

An Assessment of Perception and Experiences on the Performance of Traffic Management Systems in Kaduna, Nigeria

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Abstract- Perception and experience are major factors that influence system acceptability. Acceptability on the other hand has great influence on the successful implementation and operation of a system. However, the performance of the various traffic management systems that are operational in Nigeria have not been assessed from the publics' perception and experience point of views. Therefore, this paper employed the use of structured online questionnaire to assess the perception and the experience of the residents of Kaduna metropolis in Kaduna State, Nigeria. The collected data were analyzed using Descriptive Statistics and Chi-Square Test of Significance in Statistical Packages for Social Sciences (SPSS). The results of the analysis showed that the respondents have a fair perception and experience of the perceived performance of the different traffic management systems operated within the State. The results also showed that respondents are more biased towards the applications of modern computational tools in the management of traffic congestions. Thus, there is likely to be higher acceptability of the modern tools in the management of traffic congestions. Therefore, it is recommended that research focusing on the motorist be carried out to assess whether the acquired results will be similar to those that will be obtained in the case of motorists' perceived performance of traffic management systems within the metropolis.

Keywords: *Perception, Experience, Performance, Traffic Management, Kaduna State*

1.0 Introduction

In the today's world, vehicular ownership is continually increasing due to the luxury or the necessity they meet the respective needs of the owners. This is the experience in almost every part of the world and Nigeria is no exception. The National Bureau of Statistics (NBS) reports show continuous increase of the number of vehicles in Nigeria. It was reported that at the end of fourth quarter of 2018, there were 11,826,033 vehicles compared to the 11,583,331 vehicles at the end of fourth quarter of 2017. Therefore, the Auto Sector is considered one of the principal Industrial Revolution Plan, which is expected to continually and significantly contribute to the Gross Domestic Product (GDP) of the nation. In Kaduna State, driver license production was said to be over twenty-five thousand and over eleven thousand number plates registrations (Alade, 2018; NBS, 2018, NBS, 2020; Onoja, 2015). This implies greater increase in the number of vehicles on the roads and requires effective traffic flow management in order to minimize traffic congestions and the associated problems.

Traffic management may be manually performed or involves the use of automated traffic control systems. In manual traffic management, referred to as Manual Traffic Management (MTM), a Traffic Police officer performs scheduling using his intuition, and based on the situation of the road at any point in time. In automated traffic management, a traffic light control system performs the scheduling in static (Static Phase Scheduling of Traffic Light System - SPSTLS) or dynamic (Dynamic Phase Scheduling of Traffic Light System - DPSTLS) fashion. These traffic management approaches have their advantages and

disadvantages (Ayuba, Zachariah, & Damuut, 2018; Salehi, Sepahvand, & Yarahmadi, 2014; Simon, Abdullahi, & Junaidu, 2014; Zachariah, Ayuba, & Damuut, 2017).

The effectiveness of traffic of traffic flow management is measured in terms waiting times, travel times, level of service and number of accidents. However, employing these parameters is exclusively scientific and do not consider an essential component, which is the users' perception on the effectiveness of traffic flow management system (Harri, Fiore, Filali, & Bonnet, 2009; Lee, Kim, & Pietrucha, 2007).

Effectiveness of traffic flow management is an essential road users' requirement since they are involved in different commercial, educational and social activities in order to better their future. These they want to accomplish at the minimum possible cost, effort and time at the maximum possible level of safety, and easy access to transportation systems (Fitzgerald, 2012; Harriet & Emmanuel, 2013; Ismail, Hafezi, & Nor, 2013; Kamaruddin, Osman, & Pei, 2012). These together form a part of the road users' experiences and their perception of the effectiveness of traffic flow management systems.

Road users' perception and experience of the effectiveness of traffic management system is very important since it is what determines the acceptability level of the given approach to traffic flow management. However, efforts that have been made towards assessment of perception of the effectiveness of road traffic management system have focused on authorities' point of view. Therefore, this research assesses the perception and experience of the traffic management system from users' perspective.

2.0 Literature Review

Safety problems associated with traffic flows as well as the efforts and perceived relevance of Federal Road Safety Commission (FRSC) have been investigated by other researchers. This section presents a review of some of the most relevant research.

Identifying road crashes as a major cause of deaths recorded in Qatar irrespective of several efforts that have been put in place to minimize these occurrences, drivers' perception on the various police enforcement strategies are investigated. This was achieved using face-to-face survey approach and the results were analyzed using basic statistics. The results showed that giving safe drivers rewards as well as adoption of automated methods of enforcement had the most positive perceptions. Thus, it was recommended that future enhancements of traffic rules enforcements strategies might consider improving on the most acceptable strategies (Shaaban, 2017).

