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Barriers to Sustainable Road Freight and Physical Distribution Operations and Freight Operators Loyalty to Freight Routes in Port-Harcourt Metropolis Nigeria.

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ABSTRACT

The study evaluated the significant barriers to sustainable road Freight operations in Port-Harcourt metropolis and freight Operators' loyalty to road freight routes/corridors in the state. The aim of the study was to identify the determinant barriers to sustainable road freight logistics and physical distribution operations in Port-Harcourt metropolis. It also aimed to evaluate the freight operator's extent of loyalty to major freight routes/corridors in Port-Harcourt metropolis. It used qualitative and survey research design method in which primary data obtained from questionnaires used as survey instruments were used to elicit freight operators responses of the influences of identified barriers types on sustainable road freight operations in Port-Harcourt Nigeria. The willingness of individual operators to re-use the Eleme Junction-refinery-Onne Route (EJRO), NPA Port-Harcourt – Mile Interchange route (NM1I), Tank interchange-Rumuokoro Route (TIR), Trans-Amadi Industrial-Garrison Interchange Route (TAIG), Mile 1-Agip – mile 3 route (M1AM3), to Rumuola-Aba Road - Oyigbo (RAOY) route as a measure of route loyalty was also elicited from the respondent. The principal component factor analysis, Analysis of variance (ANOVA) and the descriptive statistics were used to analyze the data obtained. The results reveal that Excessive police harassment of freight vehicle operators, to extortion and intimidation on the road (EPHEI), Safety challenges and/or frequency of involvement of road freight vehicles in traffic accidents (SCFA), Security concerns related to armed robbery attacks on the routes (SCRAR) and Traffic congestion challenges and the associated delay (TCCD), each have respective Eigen values of 1.94, 1.37, 1.24 and 1.18 form the significant/determinant barriers and challenges to sustainable freight vehicle operators' mobility, logistics and physical distribution operations across signature road freight corridors in Port-Harcourt metropolis. The findings of the study also reveal that in Port-Harcourt metropolis, the average freight operator's loyalty to all the sampled signature road freight corridors across Port-Harcourt metropolis is an average of 51.03% with standard deviation of 6.74. It is recommended that policies be developed and implemented to address the challenges to sustainable road freight operations in Port-Harcourt, starting with the identified determinant barriers.

1.0 BACKGROUND

Mobility is considered one of the cardinal focus for a smart city concept as mobility policies and transportation services has over the years evolved in practice, size and, and targets all over the world. It has necessitated several changes in urban environment, infrastructure, policies, interventions, and services that aimed to re-align the movement of cargoes/trade, persons, and services using varied patterns and connectivity, thereby, promoting sustainable transportation options (Maxime, 2023). The study evaluates the determinant challenges cum barriers to sustainable road freight logistics and physical distribution operations in Port-Harcourt metropolis, Rivers state Nigeria. Road freight transportation is extremely important for enhancing economic development, trade distribution, job creating and ensuring sustainability mobility systems for goods, trade and services by the deployment of freight vehicles. Resource allocations and policy decision especially with regards to logistics need for roads, parking infrastructure, route separations, interventions that support safe mobility of freight systems (Berliner et al., 2015).

The Global Roadmap of Action (GRA, 2017) towards sustainable freight and physical distribution operations defines sustainable freight transportation as a road freight mobility with the capacity to provide effective and efficient freight transportation and physically distribution services that meet the freight mobility needs of a City, community or society in a manner that is satisfactory, most beneficial, least damaging, cost effective, least hazardous to the environment and does not impair or hinder the mobility needs of the future generations. Simran (2020) note that sustainable road freight operations are crucial for the development of any economy, considering its role in any meaningful transportation and distribution of goods and services across spatially distributed industrial hubs and market centres, seaports and the allied hinterland markets that serve as nodal points for freight generation and distribution.

Port-Harcourt Metropolis, Rivers State is Nigeria's economic back bone and a crucial commercial nerve center, characterized by an extensive road freight and physical distribution network that plays a crucial role in facilitating oil and gas logistics operations. The sustainability of road freight transport and physical distribution in Port-Harcourt is challenged by various barriers and impediments, which affect efficiency and effectiveness of road freight logistics and physical distribution operations in the State. Understanding these barriers is essential for developing strategic

interventionist policies for improving sustainable logistics and freight distribution within Port-Harcourt metropolis and the environs.

Olawole and Aloba (2021) observed that one critical barrier to sustainability in road freight operations in Port-Harcourt is the existence of infrastructural gap arising from poor maintenance practices culminating into traffic congestion, vehicle breakdowns, and increased fuel consumption with the associated negative socio-economic impacts. Additionally, inadequate road networks result in increased transit times, high operational costs, and reduced supply chain efficiency (Olawale et al 2021). Traffic congestion constitutes a serious challenge which has been identified as a major impediment to sustainable freight distribution. In Port-Harcourt metropolis particularly, the road freight corridor that span from the Eleme Junction on the East-West road through Refinery Junction at Elelem to the both the Federal Ocean Terminal (FOT) and Federal Lighter Terminal (FLT) in Onne oil and gas free zone, is prevalent with the worst traffic congestions experiences in Nigeria, with vehicles spending hours on the road due to poor traffic management and an overwhelming number of automobiles (Nwokedi et al, 2021). The congestion leads to excessive fuel consumption and greenhouse gas emissions, exacerbating environmental concerns (World Bank, 2019). There is also the problem of regulatory and institutional inefficiencies that further hinder sustainable freight and distribution operations. Regulatory agencies responsible for road freight management often implement inconsistent policies, leading to disruptions in logistics operations (Nwokedi et al, 2021).

