Impact of Maintenance Cost on the Operation of Inland Waterways Transport in Lagos State

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Abstract- ***Inland waterways transport plays significant activities in the mobility of freight and services, which is necessary for urban economic development. Maintenance cost is the determinant for price determination by waterways transport providers, maintenance costs are related to the operation of a business which is servicing fees at all stages, procurement of spare parts among others. Increase in high cost of spare parts, limited ferry capacity, lack of ferry accessibility and increase in other operational expenses generated to poor operations along inland waterways channel. To achieve this, the study will analyze the impact of maintenance cost on the operation of inland waterways transport in Lagos State. The data used in this research are represented by relevant variables retrieved through primary. The primary data was generated using snow balling sampling technique with aid of 836 well structured questionnaires. Multiple regression analysis was used in analyzing the data obtained.The result of the findings revealed that increase in ferry Maintenance costs influence Ferry capacity, Ferry Accessibility and Operational expense (operator remuneration) with F-value of 1024.112, P= 0.000 and adjusted R square of .790. The study concluded that ferry maintenance costs positively impacted inland waterways operations. It also recommends that to have reduction in repair cost, there should be adequate infrastructures at the terminals.***

Indexed Terms- ***Maintenance, Ferry, Costs, Spare Parts, Price***

I. INTRODUCTION

In Nigeria, inland waterways are important for the urban economic development of an area, particularly in remote areas where the potential for waterway transport depends heavily on the unique regional context, including geographic conditions, socioeconomic conditions, and available infrastructure development (Rokicki & Stępniak, 2018). Other important factors that affect waterway transport potential include the availability of terminal facilities, such as floor spaces, parking lots, fuel dumps, slipways, retail outlets (restaurants, banking halls, shops, etc.), and the provision of life jackets for both operators and passengers (Megagianni, 2022). When considering the facilities (infrastructures) that will enhance the profitable movement of freight and passengers through waterways in Nigeria, the infrastructure concession commission established by the previous government in 2010 realized that waterways transportation could not be effective and efficient with PPP operations. Anticipated developments of inland waterways terminals promote exchange rates, reduce traffic on roads, alleviate poverty, and create job opportunities for young people in the city (Kalu, Onuigbo, Imoagwu, &Njemanze, 2021).

Ferry Maintenance Costs are the expenses incurred in rendering services; however, in the context of economics, costs also include the owner-manager's compensation and the imputed value of the entrepreneur's own resources and skills. Ferry operation expenses and the cost of inland waterway transportation are highly related (Solomon, Otoo, Boateng, and Koomson, 2021). The costs associated with running a firm or a machinery, component, or facilities are known as operating costs. Additionally, because ferry maintenance costs have an impact on commuter accessibility, ferry capacity, and other operational expenses, they are extremely important to the operation of the waterways along the networks of the Lagos waterways (Afolayan & Ayantoyinbo, 2023).

Transportation pricing components include any and all expenses and financial incentives paid by travelers, such as transit prices, freight fees, fuel taxes, variable and flat rate tolls, parking fees, vehicle registration fees, and insurance payments (Sovacool, Kim, and Yang, 2021).

The study by Amaral, Santos, Roso, Oliveira, and Pujatti (2021) indicates that speed is thought to be the primary influence in fuel consumption and that as speed increases, so do maintenance costs. Similarly, changes in fuel usage and maintenance expenses will result in changes to operational costs.

Another determining statistic that raises fuel usage while moving from one place to another is Ferry Maintenance. Ferry maintenance and terminal maintenance are the two perspectives from which it can be seen. Fuel accounts for over 45% of the total cost of the transportation industry, making it nearly the greatest single cost component, according to Gao, Erokhin, and Arskiy (2019).Because of this, while buying a ferry, fuel selection needs to be taken into account. Because genuine spare parts are expensive and take longer to repair than original equipment, high operating costs, currency depreciation, and underutilization of waterways transit also have an impact on ferry operational performance.

Numerous studies concentrated on the operations of inland waterways, ignoring the impact of operating costs, which are crucial to the efficient operation of Lagos State's ferry services. Based on the aforementioned situation, this study will examine how maintenance expenses affect inland waterway operations and determine how ferry usages and inland canal operations in Lagos State are related.

II. LITERATURE

The operational activities, which are focused on the planning and monitoring of the physical flows, are carried out in accordance with the strategic planning. An operations plan is a set of tasks to be completed in accordance with the guidelines established by strategic planning (Kabeyi, 2019).Such tasks as traffic routing, export trailer loading, and collection for the following day are included in these plans of activities. The various parties involved in operational planning work together to efficiently handle various aspects of the plan, such as international traffic coordination, warehouse staff, and domestic haulage and distribution. Operating plans imply a collaborative effort, which highlights the significance of information flow. Lee defines a few essential components of operating strategies.