In a study, self-knowledge and perceived effectiveness as well as qualification of observation, sanction and fairness by the police force as well as traffic laws were assessed from the perspectives of sampled motorist in Spain. The analysis of the results showed that most motorist have clear knowledge of traffic laws and perceive them as effective at traffic management. It also showed that police observation is mostly targetted at apprehending offenders than helping to avoid the commission of the offence. Therefore, recommended promoting positive interaction between motorist and traffic laws to achieve road safety (Alonso, Esteban, Montoro, & Useche, 2017).

Realizing that different players exist in the effort to improve road safety programs, an approach based on system thinking was developed to evaluate intra and inter-organizational management structures of the key players in Iran. This was to identify major deficiencies in their effort to perform their roles effectively; and assess the influence of road safety commission in the road safety efforts. Results showed that the commission had far less influence. Therefore, policy reforms were proposed to minimize the identified deficiencies (Khademi & Choupani, 2018).

Another research investigated the roles of FRSC in management of road traffic crashes in Katsina, Nigeria. The study identified inadequate training of drivers, usage of poor tyres and roads conditions, poverty and illiteracy, as well as drug influence as major causes of road crashes. It recommended patrol, public orientation, rescue efforts as well as involvement of other agencies in the effort to minimize road crashes and its associated effects (Gwamki, Liman, & Rumah, 2018).

Passive observational research was adopted to examine the efficiency of traffic management approaches in Port Harcourt, Nigeria. Seven days were dedicated to observation and recording of traffic volumes as well as responses from road users, which were used as a base for analysis of the efficacy of the traffic management strategies. Analysis of the data showed that most respondents considered traffic management strategies in the state effective. However, it was still recommended that revitalization of traffic management agencies in the state as well as implementation of modern traffic management devices is necessary for the attainment of desired results (Obinna, Waje, & Isetima, 2018).

3.0 Methodology

For the purpose of this study, the descriptive survey research method was adopted since it employs descriptive research design that minimizes bias and maximizes reliability of results and drawn inferences. The considered population for this study was Kaduna State where the population of people is estimated to be 8.9 million (KDBS, 2020). Therefore, using Slovin's formula at 95% accuracy, a minimum sample requirement was found to be 400.

Structured questionnaire was used as a tool, and was divided into two sections. The first section consisted of the demographic questions, which sought to identify the category and eligibility of the respondents. The second section consisted of the questions whose responses are to be analyzed for conclusion. The questions were such that they took the form of Likert Scale using a four (4)-point scale. The administration of the questionnaire was online, using Google Forms. The link was shared by the researchers and encouraged respondents to also share with others on various social media groups. Therefore, sampling may be considered a random sampling technique. Responses from those that are not within Kaduna State were discarded in order to ensure the respondents were those that have had direct experience with the traffic situation within the State.

The data collected for the study were analyzed using simple frequencies and percentages for the first section of the administered instrument. The data acquired from the responses of the sampled population was analyzed using descriptive data analysis, cross tabulation (crosstabs), and chi-square.

4.0 Analysis and Discussions

Four hundred and ninety-six (496) responses were received from the administered online questionnaire. From Table 1, the classification of the respondents in their respective gender shows that ninety-eight (98) of the respondents representing 19.8% were female and three hundred and ninety-eight (398) respondents representing 80.2% were male.

Table 1: What is your gender?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Female	98	19.8	19.8	19.8
Male	398	80.2	80.2	100.0
Total	496	100.0	100.0	

Table 2: What is your age bracket?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 20 - 39 Years	395	79.6	79.6	79.6
40 - 59 Years	57	11.5	11.5	91.1
60 Years and Above	30	6.0	6.0	97.2
Less than 20 Years	14	2.8	2.8	100.0
Total	496	100.0	100.0	

The classification of the respondents into age brackets as presented in Table 2 showed that three hundred and ninety-five (395) of the respondents representing 79.6% were those between the ages twenty (20) to thirty-nine (39). This significant number shows that those within this age bracket are most actively involved in the commercial, education or social activities taking place in the city since they are in their active years. Those within the forty (40) to fifty-nine (59) age bracket followed the active persons since they are numbering to fifty-seven (57) respondents and represent 11.5%. Whereas those respondents that are less than twenty years of age are fourteen (14) representing 2.8% and only thirty (30) respondents were above fifty-nine (59) years of age, representing 6%.