Onakomaiya et al (2022) also observed that security and safety concerns are by road freight operators constitute barriers to sustainable road freight operations in Port-Harcourt. The metropolis has a high incidence of road theft, vandalism, and accidents involving freight vehicles. Onakomaiya et al. (2022), note that freight operators suffer losses due to theft and damage to goods, which affect supply chain reliability and increases risks of disruption to road freight supply chain and logistics operations. Furthermore, inadequate safety measures contribute to frequent road accidents, causing delays and increasing transportation costs. The absence of effective multi-modal transport integration limits the potential for alternative freight solutions such as rail and inland waterways, which could alleviate road congestion in Port-Harcourt and improve sustainability (Ndikom et al., 2018).

Studies by Nwokedi et al (2021) and Ndikom et al (2018) are in agreement that road freight operators in across road freight corridors in Port-Harcourt metropolis are fraught with barriers than hamper sustainability of road freight operations, ranging from Safety challenges and/or frequent accidents (SCFA), Security concerns related armed robbery attacks on the routes (SCRAR), Traffic congestion challenges and the associated delay (TCCD), Harassment by community groups and local cult groups (Agboro syndrome) (HCCG), Poor/Bad road network (PBRN), Excessive police harassment, extortion and intimidation (EPHEI) and Multiple taxation and illegal collections by appointed government officials (MTICO).

Nwokedi et al (2021) note that these challenges and barriers to sustainable road freight operations in key road freight corridors in Port-Harcourt metropolis have implications on freight operators' route preferences; route loyalty and route re-use intentions. This is because road freight operators would naturally be discouraged from re-use of road freight routes/corridors that pose the greatest safety and security barriers and challenges for example, to their operations. In Port-Harcourt for example, the Eleme Junction-refinery-Onne Route (EJRO), NPA Port-Harcourt – Mile Interchange route (NPAMI), Tank interchange-Rumuokoro Route (TIR), Trans-Amadi Industrial-Garrison Interchange Route (TRANSGA), Mile1-Agip–mile3 route (M1AM3) and the Rumuola-Aba Road -Oyigbo route (RAOY) are identified as host to majority of road freight and physical distribution operations in Port-Harcourt (Ndikom, et al, 2018; Nwokedi et al, 2021).

These routes expose road freight operators to disproportionate levels of challenges and barriers to sustainable road freight operations and an empirical knowledge of freight operators re-use intentions and loyalty level on the individual routes relative to the extent of barriers to effective road freight operations on the routes is crucial, for improving firstly, the conditions of the road freight routes by eliminating barriers to sustainable operations, and secondly, improving road freight operators re-use intention and loyalty to the routes, thereby enhancing economic development. Port-Harcourt Rivers State Nigeria.

This study is carried out with clear objectives of determining the significant barriers to sustainable road freight and physical distribution operations in Port-Harcourt metropolis, and to evaluate the extent of road freight operator's loyalty to and level of re-use intention for major road freight corridors in Port-Harcourt metropolis as aforementioned.

2.0 LITERATURE REVIEW

Sustainable road freight and physical distribution operations are critical for economic growth, environmental preservation, and social well-being. However, in rapidly urbanizing cities, several barriers hinder the adoption and implementation of sustainable practices in freight and distribution operations. As aforementioned, studies by Ndikom et al (2018); Nwokedi et al, (2021), and Ajiboye & Akinwale, (2021) are in agreement that road freight operators in across majority road freight corridors in Nigerian cities are faced with barriers to sustainability of road freight operations such as Safety challenges and/or frequent accidents (SCFA), Security concerns related armed robbery attacks on the routes (SCRAR), Traffic congestion challenges and the associated delay (TCCD), Harassment by community groups and local cult groups

(Agboro syndrome) (HCCG), Poor/Bad road network (PBRN), Excessive police harassment, extortion and intimidation (EPHEI) and Multiple taxation and illegal collections by appointed government officials (MTICO). However, the extent to which the identified challenges constitute significant barriers to sustainable road freight operations in Port-Harcourt road freight corridors seem not to have been investigated by available empirical literature.

Studies by Adeniran et al (2020) identified Infrastructure deficiencies among the most significant barriers to sustainable road freight operations in Port-Harcourt. The study is of the view that the poor state of road networks, which leads to increased vehicle wear and tear, higher fuel consumption, and elevated greenhouse gas emissions, impedes sustainable development of road freight operations in Nigeria (Adeniran et al., 2020). The lack of dedicated freight corridors and inadequate parking facilities for trucks exacerbate congestion, particularly in urban centers (Oluwaseyi et al., 2019). Furthermore, the absence of integrated transport systems limits the efficiency of physical distribution operations, forcing reliance on road transport despite its unsustainability (Adeniran 2020; Adeleke et al., 2021).

In another study, Titman (2017) grouped the identified challenges and barriers to sustainable freight logistics operations in developing urban cities to include infrastructural gaps, regulatory challenges and barriers, economic constraints, socio-cultural factors cum behavioral gaps. While the studies of Adeniran (2020) is already in agreement with Litman (2017) that infrastructural gaps constitute barriers to sustainable freight logistics and physical distribution operations in developing cities; neither of these studies were explicit to state to what extent this influences sustainable freight operations, whether significantly or otherwise.

Regulatory challenges according Litman (2017) that pose obstacles to sustainable freight operations may include for example, inconsistent enforcement of environmental regulations and weak policy frameworks, poor road freight safety and security regulations, poor road infrastructure management policy, issues related to operational policies, among others (Ogunleye et al., 2018). For instance, while there are policies aimed at reducing emissions from freight vehicles, enforcement remains lax, leading to widespread non-compliance (Adeniran et al., 2020).

