommendations for Cost Optimization in Nigerian Road Haulage

1. Implement Driver Performance Incentives: Shift from fixed salaries to performance-based pay to improve productivity and reduce costs.
2. Adopt Bulk Purchasing & Supplier Negotiations: Reduce lubricant, tyre, and fuel costs by negotiating supplier discounts.
3. Streamline Regulatory Compliance: Push for digital licensing, automated permit renewals, and reduced bureaucratic costs.
4. Invest in Preventive Maintenance: Implement scheduled fleet maintenance to lower repair and depreciation costs.
5. Leverage Technology: Adopt fuel tracking, GPS monitoring, and automated fleet management to reduce inefficiencies.

The Friedman Test results provide a clear ranking of cost drivers affecting Nigeria's road haulage sector. Driver salaries, lubricants, compliance costs, and vehicle maintenance are the top concerns, while tolls, policing fees, and excise duties have a lower impact. Strategic cost-cutting in labor, fleet maintenance, and technology adoption can significantly enhance profitability in Nigeria's haulage industry.

Principal Component Factor Analysis of which operational cost drivers have more impact on road haulage operations in Nigeria

The rotated factor matrix in Table 4 identifies 27 cost drivers in Nigerian road haulage operations, with the loadings grouped into five components. Each component represents an underlying dimension or construct that explains a portion of the variance in operational costs. The rotation (using Varimax with Kaiser normalization) helps clarify these dimensions by maximizing the loadings for each variable on one component while minimizing it on others.

Table 4: Rotated Component Matrix of Operational Cost Drivers

	Component				
	1	2	3	4	5
Vehicle Licensing and Permits	.479	.639	.153	.243	.474
Vehicle Excise Duty	.443	.153	-.039	.385	.745
Vehicle Insurance	.276	.457	.196	.621	.394
Operation License	.254	.737	.153	.274	.512
Crew wages	.300	.010	.768	-.173	.497
Driver Salary	.345	-.076	.842	.055	.084
Depreciation	.650	.480	.345	.357	-.072
Overhead cost	.198	.387	.875	.002	.060
Rent of Park Yard/Terminal	.162	.169	.889	.289	-.021
VIO Papers	.576	.516	.296	.303	.368
Vehicles/rolling stock	.730	.240	.191	.356	.320
Fuel Cost	-.252	.446	.766	.185	-.008
Lubricant	.565	.602	.393	.363	-.010
Tyres	.296	.848	.223	.297	.000
Maintenance and repair	.273	.823	.275	.344	.093
Movement restriction fee	.628	.558	.355	.349	.050
Emblems and stickers	.614	.528	.400	.396	.012
Technology: Tracker, Fuel monitoring, TMS- Transport Mgt System	.249	.289	.853	.195	-.012
Security fee at various vehicle breakdown points and trailer parks	.402	.448	.288	.704	.208
Handling costs	.654	.213	.328	.580	.063
Paid packing	.472	.348	.240	.660	.205
Policing costs at checkpoints	.222	.117	.090	.851	.383
Tolls	.063	.310	-.049	.770	-.068
Truck/Trailer Lease	.174	.592	.212	.521	.396
Driver Benefits	.862	.171	.095	.063	.434
Driver Bonuses	.884	.204	.165	.116	.270
Offense charges	.632	.352	.305	.568	-.095

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 14 iterations.

Source: SPSS 28.0

Component 1: Fixed and Administrative Costs

1. Driver Benefits (0.862) and Driver Bonuses (0.884): These two variables exhibit very high loadings, indicating that fixed labor costs are a significant part of the overall expenses.
2. Vehicles/Rolling Stock (0.730) and Depreciation (0.650): Reflect investment and wear-and-tear costs associated with fleet assets.
3. Emblems and Stickers (0.614) and Movement Restriction Fee (0.628): Likely reflect regulatory and administrative fees.

This component groups costs that are relatively fixed in nature. It includes driver-related compensation and the ongoing expense of maintaining the fleet, as well as administrative fees

related to regulatory compliance. To optimize these costs, companies may consider performance-based compensation schemes for drivers and implement fleet management systems that reduce administrative burdens. Negotiating better deals on vehicle purchases or financing arrangements could help reduce depreciation-related expenses.

