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Impacts of Train Travel Distance on Passenger Volumes (Passenger-Train-Kilometer) in Nigeria

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ABSTRACT

This paper evaluates the impacts of Trip Distance (TD) on the Average Volume of Passengers (AVP) carried by trains in Nigeria. Passenger-Train-Kilometer is one of the Key Performance Indicators (KPIs) propounded by Campos & Cantos (1998) for the analysis of railway transport operational outputs with a view to improving productivity. Primary data: Structured questionnaires. Secondary data: Nigeria Railway Corporation (NRC) reports, journal articles, etc. Data were analysed with the application of percentage tables to determine relative frequencies of observed phenomena. Spearman's Rank Order Correlation Technique was used to test the hypothesis on relationship between train Trip Distance (TD) and Average Volume of Passengers carried (AVP). Test showed strong positive relationship between TD and AVP with significant ($P<0.05$) relationship and correlation coefficient (rho) of 0.964. The study found that with increase in distance, passenger volume increases correspondingly. Based on the finding, the study went on to develop a Deterministic Model of the relationship between TD and AVP. The study concludes that government's neglect of the sub-sector results to poor network indices and infrastructural decay. These in turn, results in poor accessibility and low trip distance. Study recommended further amendment of the Nigerian Railway Act of 1955 to allow for public participation in rail transportation investment, consistent government intervention in revamping the railways, deliberate policy to encourage of long distance trips and linking of high economic centres with branch-lines, etc.

Keywords: Trip Distance, Volume, Branchline, Capacity, Downtime, Freight.

1. INTRODUCTION

A viable railway system is a sine-qua-non for economic and social development of nations as it bears the inherent capacity to open up hinterlands and rural areas through the enhancement of agricultural productivity and the emergence and growth of cottage industries (Suleiman, 2015). The rail transport

mode is unarguably the cheapest means of transportation because it has the greatest capacity to move large number of passengers and tonnage of freight within the least cost framework (Etim, 2018).

It has been shown by various studies that the Nigeria's railway system of today is mired in a lot of debilitating operational challenges so much so that it can no longer sustain itself and has consequently lost its capacity serve as a system of mass transit (Adesanya, 2010; Agunloye, 2008; Agunloye and Oduwaye, 2011; Odeleye, 2015; Ayoola, 2008; Faajir and Zidan, 2016; Abioye, 2016).

Rail transport report aptly captures the progressive deterioration of the railway service base, manifesting in dwindling volume of passengers carried over the years. The report confirms that the highest number of passengers transported from 1980 to 1984 was 15.6 million, whereas as at 2006, the lowest was 0.7million. Below is a table showing the high productivity years of the Nigerian Railways.

Table 1.1: Volume of passengers and freight carried by NRC (1970-2009)

Year	**Passenger carried**
1970	8,942,000
1971	6,151,000
1972	5,819,000
1973	5,131,000
1974	4,342,000
1975	6,755,000
1976	7,491,000
1977	6,747,000
1978	6,750,000
1979	6,771,000
1980	4,917,000
1981	9,638,000
1982	11,612,000
1983	13,142,000
1984	15,553,000
1985	11,324,000
1986	9,878,000

1987	7,383,000
1988	4,196,000
1989	6,520,000
1990	6,345,000
1991	3,443,000
1992	1,747,000
1993	1,502,000
1994	7,784,491
1995	2,889,977
1996	2,326,028
1997	2,946,940
1998	1,070,424
1999	1,788,171
2000	2,610,435
2001	1,284,002
2002	942,594
2003	1,608,447
2004	1,751,159
2005	752,842
2006	708,802
2007	1,478,700
2008	1,996,324
2009	1,285,080

Source: NRC Annual Report (2011)

It can be observed from the table above that the passenger statistics from the NRC from 1970-2009 has been on progressive decline with occasional insignificant increases followed by rapid decline. For example, between 1970 and 1975, the passenger volume decreased from 8,942,000 to 6,755,000. It rose to 7,491,000 in 1976, dropped to 6,747,000 in the following year, rose insignificantly to 6,750,000 and 6,771,000 in 1978 and 1979, again rose to 15,553,000 in 1984 and maintained insignificant increase and rapid decrease up to 1,285,080 in 2009. That means that Nigeria was losing at least 14,267,970 passengers per annum as at 2009 (i.e. Highest; 1984: 15,553,000 – 1,285,000) (NRC, 2010).