Economic constraints as another critical barrier to sustainable road freight operations may include factors related to taxation of road freight operators such as multiple taxation of road freight operators, lack of loan scheme to support acquisition of road freight assets such as freight trucks, and cost induced increase in operations costs of road freight operators and the high cost of adopting sustainable technologies, such as fuel-efficient vehicles or renewable energy-powered logistics hubs, is an observed deterrent for freight operators, particularly small and medium-sized enterprises (SMEs) (Adeleke et al., 2021). Moreover, the lack of access to financing options for road freight assets further limits the ability of operators to transition to sustainable practices (Ogunleye et al., 2018).

Ogunleye et al (2018) found that Socio-cultural factors also play a role in hindering sustainable road freight operations. For example, the touting or agboro syndrome on most freight corridors and routes in most cities in Nigeria is a major social and behavioral problem that constitute barrier to sustainable road freight operations in Nigerian cities. Similarly, a lack of awareness education and training on the benefits of sustainable practices among freight operators will hinder effective and efficient operations (Oluwaseyi et al., 2019). Cultural resistance by host communities to infrastructural development in preference to retention of traditional shrines and worship places further complicates efforts to provide road freight infrastructure and promote sustainability (Adeleke et al., 2021).

Although the aforementioned studies are in agreement with the grouping of the barriers to sustainable road freight operations, these groups are further broken down into specific barrier types for ease of measurement and assessment by Ndikom et al (2018); Nwokedi et al, (2021), and Ajiboye & Akinwale, (2021). These specific barriers factors to sustainable logistics and road freight operations in Nigerian frontline cities for example include: Safety challenges and/or frequent accidents (SCFA), Security concerns related armed robbery attacks on the routes (SCRAR), Traffic congestion challenges and the associated delay (TCCD), Harassment by community groups and local cult groups (Agboro syndrome) (HCCG), Poor/Bad road network (PBRN), Excessive police harassment, extortion and intimidation (EPHEI) and Multiple taxation and illegal collections by appointed government officials (MTICO) (Ndikom et al, 2018; Nwokedi et al, 2021: and Ajiboye & Akinwale, 2021).

Studies by Tan, et al (2016); Sanchez-Diaz et al (2016), and Ramesh et al (2018) are in agreement that the extent of barriers experienced by road freight operators on individual freight routes/corridors influence their extent of loyalty to and re-use of the individual freight corridors. By implication, with disproportionate prevalence of barriers to sustainable freight operations on individual freight corridors, there is bound to be disproportionate levels of freight operator's loyalty and re-use intention on those corridors too (Akinyemi, 2009; Anthony et al, 2014; Rahane & Saharkar, U, 2014).. In Port-Harcourt however, studies have identified the existence of barriers and challenges to sustainable freight and physical distribution operations on for example, the Eleme Junction-refinery-Onne Route (EJRO), NPA Port-Harcourt – Mile Interchange route (NM1I) , Tank interchange-Rumuokoro Route (TIR), Trans-Amadi Industrial-Garrison Interchange Route (TAIG), Mile 1-Agip – mile 3 route (M1AM3), and Rumuola-Aba Road -Oyigbo (RAOY) route in Port-Harcourt Metropolis; but the extent of freight operators loyalty to and re-use intention for the road freight routes relative to the extent of barriers on the routes have not

been investigated in available empirical literature. These are the gaps that this study seeks bridge in order to provide empirical information and knowledge for the development of sustainable road freight logistics and physical distribution operations in Port-Harcourt metropolis Nigeria.

3.0 DATA AND METHODS

The study used qualitative and survey research design methods in which primary data were obtained using questionnaire as survey instrument. The study area consists of Port-Harcourt metropolis with emphasis on the identified road freight corridor/routes in Port-Harcourt metropolis. Therefore, six (6) signature road freight routes/corridors were sampled in Port-Harcourt metropolis which include Eleme Junction-refinery-Onne Route (EJRO), NPA Port-Harcourt – Mile Interchange route (NM1I), Tank interchange-Rumuokoro Route (TIR), Trans-Amadi Industrial-Garrison Interchange Route (TAIG), Mile 1-Agip – mile 3 route (M1AM3), to Rumuola-Aba Road -Oyigbo (RAOY) route. These locations in Port-Harcourt Nigeria were chosen because available extant literature justified these routes as the frontline road freight corridors/routes in Port-Harcourt responsible for handling most freights and articulated vehicles in the City as a result of the existence of the major seaports, international airport and other signature infrastructures that handle freight. These corridors are host to the signature infrastructure like seaports, industrial layouts, and refineries, etc. Primary data was sourced from road freight operators in the identified freight routes and statistical analysis were implemented in line with the objectives of the study while the results and findings were discussed.

3.1 Population and Sampling Technique

The population of the study areas (Port-Harcourt) sourced from the National Population Commission (NPC) formed the population of this study. Though the population of inhabitants of Port-Harcourt Rivers state is estimated at about 15million inhabitants is known, not all inhabitants of Port-Harcourt are directly involved in the road freight and physical distribution sector. There is no accurate data of the actual number of all registered road freight logistics and physical distribution operators operating solely in the sampled freight routes in Port-Harcourt over the years. So the study employed z-score for unknown population to determine the sample size.

The determination of sample of unknown population using Z score is given as:

$N = Z^2 (P) (1-P) / C^2$ ---------- (3.1)

Where Z = standard normal deviation set at 95% confidence interval =1.96
P = percentage picking a choice or response =50%
C = confidence interval = 0.05

Therefore N = (1.96)2(0.5) (1-0.5)/ (0.05)2
N= 0.9604/0.0025
N= 384.16
=384

About 385 copies of the survey questionnaire were distributed among the road freight vehicle operators operational in Port-Harcourt, Rivers state. Recall that a total of six (6) road freight corridors/routes were sampled in Port-Harcourt metropolis which include the Eleme Junction-refinery-Onne Route (EJRO), NPA Port-Harcourt – Mile Interchange route (NM1I) , Tank interchange-Rumuokoro Route (TIR), Trans-Amadi Industrial-Garrison Interchange Route (TAIG), Mile 1-Agip – mile 3 route (M1AM3), to Rumuola-Aba Road -Oyigbo (RAOY) route. Therefore a total of 64 survey questionnaires were issued to road freight operators in each road freight route/corridor. The average score from the 64 respondents on all the six sampled road freight routes are determined as the Port-Harcourt average for each parameter/variable considered in the study. The collected data was normalized and used to implement the analysis in line with the objectives of the study.