Component 2: Regulatory and Maintenance Costs

1. Operation License (0.737) and Vehicle Licensing and Permits (0.639): These are strongly associated with regulatory compliance.
2. Lubricant (0.602), Tyres (0.848), and Maintenance and Repair (0.823): Reflect recurring maintenance costs.
3. Truck/Trailer Lease (0.592) also loads moderately on this component.

This component captures the cost elements driven by regulatory requirements and routine maintenance. It suggests that costs associated with vehicle upkeep and meeting regulatory standards are significant. Improving road infrastructure and negotiating bulk deals with suppliers for lubricants, tyres, and maintenance services could lower these costs. There is an opportunity for advocacy or streamlining regulatory processes to reduce licensing and inspection expenses.

Component 3: Operational and Technological Costs

1. Crew Wages (0.768) and Driver Salary (0.842): These load heavily, highlighting the critical role of labor in daily operations.
2. Overhead Cost (0.875) and Fuel Cost (0.766): Indicate the operational expenses that directly affect the day-to-day functioning of haulage activities.
3. Technology: Tracker, Fuel Monitoring, TMS (0.853): High loading suggests that investments in technology to improve operations are becoming more prominent.

Component 3 combines variable operational costs with investments in technology. This suggests that while labor and fuel are significant ongoing costs, strategic technology adoption can help in managing these expenses through enhanced efficiency and real-time decision-making. Investing in fleet management technologies, such as telematics and TMS, can improve fuel efficiency and reduce downtime. Training drivers and crew to leverage these technologies can lead to operational improvements and cost savings.

Component 4: Logistics Operational Compliance Costs

1. Vehicle Insurance (0.621), Security Fee at Breakdown Points (0.704), Policing Cost at Check Points (0.851), Tolls (0.770), and Paid Packing (0.660):
2. Handling Costs also load moderately on this component (0.580).

This component represents costs associated with security, safety, and compliance during the transportation process. It reflects expenditures related to ensuring that the logistics operations meet both safety standards and regulatory requirements. Negotiating with service providers for better security arrangements and investing in technologies to reduce manual handling (e.g., automated

packing systems) may help lower these costs. Collaborating with regulatory agencies could lead to streamlined procedures that reduce tolls and policing costs at checkpoints.

Component 5: Tax and Statutory Fees

1. Vehicle Excise Duty (0.745) and contributions from Vehicle Licensing and Permits (0.474) fall under this component.

This component specifically captures taxation and other statutory fees that are imposed on vehicles and related operations. Since these costs are influenced by government policies, firms might focus on engaging with industry bodies and policymakers to advocate for tax incentives or reforms. Exploring local assembly or manufacturing options may reduce the impact of import duties and excise taxes.

We hereby summarize the principal components of the operational cost drivers in the Nigerian road haulage industry as follows:

Table 5: Summary of Ranked Operational Cost Drivers of Road Haulage Transport in Nigeria

Component	Key Cost Drivers	Description and Implications
1. Fixed and Administrative Costs	Driver Benefits, Driver Bonuses, Vehicles/Rolling Stock, Depreciation, Emblems and Stickers, Movement Restriction Fee	Represents fixed labor costs and fleet asset expenses, plus administrative fees related to regulatory compliance. Optimization through performance-based pay and fleet management systems is suggested.
2. Regulatory and Maintenance Costs	Operation License, Vehicle Licensing and Permits, Lubricant, Tyres, Maintenance and Repair, Truck/Trailer Lease	Covers regulatory compliance fees and routine vehicle maintenance costs. Opportunities include infrastructure improvement, supplier negotiation, and regulatory streamlining.
3. Operational and Technological Costs	Crew Wages, Driver Salary, Overhead Cost, Fuel Cost, Technology (Tracker, Fuel Monitoring, TMS)	Combines labor and fuel expenses with technology investments aimed at operational efficiency. Emphasizes technology adoption for cost control and improved fleet management.
4. Logistics Operational Compliance Costs	Vehicle Insurance, Security Fee at Breakdown Points, Policing Cost at Check Points, Tolls, Paid Packing, Handling Costs	Encompasses security, safety, and compliance-related costs during transport. Suggests negotiating security services, investing in automation, and collaborating with regulators to reduce fees.
5. Tax and Statutory Fees	Vehicle Excise Duty, Vehicle Licensing and Permits	Represents taxation and statutory fees impacting vehicle operations. Highlights the need for policy advocacy and exploring local sourcing to mitigate these costs.