2. MATERIALS & METHODS

Research design: Research design is correlation as it explores relationship between variables. The research methodology is quantitative.

The population for this study: The population for this study was the entire active train stations/terminuses across the two rail districts in Nigeria. Only ten (10) stations were found to be active in the two districts of the NRC, with 5 in each district. All 10 active stations formed the population for the study.

Sampling Technique: The stratified sampling technique was used to classify the two railway districts in Nigeria (Eastern and Western rail lines) into various strata, based on the current level of functionality of stations/terminals. The entire active stations were selected for sampling.

Purposive sampling technique: The purposive or judgmental sampling technique was employed to choose the functional stations/terminuses for data collection. Only five stations were functional in each of the districts at the time of survey. That gave the total of ten (10) functional stations and all were chosen for sampling.

Sample size: There were 27 identified train stations across the two districts. Only five (5) in each district, making a total of ten (10) were active at the time of this study. 12 members of staff drawn from 7 designations were sampled. That gave a sample size of 120 members of staff (i.e. 12 x 10 = 120).

Nature of Data: Ordinal data. The data obtained were ordinal in nature as the options available were ordered/ranked (<5, 6-10, 11-15, 16-20, >20). Likert scaling was introduced were necessary (Strongly agreed (1), Agreed (2), Neutral (3), Strongly Disagreed (4), Disagree (5).

Sources of Data: Primary Source: Structured questionnaires. Secondary sources: Annual reports of the NRC, journals, books, internet/online sources, reports from the National Bureau of Statistics; etc.

Method of Data Analysis: Percentage tables and Spearman's Rank Order Correlation technique for hypothesis testing.

3. RESULTS & DISCUSSIONS

Table 3.1: Summary Statistics of Questionnaire Distribution

	Frequency	Percentage
Questionnaires Distributed	120	100.00
Questionnaires Retrieved/Returned	113	94.17
Invalid Questionnaires	0	0.00
Clean and Valid Question	113	94.17

A total of 120 questionnaires were distributed to various respondents across various railway stations. Of the 120 distributed questionnaires, only 113 being 94.17% of total distributed questionnaires were duly filled and returned.

Table 3.2: Questionnaire Distribution by Train Station

Name of train station		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ebute Metta Station	12	10.6	10.6	10.6
	Airport (Abuja) Station	12	10.6	10.6	21.2
	Metro (Abuja) Station	11	9.7	9.7	31.0
	Idu (Abuja) Station	12	10.6	10.6	41.6
	Kaduna (Rigasa) Station	10	8.8	8.8	50.4
	Port Harcourt Station	12	10.6	10.6	61.1
	Aba Station	11	9.7	9.7	70.8
	Enugu Station	12	10.6	10.6	81.4
	Jos Station	12	10.6	10.6	92.0
	Maiduguri Station	9	8.0	8.0	100.0

Total	**113**	**100.0**	**100.0**	

Twelve (12) questionnaires were distributed to each sampled station. The full distributed copies (12) were retrieved from Ebute Metta, Airport (Abuja), Idu (Abuja), Port Harcourt, Enugu and Jos stations. Questionnaires from Metro (Abuja) and Aba stations were less by one as only 11 were retrieved from the two stations. 10 questionnaires were retrieved from Kaduna (Rigasa) station, while only 9 questionnaires were retrieved from Maiduguri station.

Table 3.3: Long distance impacts increase overall volume of passengers carried

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	9	8.0	8.0	8.0
	Disagree	7	6.2	6.2	14.2
	Neutral	14	12.4	12.4	26.5
	Agree	36	31.9	31.9	58.4
	Strongly Agree	47	41.6	41.6	100.0
	Total	113	100.0	100.0	

It could be observed from the responses that 9 respondents, representing 8% of respondents strongly disagreed to the statement that long distance trips increase overall volume of passengers carried. 7 respondents which connote 6.2% of aggregate sample size disagreed to this statement. 14 respondents showing 12.4% of total sample size were neutral about this, while 36 respondents being 31.9% of total sample agreed to this statement and 47 respondents representing 41.6% of sample size strongly agreed to this statement. This response pattern points to the fact that respondents perceive that long distance trips tend to increase the overall volume of passengers carried by trains.