The sampling technique used is the purposive random sampling technique. This is because the survey instruments were purposively issued to only road freight operators on the selected road freight corridors/routes who were randomly selected to provide responses to the contents of the survey instrument.

3.2 Sources of Data and Types

Data for this study will be collected through primary sources. As aforementioned, the study used questionnaire as survey instrument to obtain primary data from road freight operators on the major challenges and barriers they face with road freight logistics and physical distribution operations in both Port-Harcourt metropolis. For example, the review of extant literature reveal that sustainable road freight operations in both Lagos metropolis faces challenges/barriers such as: Safety challenges and/or frequent accidents (SCFA), Security concerns related armed robbery attacks on the routes (SCRAR), Traffic congestion challenges and the associated delay (TCCD), Harassment by community groups and local cult groups (touting/Agboro syndrome) (HCCG), Poor/Bad road network (PBRN), Excessive police harassment, extortion and intimidation (EPHEI) and Multiple taxation and illegal collections by appointed government officials (MTICO). Primary data on the extent to which these constitute barriers to sustainability in road freight logistics and physical distribution operations in Port-Harcourt were elicited by the use of questionnaire as survey instrument. The data sourced for each road freight route/corridor was normalized as explained above and analyzed by the use of Principal Component factor Analysis (PCA)

Similarly, the primary data on freight vehicle operator's route loyalty scores and re-use intention for all the identified routes sampled in Port-Harcourt was obtained by the use of loyalty and re-use intention survey method were obtained through primary survey.

3.3 Validity and Reliability of Research Instruments

The validity test of the research question helps to determine if the measurement truly reflects the concept being studied, while the reliability test determines the consistency that the research items in a scale of measurement should be able to obtain the same answer each time the scale is replicated under the same assumptions and conditions. The validity test was achieved through the content validity test of the instrument (content-related evidence) by supervisors of this PhD thesis who are senior academic staff and experts from the field of urban transportation planning to determine the appropriateness of its contents. The result provided validation that the items in the instrument covered the breadth of the content area. The test-retest reliability method was used to test the reliability of the instrument. The result of the reliability test gave a correlation coefficient of 0.85; suggesting about 85% correlation. This indicated that the responses are reliable.

3.4 Method of Data Analysis

Various quantitative methods were used to analyze the dataset obtained for the study in line with the objectives of the study. These include the Principal Component factor Analysis (PCA) and the Re-use Intention Analysis (RIA) for measuring route loyalty.

3.4.1 Principal Component factor Analysis

The first objective of the study was to identify the determinant barriers/Challenges to sustainable road freight and physical distribution operations across all signature freight routes in Port-Harcourt Metropolis. The study used the Principal Component factor Analysis (PCA) to analyze the data obtained from field survey in order to determine the determinant barriers/challenges that significantly impede sustainable road freight and physical distribution operations across all signature freight routes in Port-Harcourt Metropolis. It is revealed in empirical literature that the identified by majority road freight operators as constituting barriers/challenges to sustainable road freight and physical distribution operations across all Signature freight routes include:

- Safety challenges and/or frequent accidents (SCFA)
- Security concerns related armed robbery attacks on the routes (SCRAR)
- Traffic congestion challenges and the associated delay (TCCD)
- Harassment by community groups and local cult groups (Agboro syndrome) (HCCG)
- Poor/Bad road network (PBRN)
- Excessive police harassment, extortion and intimidation (EPHEI) and,
- Multiple taxation and illegal collections by appointed government officials (MTICO)

The determinant barriers/challenges that significantly impede Sustainable road freight and physical distribution operations across all Signature freight routes in Port-Harcourt Metropolis was determined by subjecting the data obtained to principal Component Analysis using SPSS version21 analytical software.

3.4.2 Route Re-use Intention (RIA) Approach to Route Loyalty Analysis

The second objective of the study was to estimate freight operators' route loyalty scores cum willingness to re- use specific routes relative to the challenges posed to sustainable road freight logistics. This was realized by using the route re-use intention approach to measure the freight vehicle operator's loyalty to each freight route/ corridor. The approach used questions included in the survey instrument to elicit responses from each operator on the sampled routes/corridors regarding the percentages (%) of their willingness to re-use the route continuously in the future in view of their past and current experiences of barriers to effective operations on the routes and given the availability of alternative routes. The individual responses are collated, summed and averaged using descriptive statistics to determine the average road freight vehicle operator's route loyalty score for each freight corridor sampled in Port-Harcourt metropolis. The Analysis of variance method (ANOVA) was used to compare the loyalty scores of the freight corridors to determine if significant difference exists among them.