Throughout an item's life cycle, maintenance refers to any technical, administrative, and management operations done to keep it intact or return it to a state where it can function as needed. According to RojekMikolajewski and Dostatni (2020), maintenance has greatly improved in response to the world of technology's constant evolution and quick change. Nonetheless, one of the most common problems facing organizations in developing nations is poor maintenance. Because most developing nations view maintenance as a low-importance task and lack awareness of the notion, it is not given high priority (Vu Grant and Menachof, 2020).Culture in less developed nations significantly affects how maintenance is seen and carried out, which, according to the globe of maintenance embraces culture.

According to Zhang Yang & Wang (2019), proper maintenance is necessary for equipment to continue serving the intended purpose and continue to perform normally when needed. According to Mikolaj & Remek (2016), the maintenance concept is the overall framework that specifies the kinds of maintenance activities (corrective, preventative, condition-based, etc.) that must be carried out. Corrective maintenance and preventive maintenance, which encompasses condition-based and scheduled maintenance, are the two primary categories into which maintenance operations fall.

Maintenance of tangible assets can be divided into four main categories: custodial maintenance (i.e., daily routine maintenance activities), corrective maintenance, preventive maintenance, and emergency maintenance. Sarbini et al., (2021) define maintenance management as a management system or procedure designed to allow building owners or managers to oversee their buildings in an efficient, well organized, and cost effective manner. Adegoriola (2023) agreed. According to Adegoriola (2023), there are four primary categories into which maintenance of tangible

assets can be divided: custodial maintenance, which refers to normal maintenance carried out on a daily basis; corrective maintenance; preventative maintenance; and emergency maintenance. According to Mikolaj & Remek (2016), the maintenance concept is the overall framework that specifies the kinds of maintenance activities (corrective, preventative, condition-based, etc.) that must be carried out. Corrective maintenance and preventive maintenance, which encompasses condition-based and scheduled maintenance, are the two primary categories into which maintenance operations fall.

These differ from corrective maintenance, or breakdown maintenance, when the machinery is used until it breaks down and is then fixed. When preventive maintenance is done, wear or failure is anticipated, and an examination, replacement, or adjustment is provided in a timely manner in an effort to avoid breakdown. Generally speaking, preventive maintenance is thought to be more costly than corrective or breakdown maintenance. However, the extra cost invested helps to reduce plant breakdown.

Transport by water is intrinsically more energy-efficient than transportation by rail or vehicle. The most energy-efficient method of transporting bulk goods, including coal, grain, aggregates, iron, steel, petroleum, and chemical products, is via inland waterways. Barges carry one tonne of cargo 576 miles per gallon (245 km per liter) of fuel on average in the United States. Railroads can convey the same quantity of freight an average of 413 miles per gallon (176 km per liter), and a vehicle just 155 miles per gallon (66 km per liter) (Fratila et al. 2021).Because of this efficiency, delivering freight by water yields fewer air pollutants than rail or truck (Fratila, Gavril, Nita & Hrebencius 2021).

Fuel consumption rate refers to an amount in volume of fuel used up per unit distance for a ferry in motion. It can also be referred to as fuel mileage (Maduekwe *Akpan & Isihak*, 2000). Fuel economy, on the other hand refers to magnitude to distance travelled per unit volume of fuel. Thus, fuel economy can be explained as fuel usage. This section deals with fuel efficiency measures that require investment in new equipment or the modification of existing equipment. Many of the technical ideas outlined are best considered when a vessel owner is either contemplating the construction of a new vessel or overhauling an existing vessel. Wherever possible, some indication is given of the cost of technical alternatives along with the fuel savings that could be expected through their application.

III. METHODOLOGY

A cross-sectional survey was used to analyze the impact of maintenance costs on the operations of inland waterways transport in Lagos State. The data used in this research are represented by relevant variables retrieved through both primary and secondary data. The primary data was generated from 1360 passengers plying the four selected ferry terminals in Lagos State during peak period daily. 836 well structured questionnaires were administered from the sample size via Cochran's sampling formula and interviewed. The variables included in the model are maintenance indicators such as ferry capacity, ferry accessibility, spare part cost, and operational expenses. Chi-square and Multiple Regression Analysis was used to analyze the data obtained. This was done in order to analyze the impact of maintenance costs on the operation of inland waterways operations in Lagos State.

The model is specified as:

$Y = a_0 + b_1x_1 + b_2x_2 + \ldots\ldots\ldots\ldots b_nx_n + e.$

Where Y = Maintenance cost (servicing and spare parts cost)

X1, x2, x3, …..x,…xn == Explanatory Variable

$a_{0=}$ Constant.