Table 3.4: Trip distance's impact on overall passenger carried

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	41	36.3	36.3	36.3
	Disagree	46	40.7	40.7	77.0
	Neutral	5	4.4	4.4	81.4
	Agree	13	11.5	11.5	92.9
	Strongly Agree	8	7.1	7.1	100.0
	Total	113	100.0	100.0	

It can be observed from the table above that 41 respondents, representing 36.3% of total sample respondents strongly disagreed to the statement that trip distance has no significant impact on overall passenger carried. 46 respondents which connote 40.7% of aggregate sample size disagreed to this statement. 5 respondents showing 4.4% of total sample size were neutral about this, while 13 respondents being 11.5% of total sample agreed to this statement and 8 respondents representing 7.1% of sample size strongly agreed to this statement. This showed that significant number of respondents disagree to the statement that trip distances have no significant impact on overall passenger yield and therefore agree that trip distance has a significant implication on the overall passenger yields.

Table 3.5: Estimate of the average daily volume of passengers carried by a train in the fleet.

	Frequency	Percent	Valid Percent	Cumulative Percent
200 passengers or less	28	24.8	24.8	24.8
201 - 400 passengers	49	43.4	43.4	68.1
401 - 600 passengers	23	20.4	20.4	88.5
601 - 800 passengers	8	7.1	7.1	95.6

Above 800 passengers	5	4.4	4.4	100.0
Total	113	100.0	100.0	

From the table, 28 respondents, representing 24.8% of total sample size observed that the estimated daily volume of passengers carried by a train in the fleet is about 200 passengers or less. Following this, 49 respondents, accounting for 43.4% of respondents observed that it is between 201 to 400 passengers. 401 to 600 passengers were observed by 23 respondents who represented 20.4% of total sample size. 8 respondents, constituting 7.1% of total sample size estimated between 601 to 800 trains, while 5 respondents estimated it to be above 800 passengers. Overall, the study shows that the daily volume of passengers carried by a train in the fleet is between 201 passengers to 400 passengers.

Table 3.6: Relationship between train trip distance (TD) and the average volume of passengers (AVP) carried in Nigeria.

			AVP					Total
			< 200	201-400	401-600	601-800	>800	
TD	< 50 Km	Count	28	5	0	0	0	33
		% of Total	25.2%	4.5%	0.0%	0.0%	0.0%	29.7%
	51-100	Count	0	44	0	0	0	44
	Km	% of Total	0.0%	39.6%	0.0%	0.0%	0.0%	39.6%
	101-	Count	0	0	20	0	0	20
	150Km	% of Total	0.0%	0.0%	18.0%	0.0%	0.0%	18.0%
	151-	Count	0	0	3	8	0	11
	200Km	% of Total	0.0%	0.0%	2.7%	7.2%	0.0%	9.9%
	> 200	Count	0	0	0	0	3	3
	Km	% of Total	0.0%	0.0%	0.0%	0.0%	2.7%	2.7%
Total		Count	28	49	23	8	3	111
		% of Total	25.2%	44.1%	20.7%	7.2%	2.7%	100.0%

Source: Researcher's Field data 2020.Analysis from SPSS v. 25 software.

The table above is a cross-tabulation of data on trip distance (TD) and average volume of passengers (AVP) carried in Nigeria.

Table 3.7: Correlation analysis of the relationship between trip distance (TD) and the average volume of passengers (AVP) carried in Nigeria.

			TD	AVP
Spearman's rho	TD	Correlation Coefficient	1.000	.964**
		Sig. (2-tailed)	.	.000
		N	112	112
	AVP	Correlation Coefficient	.964**	1.000
		Sig. (2-tailed)	.000	.
		N	112	113

**. Correlation is significant at the 0.01 level (2-tailed).

Above table shows the strength of the relationship between TD and AVP. The Spearman's Rank Order Correlation analysis of the responses of respondents on the relationship between TD an AVP carried in Nigeria revealed a significant (P<0.05) relationship with a correlation coefficient (rho) of 0.964. This directly portends a very strong and positive relationship between the TD and AVP.