4.0 RESULTS AND DISCUSSION OF FINDINGS

Table 1: Determinant barriers/Challenges to Sustainable freight Distribution Operations Across all Signature Routes in Port-Harcourt Metropolis

	Mean	Std. Deviation	Analysis N
EPHEI	16.3636	4.85479	55
SCFA	15.0909	5.04525	55
SCRAR	14.9091	5.04525	55
TCCD	14.5455	5.02519	55
HCCG	12.5455	4.39620	55
PBRN	13.2727	4.73542	55
MTICO	13.2727	4.73542	55

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.939	27.706	27.706	1.939	27.706	27.706
2	1.373	19.617	47.323	1.373	19.617	47.323
3	1.235	17.649	64.972	1.235	17.649	64.972
4	1.182	16.885	81.858	1.182	16.885	81.858
5	.719	10.267	92.125			
6	.551	7.875	100.000			
7	4.726E-017	6.752E-016	100.000			

Extraction Method: Principal Component Analysis.[a] 4 components extracted. Source: Author's calculation

Table 1 shows the results of the Principal Component factor Analysis (PCA) implemented to determine the determinant barriers/challenges to Sustainable road freight and physical distribution operations across all signature routes in Port-Harcourt Metropolis. The results of the study, as shown in Table50 indicate that Excessive police harassment of freight vehicle operators to extortion and intimidation on the road (EPHEI) has a mean score of 16.3636 with standard deviation of 4.8548. Safety challenges and/or frequency of involvement of road freight vehicles in traffic accidents (SCFA) has a mean value of 15.0909 with standard deviation of 5.045 while Security concerns related armed robbery attacks on the routes (SCRAR) has average score of 14.9091 with standard deviation of 5.041. Traffic congestion challenges and the associated delay (TCCD) has mean score of14.5455 with standard deviation of 5.03 while Harassment by community based groups and local cult groups (Agboro syndrome) (HCCGA) achieved a mean score of12.5455 with standard deviation of 4.39. Poor/Bad road network (PBRN) and Multiple taxation and illegal collections by appointed government officials (MTICO) have respective mean scores of 13.2727 and 13.2727 with standard deviations of 4.74 and 4.35 respectively.

The results of the PCA further reveal that the barriers and challenges to sustainable freight vehicle operators mobility, logistics and physical distribution operations across signature road freight corridors in Port-Harcourt metropolis Nigeria include Excessive police harassment of freight vehicle operators to extortion and intimidation on the road (EPHEI) with a mean score of 16.3636, Safety challenges and/or frequency of involvement of road freight vehicles in traffic accidents (SCFA) with mean value of 15.0909, Security concerns related armed robbery attacks on the routes (SCRAR) with average score of 14.9091 and Traffic congestion challenges and the associated delay (TCCD) with average score of 14.455 with each have respective Eigen values of 1.94, 1.37, 1.24 and 1.18. Since each of the four identified barriers/challenges to sustainable freight logistics and distribution operations in Port-Harcourt have Eigenvalues greater than one (Eigenvalue>1), the study infers that EPHEI, SCFA , SCRAR and TCCD constitute the detainment barriers/challenges to sustainable mobility of road freight operators and physical distribution operations in Port-Harcourt metropolis.

The implication is than to ensure sustainability in the road freight sector and physical distribution operations in Port-Harcourt metropolis, the Rivers state transportation authorities should prioritize promoting policies that are aimed at reducing road accident involving freight vehicles across the routes, eliminate issues of police extortion and intimidation of road freight vehicle operators on the freight routes, eliminate problems of insecurity related armed robbery attacks against freight vehicle operators and promote policies that address the challenges of traffic congestion involving road freight vehicles and the associated delay on Port-Harcourt roads.

The findings of the study also indicates that issues related to multiple taxation of road freight operators (MTICO), poor and bad road networks (PBRN) and Harassment by community based groups and local

cult groups (Agboro syndrome) (HCCGA) each with respective Eigen values of 0.719, 0.551 and 4.726E-017 which is each less than 1 (0.719<1, 0.551<1; 4.726E-017 <1) does not constitute significant barriers/challenges to the development of sustainable freight logistics and physical distribution operations in Port-Harcourt metropolis. Figure1 below present in chart form the decreasing order of influence of the identified five determinant barriers/challenges to sustainability in road freight logistics and physical distribution operations in Port-Harcourt Rivers state Nigeria.