The factor analysis provides a structured view of the major cost drivers in Nigerian road haulage operations, segmented into five distinct dimensions:

1. Fixed and Administrative Costs (Component 1): High driver compensation and administrative fees indicate that labor and regulatory compliance constitute a significant portion of operating expenses. Strategic cost management and technology adoption could reduce these burdens.
2. Regulatory and Maintenance Costs (Component 2): Frequent maintenance and regulatory compliance fees point to challenges associated with poor road infrastructure and stringent regulatory requirements. Investment in preventive maintenance and supplier negotiations is critical.
3. Operational and Technological Costs (Component 3): Labor costs and fuel consumption are primary operational concerns, but technology (e.g., TMS, GPS tracking) shows potential to streamline these expenses. There is an opportunity to integrate advanced fleet management systems to improve efficiency.
4. Logistics Operational Compliance Costs (Component 4): Security, tolls, and handling costs highlight the need for optimized logistics processes and better collaboration with regulatory agencies to minimize disruptions and reduce costs.
5. Tax and Statutory Fees (Component 5): Although lower in overall weight, taxation and statutory fees represent a consistent cost that can be addressed through policy advocacy and strategic sourcing.

The following are recommended for the strategy development of road haulage operations in Nigeria.

Optimize Driver and Labor Costs:

1. Performance-Based Incentives: Shift toward a compensation model that rewards efficiency and performance.
2. Training: Enhance driver skills to reduce fuel consumption and improve safety, thereby indirectly reducing overhead costs.

Enhance Fleet Maintenance and Regulatory Compliance:

1. Preventive Maintenance Programs: Implement regular maintenance schedules to lower repair costs and prolong vehicle life.
2. Regulatory Advocacy: Engage with government bodies to simplify licensing and inspection processes, potentially reducing fees.

Adopt Advanced Technology:

1. Fleet Management Systems: Invest in TMS and GPS tracking to improve route optimization, fuel monitoring, and real-time decision-making.
2. Digital Transformation: Implement data analytics to monitor performance metrics and identify areas for cost reduction.

Negotiate with Suppliers:

1. Bulk Purchasing: Negotiate better terms for purchasing tyres, lubricants, and spare parts.
2. Long-Term Contracts: Establish long-term relationships with suppliers to secure favorable pricing and reduce volatility.

Policy and Tax Incentives:

1. Industry Collaboration: Work with industry associations to advocate for tax breaks and incentives that reduce the burden of vehicle excise duty and licensing fees.
2. Local Manufacturing: Explore opportunities for local assembly to reduce import-related taxes and improve spare parts availability.

The rotated factor matrix reveals that Nigeria's road haulage industry is influenced by a multifaceted cost structure comprising fixed, regulatory, operational, compliance, and tax-related costs. By understanding these components, logistics operators can develop targeted strategies to optimize their operations. Through strategic investments in technology, proactive maintenance, effective supplier negotiations, and advocacy for regulatory reforms, companies can reduce costs, improve efficiency, and gain a competitive advantage in the Nigerian market. The insights derived from the Friedman test provide a roadmap for addressing the most significant cost drivers, enabling operators to transform challenges into opportunities for enhanced performance and profitability.

CONCLUSION

The study provides a comprehensive evaluation of Nigeria's road haulage industry, focusing on cost drivers, fleet efficiency, truck model preferences, and strategic management practices. The conclusions drawn from the research are categorized as follows:

1. **Key Cost Drivers in Nigerian Road Haulage Operations:** The study establishes that the most significant costs in Nigeria's haulage sector include driver salaries, maintenance, lubricants, compliance fees, and fleet depreciation. Driver salary ranks as the highest cost component (17.46), indicating that labor expenses are a major burden in the industry. Maintenance and lubricants (Ranks 2 and 5) contribute significantly due to poor road infrastructure and frequent vehicle breakdowns. Regulatory costs (emblems, stickers, VIO papers) impose a heavy financial burden, necessitating streamlined compliance procedures. Fuel costs, though significant, are not the top-ranked expense, suggesting that companies are already optimizing fuel use. The costliest components in Nigeria's haulage industry are labor, maintenance, and regulatory compliance fees, reinforcing the need for strategic cost-cutting measures.