X_1: Ferry capacity

X_2: Ferry Accessibility

X_3: Operational expense (operator remuneration)

IV. RESULT AND DISCUSSION

Result from the table below, using Pearson chi-square value was given as 906.423^a, with the degree of freedom of 9 and significance level of 0.000 explained the relationship between ferry utilization and inland waterways operations in Lagos State. Therefore, the alternate hypothesis is accepted and the null hypothesis is rejected. This implied that there is significant relationship between ferry utilization and inland waterways operations in Lagos State.

Table 1: Relationship between ferry utilization and inland waterways operations in Lagos State.

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	906.423[a]	9	.000
Likelihood Ratio	859.595	9	.000
Linear-by-Linear Association	142.193	1	.000
N of Valid Cases	818		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.21.

Source: Authors Field Survey, 2023.

The hypothesis which states "There is no significant relationship between ferry utilization level and inland waterways operations in Lagos State" is tested using Pearson's chi-square test. The dependents variable is travel choice and the independents variable is the distance covered by the passengers. The outcome of this result corroborated similar findings of Udechukwu & Mobolaji, (2020). They agreed that the operational characteristics against supply of inland waterway transportation service in the coastal areas.

Table 2: Model Summary of the impact of Repair costs on Inland waterways operation

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.889[a]	.791	.790	.15815

a. Predictors: (Constant), Ferry capacity, Ferry Accessibility and Operational expense (operator remuneration)

Source: Authors Field Survey, 2023.

Table 3: ANOVA of the impact of Repair costs on Inland waterways operation

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	76.840	3	25.613	1024.112	.000[b]
	Residual	20.358	814	.025		
	Total	97.198	817			

a. Dependent Variable: Repair Cost

b. Predictors: (Constant), Ferry capacity, Ferry Accessibility and Operational expense (operator remuneration)

Source: Authors Field Survey, 2023.

The joint contribution of variable x_1, x_2 and x_3 that is ferry capacity, ferry accessibility and operational expenses to inland waterways operations in Lagos State were analyzed in table 2 and 3 of multiple regression analysis below where the relationship between the dependent variable and independent variables were examined.

Table 4: Coefficients of the impact of Repair costs on Inland waterways operation

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	.079	.071		1.116	.265
	Capacity	.147	.070	.036	2.090	.037
	Operators remuneration	.386	.052	.367	7.355	.000
	Ferry Accessibility	.558	.052	.531	10.800	.000

a. Dependent Variable: Repair Cost
Source: Authors Field Survey, 2023.

In a bid to analyze the impact of Repair costs on Inland waterways operation in the study area, multiple regression analysis was employed in table 2, 3 and 4. It was observed that, 88.9% of the variation impact of repair cost on inland waterways operation in Lagos State could be explained by the multiple regression model. Therefore, it was statistically significant by an F-value of 1024.112, P= .000 and adjusted R square of .790 as depicted in table 4. Again, all of the examined variables are statistically significant. This demonstrates the combined impact of independent variables on the dependent variable and the fitness of data into the model.

Repair cost impact on inland waterways operations in Lagos State is depicted in Table 4, using the independent variables such as Ferry capacity, Ferry Accessibility and Operational expense (operator remuneration). Among the identified variables, Ferry Accessibility had the highest significant contribution to the dependent variable, at 0.531 (53.1%) followed by operator remuneration, which made a considerable contribution of .367 (36.7%), Ferry capacity with significant contribution of 0.036 (3.6%) but less than other variables. This showed that Ferry Accessibility and Operational expense within inland waterways transport influences repair costs during transitional service, schedule service and overhauling service which resulted in a unit increase in waterway transport operations cost in Lagos State.

Since the critical p-value was 0.000 < 0.05 then the null hypothesis that Repair costs has no significant impact on Inland waterways operation in the study area was reject while the alternative hypothesis that Repair costs has statistically significant impact on Inland waterways operation was accepted in the study area.

CONCLUSION

Ferry Maintenance costs is very critical to successful or efficient transport operations, which will determine numbers of traffic demand on waterways infrastructures. Furthermore, availability of affordable and high speed waterways transport network increases the level of ferry utilization, thereby increasing the rate of fuel/gas consumption used during transit and ferry servicing time. Passengers or commuters demand a convenient and comfortable transport system having high rate of accessibility and reliability, while Ferry operators aim to increase the level of profit generated by providing good service, thereby maximizing patronage level. In the same vein, the higher the level of utilization, the higher the costs of maintenance for inland waterways. More important is the role played by Ferry capacity, Ferry Accessibility and Operational expense (operator remuneration) that contributed to the daily costs of maintenance of ferry service. The study recommend that to have reduction in repair cost, there should be enough craft along the waterways networks with adequate infrastructures at the terminals in order to have efficient inland waterways operations leading to total reduction in maintenance cost.

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