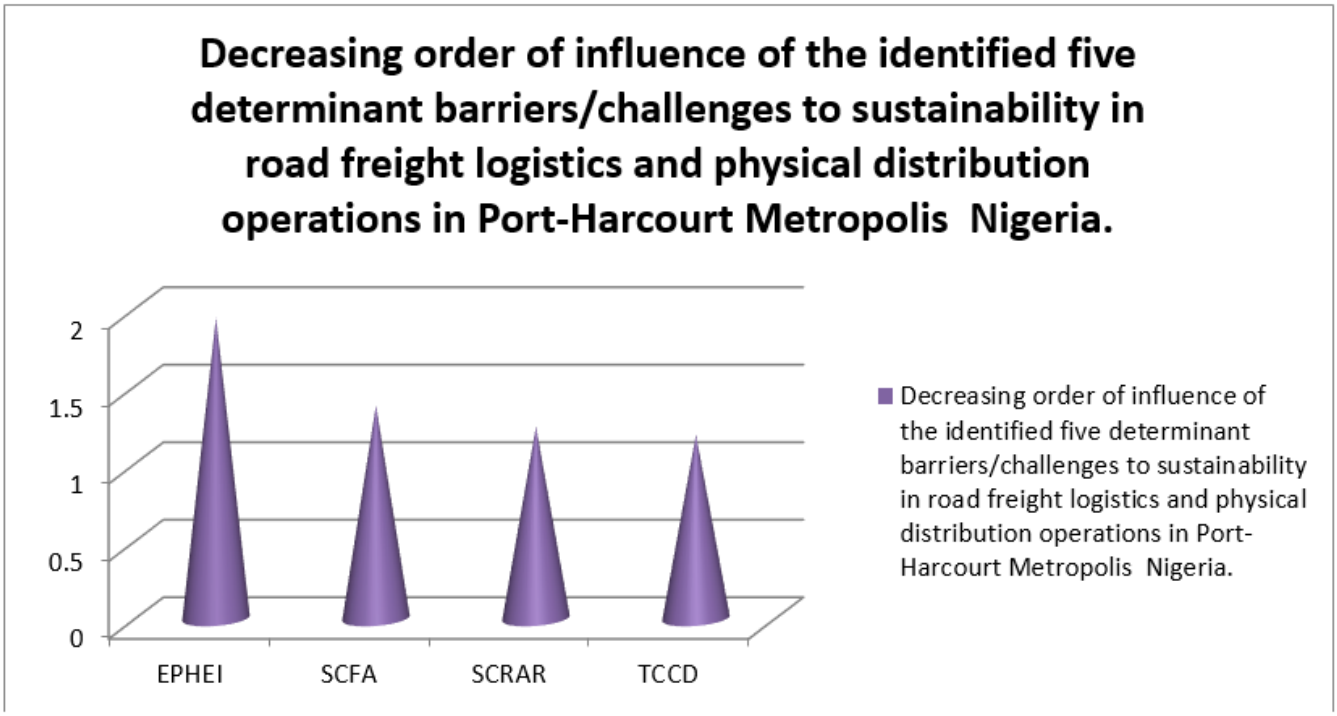

Figure-1: Decreasing order of influence of the identified five determinant barriers/challenges to sustainability in road freight logistics and physical distribution operations in Port-Harcourt Metropolis Nigeria. Source: Prepared by the author

Table 2: Freight Operators Route Loyalty Score (%) Indicating their Willingness to Continuously Re-use the Routes given the Challenges and Availability of Alternative Routes in Port-Harcourt

	N	Range	Minimum	Maximum	Sum	Mean
EJRO	55	40.00	20.00	60.00	2170.00	39.4545
NM1I	55	60.00	20.00	80.00	3080.00	56.0000
TIR	55	40.00	40.00	80.00	3360.00	61.0909
TAGI	55	40.00	40.00	80.00	3360.00	61.0909
M1AM3	55	50.00	20.00	70.00	2490.00	45.2727
RAOY	55	40.00	20.00	60.00	2380.00	43.2727
PHALLROUTELOYAL	55	31.67	33.33	65.00	2806.67	51.0303
Valid N (listwise)	55					

Descriptive Statistics

	Std. Deviation
EJRO	15.44622
NM1I	14.22049
TIR	12.27354
TAGI	12.27354
M1AM3	15.25761
RAOY	14.78920
PHALLROUTELOYAL	6.73950
Valid N (listwise)	

Source: Author's calculation

In view of the challenges faced by road freight vehicle operators on individual signature freight routes in Port-Harcourt metropolis, the result of the study presented in Table-2 shows the freight vehicle operators loyalty to individual freight corridors/routes in Port-Harcourt metropolis which confirms their willingness to continuously use the routes in the future, given the extent of challenges each corridor/route pose to sustainable road freight logistics and physical distribution operation in Port-Harcourt.

The result indicates that the mean score of freight operator's loyalty to the Eleme Junction-refinery-Onne Route (EJROR) indicating the willingness of the freight vehicle operators to continue to use the route in the future in view of the challenges they faced on the route over time is 39.46%with a standard deviation of 15.45. The range which shows the difference between the least and highest loyalty scores in line with the perceptions of the respondents on the route is 40%. The minimum and maximum recorded royalty score on the Eleme Junction-refinery-Onne Route (EJROR) is 20% and 60% respectively. This implies on the EJIROR corridor, the freight vehicle operator's loyalty to the route falls within the range: 20%≥40%≥60%.

On the NPA Port-Harcourt – Mile Interchange route (NPAM-1) the average route loyalty score of freight vehicle operators to the route is 56.00% with standard deviation of 14.22. The maximum and minimum route loyalty scores of respondents of the NPAM-1 route and the range indicating the difference between the minimum and maximum scores indicates that on the NPAM-1 route, freight vehicle operator's loyalty score falls within the range depicted as: 80%≥60%≥20%. The average route loyalty score on the Tank interchange-Rumuokoro Route (TIRR) is 61.09% with a standard deviation of 12.27. On the TIRR corridor, freight vehicle operator's loyalty score falls within the range depicted as: 80%≥40%≥40%.

Similarly, on the Trans-Amadi Industrial-Garrison Interchange Route (TRANSGAR), the mean freight operators' loyalty to the route which indicates their willingness to continuously use the route in the future given the challenges they faced on the route and the availability of alternative routes is 61.091% with a standard deviation of 11.37. On the Trans-Amadi Industrial-Garrison Interchange Route (TRANSGAR), freight vehicle operator's loyalty score falls within the range depicted as: 80%≥50%≥30%. While the average freight operators route loyalty score to the Mile 1-Agip – mile 3 route (M1AGIPR) is 45.27% with a standard deviation of 15.25761, it is an average of 43.27 on the Rumuola-Aba Road -Oyigbo route(RAOR) with a standard deviation of 14.79. The range of freight vehicle operators loyalty scores to each of Mile 1-Agip – mile 3 route (M1AGIPR) and Rumuola-Aba Road -Oyigbo route(RAOR) are 70%≥50%≥20% and 60%≥40%≥20% respectively.

In Port-Harcourt metropolis, the average freight operator's loyalty to all the sampled signature road freight corridors across Port-Harcourt metropolis is an average of 51.03% with standard deviation of 6.74. This is higher than the average route loyalty for freight corridors in Lagos metropolis. Figure-2 below shows a chart presentation that compares the percentage of freight vehicle traffic flow rate per period and the freight vehicle operator's route loyalty score on individual signature freight corridors in Port-Harcourt metropolis.