2. **Dominance of Low-Cost Chinese Truck Models:** The study confirms that Chinese-manufactured trucks (HOWO, Foton, Hohan) dominate Nigeria's road haulage fleet due to their affordability and ease of maintenance. HOWO and Foton trucks are widely used by leading logistics firms,

signifying cost-driven fleet acquisition decisions. European trucks (DAF, Scania, MAN, and Volvo) are less common due to higher purchase prices and maintenance challenges. Articulated trailers (Mack, Hohan) are preferred for heavy cargo, particularly in fuel transport. Nigeria's haulage sector prioritizes cost-effectiveness over premium durability, leading to widespread adoption of Chinese truck models.

3. Weak Adoption of Digital Logistics Solutions: Despite global trends in transport management systems (TMS), fleet tracking, and automation, the study finds that Nigerian firms underutilize technology. Fleet tracking and GPS adoption remain low, increasing inefficiencies in route planning and fuel consumption. TMS solutions, such as digital scheduling and fuel monitoring, are rarely used, leading to higher operational costs. Security and policing costs, though present, are not the primary concerns, but investments in logistics tech could further reduce these risks. Nigeria's haulage industry lags in technology adoption, creating an opportunity for digitization to enhance operational efficiency.

4. Impact of Regulatory Burdens and Road Infrastructure: Regulatory compliance costs and inconsistent road conditions significantly affect fleet operations. VIO papers, licensing fees, and enforcement charges rank among the top cost drivers, suggesting a need for policy reforms. Poor road quality contributes to excessive maintenance costs, especially for companies relying on older fleets. Haulage firms face inefficiencies due to inconsistent regulations across states, increasing administrative burdens. Regulatory streamlining and government investment in road infrastructure are critical for reducing operational inefficiencies in the haulage sector.

5. Strategic Fleet Management Practices: The study identifies best practices that can help optimize costs: Preventive maintenance strategies can extend vehicle lifespan and reduce downtime, Diversified fleet composition (Chinese and European trucks) balances cost-efficiency with durability, Driver performance incentives may reduce salary burdens while improving productivity, and Bulk purchasing of fuel and lubricants can help stabilize costs and improve profitability. Haulage firms must implement better fleet management, preventive maintenance, and procurement strategies to remain competitive.

Implication of Findings

The study came up with the following implications for the Nigerian logistics and haulage industry:

(i) **Balanced Representation of Roles:** The surveyed positions cover a wide range of logistics functions, from executive planning to hands-on operations. This ensures that insights gathered from the survey reflect multiple aspects of the haulage industry, from financial planning to vehicle maintenance and driver management.

(ii) **Strong Focus on Fleet and Maintenance Efficiency:** The presence of multiple fleet managers, technical service managers, and driver trainers shows that companies are prioritizing vehicle

reliability, fuel efficiency, and cost-effective maintenance. This suggests a growing adoption of preventive maintenance strategies to reduce breakdowns and operational costs.

(iii) Need for Enhanced Training and Safety Compliance: The inclusion of Head of Training and Driver Training Manager roles highlights a commitment to driver safety and skill development. As Nigeria experiences high accident rates and regulatory enforcement challenges, continuous training programs can reduce risks and improve road safety.

(iv) Strategic Financial Oversight in Logistics: The presence of finance professionals (Finance Analyst, Financial Controller) suggests that companies are increasingly focusing on financial sustainability. Logistics firms are likely emphasizing cost efficiency, return on investment (ROI), and budgetary discipline.

The study makes several significant contributions to Nigeria's logistics sector. Develops a Structured Cost Ranking Framework. First study to quantify operational cost drivers in Nigerian road haulage using the Friedman Test. It establishes a Link between Cost Drivers and Fleet Performance. It further demonstrates how fleet composition, fuel efficiency, and road conditions affect total logistics expenses. In the same vein, the study highlights the technology deficit in Nigerian road haulage operations. The study equally identifies low adoption rates for digital fleet management solutions, creating a research gap for future studies. It provides policy recommendations for regulatory reforms and suggests strategies for reducing licensing, VIO, and enforcement costs, benefiting both private sector operators and policymakers. The study provides a roadmap for reducing costs and improving efficiency in Nigeria's road haulage industry. Labor expenses, maintenance costs, and regulatory fees are the biggest financial burdens, while technology adoption and regulatory reforms offer the greatest opportunities for optimization. To remain competitive, Nigerian logistics firms must embrace digital transformation, implement better fleet management, and advocate for industry-friendly policies.

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