On the classification of respondents based on occupation as shown in Table 3, it shows that on hundred and forty-two (142) respondents representing 28.6% are private business owners. Ninety (90) respondents representing 18.1% are public and civil servants. One hundred and ten (110) respondents representing 22.2% are students. In addition, one hundred and fifty-four (154) respondents representing 31.0% are teachers at the secondary school or tertiary institutes.

Table 3: What is your occupation?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Business/Private Practice	142	28.6	28.6	28.6
Civil/Public Servant	90	18.1	18.1	46.8
Student	110	22.2	22.2	69.0
Teacher/Lecturer	154	31.0	31.0	100.0
Total	496	100.0	100.0	

From Table 4 where respondents were classified based on their residential area, it was found that seventy-two (72) respondents representing 14.5% live around the Central Market Area of the metropolis. Those living in other areas other than the Central Market Area of the metropolis were two hundred and eighty-two (282) representing 56.9% and those at the outskirts of the metropolis were one hundred and forty-two (142) representing 28.6%. From this it is clear that most people who have one business or the other such that they often visit the Central Market Area.

In assessing the respondents knowledge of the various traffic management systems used in Kaduna metropolis, the results of the analysis of responses presented in Table 5 showed that all traffic management strategies such as manual, automated and non-usage of automated solutions are available in the metropolis and the respondents know about all of them. However, automated traffic management systems referred to as traffic light system are mostly seen by the respondents.

Table 4: Which best describes your residential area?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Central Market/Inside Town	72	14.5	14.5	14.5
Other Area/Cities Within the Town (Metropolis)	282	56.9	56.9	71.4
Outskirt/Suburb Town (Metropolis)	142	28.6	28.6	100.0
Total	496	100.0	100.0	

Assessing the frequencies with which the respondents often travel to or past the Central Area, the result presented in Table 6 showed that majority of the respondents represented by over 70% often travel to or past the Central Market Area while the remaining visit less often. This supports the fact that most commercial, educational and social events often take place around the Central Area of the metropolis.

Table 5: What are the different traffic management systems/strategies you know and see within Kaduna Metropolis?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Manual (Traffic Police)	100	20.2	20.2	20.2
Manual (Traffic Police); Traffic Light System	153	30.8	30.8	51.0
No traffic Control Systems	14	2.8	2.8	53.8
No traffic Control Systems; Manual (Traffic Police)	6	1.2	1.2	55.0
No traffic Control Systems; Manual (Traffic Police); Traffic Light System	76	15.3	15.3	70.4
No traffic Control Systems; Traffic Light System	2	.4	.4	70.8
Traffic Light System	145	29.2	29.2	100.0
Total	496	100.0	100.0	

Table 6: How often do you travel past the central market area?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Less Often	130	26.2	26.2	26.2
Often	186	37.5	37.5	63.7
Very Often	180	36.3	36.3	100.0
Total	496	100.0	100.0	

Table 7: How often do you experience traffic congestion?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Less Often	155	31.3	31.3	31.3
Never At All	2	.4	.4	31.7
Often	231	46.6	46.6	78.2
Very Often	108	21.8	21.8	100.0
Total	496	100.0	100.0	

Assessing the respondents' experience of traffic congestions, Table 7 shows that almost 70% of the respondents often experience traffic congestions. This is in agreement with the number of people who often travel to the Central Area of the metropolis.

Although most respondents agree to frequent experience of traffic congestions, they have a fair perception that traffic congestion may not necessarily result to accidents. This is shown in Table 8 where most respondents numbering to over two hundred (248) representing 45.9% agreed to less frequent occurrence of accidents due to traffic congestions. Also, most respondents agree that road traffic crashes may not necessarily be attributed to the Traffic Wardens, or Traffic Lights Control Systems or the absence of traffic management systems as shown in Table 9 and Table 10. This implies that road users have positive perception on the usage of traffic management systems within the metropolis.

Table 8: How often do you see accidents that may be attributed either directly or indirectly to traffic congestion?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Less Often	222	40.7	40.7	40.7
Never At All	26	5.2	5.2	45.9
Often	196	39.5	39.5	89.5
Very Often	52	10.5	10.5	100.0
Total	496	100.0	100.0	

Table 9: How often do you see accidents that may be attributed either directly or indirectly to traffic light systems?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Less Often	220	44.4	44.4	44.4
Never At All	70	14.1	14.1	58.5
Often	182	36.7	36.7	95.2
Very Often	24	4.8	4.8	100.0
Total	496	100.0	100.0	

Table 10: How often do you see accidents that may be attributed either directly or indirectly to traffic police on duty?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Less Often	218	40.0	40.0	40.0
Never At All	66	13.3	13.3	53.3
Often	184	37.1	37.1	94.4
Very Often	28	5.6	5.6	100.0
Total	496	100.0	100.0	

In assessing the respondents' perception and rating of the efficacy of traffic management approaches used in the metropolis, responses showed that they have a fair perception and rating of the traffic management strategies. This is shown Table 11 where 46.7% rate the traffic management strategies as adequate while the remaining 53.3% rate them as inadequate. This implies that more is expected from the strategies employed in traffic management. This is supported in their responses shown in Table 12 where more than 90% recommended that there is need for improvement in the traffic management systems used in the State.