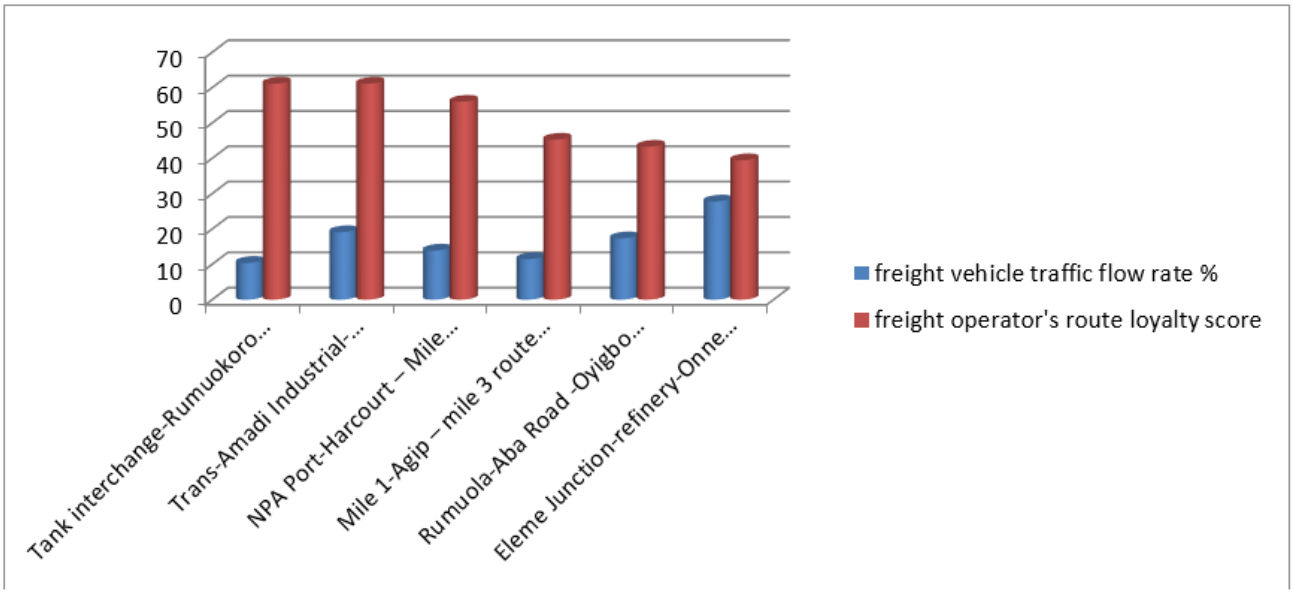

Figure-2: comparing the percentage of freight vehicle traffic flow rate per period and the freight vehicle operator's route loyalty score on individual signature freight corridors in Port-Harcourt metropolis. Source: prepared by the author

The distribution of the freight vehicle traffic flow rate across the freight corridors in Port-Harcourt and the route loyalty scores tend to show that freight corridors such as Eleme Junction-refinery-Onne route Rumuola-Aba road-Oyigbo routes which have higher freight vehicle traffic flow rates have less route loyalty scores while corridors such as tank-interchange-rumuokoro and Mile1-Agip-Mile3 routes with lower freight vehicle traffic flow rates have higher route loyalty scores.

Table 3: Comparing Significances of the variations in Freight Operators loyalty to the Signature Freight Routes in Port-Harcourt Metropolis

Groups	*Count*	*Sum*	*Average*	*Variance*
EJROR	55	2170	39.45455	238.5859
NPAM1	55	3080	56	202.2222
TIRR	55	3360	61.09091	150.6397
TRANSGAR	55	3360	61.09091	150.6397
M1AM3	55	2490	45.27273	232.7946
RAOR	55	2380	43.27273	218.7205

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	24995.15	5	4999.03	25.12912	2.08E-21	2.241852
Within Groups	64454.55	324	198.9338			
Total	89449.7	329				

Source: Author's calculation

The result of the study on Table 3 shows the output of the comparison carried to determine the significance of the variations in loyalty of freight vehicle operators to the individual signature freight corridors sampled in Port-Harcourt metropolis. The result of the analysis of variance (ANOVA) shows f-score of 25.129, p-value of 2.08E-21 and f-critical score of 2.2419. Since the f-score is greater than the f-critical (i.e.; 25.129≥2.2419), the study infer that there is significant variation in the loyalty of the freight operators to the individual routes with the TIRR and TRANSGAR routes having the most freight operator's loyalty. The implication is that freight corridors such as the EJROR with the least loyalty score should improve the conditions on the route and address the barriers and challenges that freight operators face in the use of such routes for physical distribution and road freight operations.

5.0 DISCUSSION OF RESULTS AND POLICY IMPLICATIONS

The findings of the study offer valuable insights into freight vehicle operators' loyalty to individual signature freight routes in Port-Harcourt, Rivers State. The analysis of operators' willingness to continue using specific routes in the future, despite the challenges they face, reveals interesting patterns that can inform infrastructure development, policy-making, and sustainability strategies for the road freight sector in Port-Harcourt.

The findings suggest varying levels of loyalty to the sampled freight routes, with certain routes receiving higher loyalty scores than others. For example, the Eleme Junction-refinery-Onne Route (EJROR) received an average loyalty score of 39.46%, with a standard deviation of 15.45. This indicates that while some freight operators show significant loyalty to the route, a substantial proportion of operators express reluctance or dissatisfaction, potentially due to challenges such as congestion, road conditions, or other operational difficulties. The loyalty range (20% to 60%) further highlights the variance in operator perceptions of the route.

In contrast, the NPA Port-Harcourt – Mile Interchange route (NPAM-1) saw a higher average loyalty score of 56.00%, with a range from 20% to 80%. Similarly, routes like the Tank interchange-Rumuokoro Route (TIRR) and the Trans-Amadi Industrial-Garrison Interchange Route (TRANSGAR) recorded loyalty scores of 61.09%, reflecting a relatively stronger commitment from operators, despite challenges on these routes. The Mile 1-Agip – Mile 3 Route (M1AGIPR) and the Rumuola-Aba Road -Oyigbo Route (RAOR) recorded average loyalty scores of 45.27% and 43.27%, respectively, indicating moderate levels of loyalty.