Research Hypothesis:

Ho: There is no statistically significant relationship between trip distance (TD) and the average volume of passengers (AVP) carried (passenger-train-kilometer) in Nigeria Railway.

Considering the above result, the null hypothesis was thus rejected and the alternate hypothesis accepted; thus meaning that there exists a very strong significant relationship between TD and AVP.

Models of the Study

Table 3.8: The regression analysis model summary of the relationship between train trip distance (TD) and the average volume of passengers (AVP) carried in Nigeria.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.967[a]	.935	.935	.268

a. Predictors: (Constant), Estimate the daily volume of passengers carried by the fleet

Source: *Researcher's Field data 2020.Analysis from SPSS v. 25 software.*

With adjusted R Square of 0.935 the model implies that the AVP is a good predictor of the TD.

Table 3.9: The regression analysis coefficients on the relationship between train trip distance (TD) and the average volume of passengers (AVP) carried in Nigeria.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.087	.062		-1.396	.165
	AVP	1.032	.026	.967	39.631	.000

a. Dependent Variable: TD

Source: Researcher's Field data 2020.Analysis from SPSS v. 25 software.

Deterministic Model of the Study:

From the preceding results in table, a deterministic model may be propounded as follows:

$$TD = -0.087 + 1.032\,AVP$$

The model implies that for every 1 additional average volume of passengers, the train trip distance increases by 1.032 kilometers.

Mathematical Model:

Mathematically, the model is denoted as follows:

$$TD \propto AVP \text{ or } \pm TD = \pm AVP$$

Where: TD = Trip Distance (Travel Distance)

AVP = Average Volume of Passenger Carried (Passenger Carriage Volume)

$\propto$ = Mathematical symbol of proportionality

$\pm$ = Additional or subtracted values for TD and AVP

4. Discussion of Findings

a. Positive significant relationship between trip distance and average volume of passenger carried in Nigeria:

There is an indication of positive passenger-train-kilometer values. The study showed that the longer the distance of the trip, the more the likelihood of patronage by passengers. It has been noted that unlike in road transport where spatial distances yields less passengers, the railway is a direct opposite.

b. Government exclusive right over rail transport hampering railway development in Nigeria: The Nigerian Railway Corporation establishment Act of the parliament of 1955 (amended in 1990) grants sole right over rail transport to the government. This confers unfair monopoly on the NRC at the expense of the development of the industry

c. Critical Challenges of the Nigerian Railway Services: Low passenger travel distance is the most notable challenge Following this is the low freight haulage distance which comes second on the list of factors that affects operational output.

5. Recommendations

a. Amendment of Railway Acts for Public Participation

The sole right of government over rail transport operations has not allowed for private sectors driven investment in the industry and private participation that will engender competition and put the railways back on track. For the rail transport which is essential service, government may maintain minimal regulatory power but allow private sectors to drive the industry.

b. Linking of High Economic Activity Centres through Branch Lines

There is need to connect major activity centres such as the city markets like Mile 3, Timber and Oil Mill market in Port Harcourt, the Ochanja market in Onitsha, the Ariaria market in Aba as well as the industrial layouts in Okpebi (Lagos), Trans-Amadi (Port Harcourt), Emene (Enugu), etc through branch

lines. The linking of the centres will significantly increase yield of freight and passengers thereby improving the revenue of the corporation.

c. Total Rehabilitation of Existing Rail Infrastructure

To get the railways function effectively, unremitting attention must be given to the rehabilitation or total overhaul of the existing tracks, stations, rolling stock, signal and communication equipments, etc. These infrastructural facilities are currently in various state of terrible disrepair.

d. Encourage more Long Distance Trips

This study found that the longer the distance a train is willing to travel, the higher the average passenger and freight volume. This study therefore strongly recommends that more trains should be scheduled for long distance trips and just few (those with high depreciation values) may be allowed to offer intra-cities services.

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