Table 11: How do you consider the traffic management schemes/approaches within Kaduna metropolis?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Adequate.	215	43.3	43.3	43.3
Highly Inadequate	67	13.5	13.5	56.8
Inadequate	197	39.7	39.7	96.6
Very Adequate.	17	3.4	3.4	100.0
Total	496	100.0	100.0	

Table 12: To what extend would you recommend the need for improvement over existing traffic management systems within Kaduna metropolis.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Highly Recommended.	233	47.0	47.0	47.0
Indifferent	2	.4	.4	47.4
Not Recommended	34	6.9	6.9	54.3
Recommended.	227	45.8	45.8	100.0
Total	496	100.0	100.0	

In order to understand the category of traffic management systems the respondents recommend for improvement, the researcher sought to understand their perception about the usage of automated traffic management systems, which involves the application of modern computing tools. The result of their responses shown in Table 13 showed that they prefer the use of modern computing tools in traffic management; since almost 100% recommended the adoption of the modern computing tools.

Table 13: To what extend would you recommend the adoption modern computing (Information and Communication Technology) tools for traffic management systems within Kaduna metropolis.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Highly Recommended.	401	80.8	80.8	80.8
Indifferent	2	.4	.4	81.2
Not Recommended	2	.4	.4	81.6
Recommended.	91	18.4	18.4	100.0
Total	496	100.0	100.0	

This section assesses the degree of association between variables used in this research. The use of Chi-Square Test of Significance with an alpha level less than 0.05 is used.

An assessment of whether or not the frequency with which respondents often travel to or past the Central Area of Kaduna metropolis has significant relationship with the frequency of road traffic crashes seen by the respondents was performed. The Chi-Square test showed that there is a significant relationship between the two variables since it showed Chi-Square of 59.537 at 6 degrees of freedom with an alpha value of 0.008, which is less than 0.05 as shown in Table 14. This implies that the more the frequency of traveling the likely the number of road traffic crashes seen or experienced.

Table 14: Chi-Square Tests Between Traveling and Seen Crashes Frequencies

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	59.537 ^a	6	.008
Likelihood Ratio	60.578	6	.012
Linear-by-Linear Association	1.204	1	0.272
N of Valid Cases	496		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.81.

An assessment of the relationship between traffic congestion experienced and the available traffic management systems used in the metropolis was also performed. The Chi-Square Test result showed a value of 45.005 at 18 degrees of freedom and an alpha value of 0.000, which is less than 0.05 as shown in Table 15. This implies that there is significant relationship between these variables.

Table 15: Chi-Square Tests Between Traffic Management Systems and Traffic Congestions

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	45.005 ^a	9	.000
Likelihood Ratio	40.568	9	.000
Linear-by-Linear Association	18.674	1	.000
N of Valid Cases	496		

a. 5 cells (31.3%) have expected count less than 5. The minimum expected count is .07.

5.0 Summary and Conclusion

This research performs an assessment of road users' perception and experience of the effectiveness of traffic management systems used in Kaduna metropolis. The results of the analysis showed that road users have knowledge of the various traffic management systems used in Kaduna metropolis. On the traffic congestions experience, the results showed that the respondents often experience traffic congestions. On their experiences with traffic management systems, the respondents showed positive experience. However, they showed only a fair perception of the effectiveness of the systems and so, showed interest in the adoption of modern computing tools for modification and improvement of traffic management systems within the state.

From the findings of this research, it is concluded that the traffic management systems employed in Kaduna metropolis for traffic control have gain acceptability by the residents of the states. However, the respondents have some level of biasness towards the usage of modern computing tools in the management of traffic flows.

This research was done in the general sense of all traffic management systems. To this end, it is important to state that the biasness of the respondents to modern computing tools was only implied based on the obtained statistics. Therefore, other studies may be carried out to assess the particular traffic management system that road users prefer based on the perceive

effectiveness of the traffic management system. In addition, it is recommended that drivers/motorist should be assessed in this direction and other directions such as the effect of the use of hard drugs on their driving abilities and safety consciousness.

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