This suggests the need for targeted infrastructure improvements. The lower loyalty scores on routes such as the EJROR (39.46%) suggest that significant improvements are needed to address operator concerns. These might include reducing congestion, enhancing road conditions, improving safety, and offering better maintenance schedules. For routes with higher loyalty scores (such as TIRR and TRANSGAR, policymakers could focus on maintaining road quality and further enhancing operator satisfaction.

Also Incentivizing Loyalty can form another policy option to encourage road freight operators. For routes with lower loyalty scores, targeted policy interventions could include incentives for operators to continue using these corridors, such as offering tax relief, subsidies, or access to additional services that improve operational efficiency. Enhancing the attractiveness of these routes could be achieved through better infrastructure and the reduction of operational costs. Given that the loyalty scores vary across routes, policies must be tailored to the specific needs and challenges of each corridor. High-traffic routes with lower loyalty might require substantial improvements to attract continued use, whereas routes with lower traffic but higher loyalty might benefit from policies that reinforce their reliability and convenience.

The distribution of freight vehicle traffic flow across different routes and the corresponding route loyalty scores offer a clear indication of the challenges faced by freight operators. Notably, routes such as Eleme Junction-refinery-Onne and Rumuola-Aba Road-Oyigbo carry a higher percentage of freight vehicle traffic (27.78% and 17.36%, respectively), but exhibit lower loyalty scores. This suggests that these heavily trafficked routes may face challenges such as congestion, safety concerns, or infrastructural shortcomings that lead operators to question their long-term viability, despite the high traffic volume. On the other hand, routes like the Tank Interchange-Rumuokoro and Mile 1-Agip-Mile3 corridors, which experience lower traffic volumes, display higher operator loyalty. This could indicate that operators on these routes encounter fewer logistical challenges, such as less congestion or better-maintained roads, making them more likely to continue using these routes despite their lower traffic flow.

By implications, Balancing Traffic Volume and Route Quality (BTVRQ) could form a good policy option for improving route performance and loyalty. There is a need to balance traffic flow with the quality of infrastructure on freight corridors. High-traffic routes should be prioritized for upgrades to reduce congestion and improve overall operational efficiency. Investment in traffic management systems, additional lanes, and road expansion could help alleviate congestion on high-traffic routes, leading to higher loyalty scores. Another policy direction is focusing on low-traffic routes with high Loyalty. Routes like TIRR and M1AGIPR, with higher loyalty and lower traffic volumes, should be developed further to ensure that they remain attractive to operators. Investments could focus on optimizing capacity without overloading the infrastructure, ensuring that operators experience smooth operations even as the freight flow increases.

With the average loyalty score of 51.03% for all sampled routes in Port-Harcourt, it suggests a moderate level of commitment among freight operators to the routes in the city. This score is higher than those recorded for freight corridors in other major Nigerian cities, such as Lagos. While this suggests a relatively favorable operating environment in Port-Harcourt, it also highlights areas for improvement to achieve even higher loyalty and ensure long-term sustainability in the road freight sector.

Given that Port-Harcourt's average loyalty score is higher than that of other metropolises, policymakers should seek to build on existing strengths, such as the relatively well-developed infrastructure on certain routes, by expanding capacity and ensuring that operators' concerns are addressed. Operator engagement policies will also be useful. This entails engaging freight vehicle operators in dialogue and incorporating their feedback into future policy and infrastructure development could lead to more sustainable improvements. Continuous monitoring of loyalty levels across different routes is essential to ensure that policies are responsive to changing needs and conditions. Finally, to ensure the sustainability of freight vehicle operations, long-term strategic planning must consider both the expansion of infrastructure and the resolution of challenges such as congestion, road maintenance, and safety. Addressing these issues proactively will help increase operator loyalty, optimize traffic flow, and ensure efficient logistics operations across Port-Harcourt's freight corridors.

6.0 CONCLUSION

The study concludes in line with the findings of the study that the determinant barriers and challenges to sustainable freight vehicle operators mobility, logistics and physical distribution operations across signature road freight corridors in Port-Harcourt metropolis Nigeria include Excessive police harassment of freight vehicle operators to extortion and intimidation on the road (EPHEI) with a mean score of 16.3636, Safety challenges and/or frequency of involvement of road freight vehicles in traffic accidents (SCFA) with mean value of 15.0909, Security concerns related armed robbery attacks on the routes (SCRAR) with average score of 14.9091 and Traffic congestion challenges and the associated delay (TCCD) with average score of 14.455 with each have respective Eigen values of 1.94, 1.37, 1.24 and 1.18. Since each of the four identified barriers/challenges to sustainable freight logistics and distribution operations in Port-Harcourt have Eigenvalues greater than one (Eigenvalue>1), the study infers that EPHEI, SCFA , SCRAR and TCCD constitute the detainment barriers/challenges to sustainable mobility of road freight operators and physical distribution operations in Port-Harcourt metropolis.

In Port-Harcourt metropolis, the average freight operator's loyalty to all the sampled signature road freight corridors across Port-Harcourt metropolis is an average of 51.03% with standard deviation of 6.74. The distribution of the freight vehicle traffic flow rate across the freight corridors in Port-Harcourt and the route loyalty scores tend to show that freight corridors such as Eleme Junction-refinery-Onne route Rumuola-Aba road-Oyigbo routes which have higher freight vehicle traffic flow rates have less route loyalty scores while corridors such as tank-interchange-rumuokoro and Mile1-Agip-Mile3

routes with lower freight vehicle traffic flow rates have higher route loyalty scores. This calls for the implementation of road freight policies aimed at reducing the prevalence of barriers and challenges to road freight operations in Port-Harcourt in order to achieve sustainability in road freight and physical distribution operations in Port-Harcourt metropolis.

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