MEASUREMENT MODEL OF HUMAN FACTORS ANALYSIS IN TRAFFIC ACCIDENTS IN NIGERIA.

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ABSTRACT

This study has provided valuable insight regarding human factors and its contribution to traffic accident in Nigeria. The study will be approached under three major identified human factors (driving hazard, driving distraction and driving risk). The knowledge of these three identified human factors is important so as to reduce the rate of accident among road users. The respondent was in the age range of 25 to 55 years old, Majority (52.7%) were in the age category of 36 to 44 years old. The variables were tested statistically reliable and measurement model developed revealed adequate fitness for the sample n=150 with significant a Chi–square statistics at $\chi 2 = 201.453$, 84 degree of freedom, with the following indices: GFI = .903, CFI = .918 and RMSEA = .091, CMIN/DF = 2.233. The findings are useful both as a safety measure and traffic accident monitoring by the stake holders.
Keywords - Human Factors, Accident, Distraction, Hazard and Risk

1.0. Introduction

News and report in the media reveal the high rate of commercial bus accidents which has become a serious menace that threatens life and properties at an alarming rate particularly in developing nations like Nigeria, Assum and Sorensen (2010). The number of fatalities in bus traffic accidents is relatively high. As car ownership increases, the statistics show that the number of accidents per 10,000 vehicles increased from 657 in 1987 to 880 in 1994, while the number of injuries and fatalities remained stable in Jodan, Hamed *et al.,* (1998). Accident also increases from 162,491 in 1995 to 414,421 in 2010 in Nigeria, (WHO, 2012), while the number of injuries and fatalities were also at an increase, accident in commercial bus were not left out as casualties rose from 106 in 2003 to 182 in 2012 in Nigeria, WHO, 2012. Commercial bus represents only about 1.2% Hamzah *et al.,* (2012) of the total number of registered vehicles in Nigeria, the number of causalities caused by commercial bus is always high due to the high number of passengers involved Koshy *et al.,* (2012).

In Nigeria, 254,492 motor traffic accidents were recorded between 1980 and 1988 resulting in 78,738 deaths with many persons sustaining injury (Idris, 1997). The annual loss in property resulting from road traffic accidents is put at more than 100 billion Naira (The Punch, 2002). In the USA, Polanis (1995) estimated that the loss in property due to road traffic accidents was about 65 billion dollars in 1990 rising to 72 billion dollars by 1991. The World Health Organization Peden *et al.,* (2006) stated that road traffic accident has become

the second leading cause of death after HIV/AIDS among 15-29 years old in low and middle income countries. It also projected that by year 2030, it will rank 7th among the major diseases and injuries in the world. The relationship between the factors of fatigue (working schedule, working condition) and bus accident was considered, which later revealed that the dominant factor that showed strongest unique contribution based on multiple regression analysis was working condition and recommended that serious attention should be given to improve the bus and working condition to reduce accidents on roads Alhaji (2007). It was projected that by 2030 the number of fatalities is expected to triple to 3.6 million according to WHO, 2012. World report on traffic injury shows recent statistics that the number of crashes and fatalities occurring on our nation's roadways involving large trucks ($\geq$ 10,000 pounds) were now decreasing which was due to reduction in new safety technologies, (Chen, 2009). This paper therefore analyzed three major human factors contributors (Hazard, Risk and Distraction) to bus traffic accident (TA) with the objective of knowing the level of their individual contributions and thereafter come up with suggestion of bringing a reasonable solution that the stakeholders can work upon in providing solution to the problems of commercial bus traffic accident.

Findings from other related work include a confirmatory factor analysis of the behaviour of young novice drivers by Scott-Parker et al., (2012) and their model was a good fit for the model proposed. Karim *et al.,* (2012) used CFA and SEM to model and analysed traffic safety perceptions of drivers in application to speed limit reduction. Safety propensity index for signalized intersections with seventeen factors was developed with structural equation model (SEM) Zhang and Kaber (2013). Logistic regression model was on social-demographics, driving experience and yearly driving distance in relation to a tour bus driver's at –fault accident risk and concluded that driver's yearly driving distance and use of an Automatic Vehicle Location (AVL) system were significantly associated with proposed model, Tseng (2011).

2.0 Methodology

This study exclusively relied on two sources of data: (A). Accident database from 1993 – 2012 and (B). Accident perception data through survey questionnaire administered to 150 drivers of a reputable transport company in Lagos Nigeria. The collected questionnaire was input into Statistical Package for Social Science (SPSS 16) and Analysis of Moment Structures (AMOS 16) for necessary statistical analysis.

A. Data collection from accident database (1993 - 2012)

The data for this study was collected from a secondary source with the purpose of having the knowledge and trend of commercial bus accident in Nigeria from 1993 to 2012. The results of the analysis from the accident database can be presented by considering the number of buses and cars involved in road accident, death and casualties similar to that of Schepers et al,.(2014) which was conducted on cyclic using(environment, driver attitude and the role of management).

B. Data collection through survey questionnaire (sample size, n= 150 respondents)

A set of self-designed questionnaire through literature containing four major parts (3 endogenous variables: driving hazard, driving risk, driving distraction) and one exogenous variables (traffic accident). Total number of items in endogenous variable is 15 items and exogenous variables are 6 items. The details of the items in the questionnaire are shown in Table 1.

TABLE 1 Items in the Questionnaire

Human Factors	Items
Driving Hazard	1. Long hour of driving causes fatigue & tiredness. 2.Traffic jam and hold up 3.Long hour of driving 4.Driving at high speed 5.Pressure from passengers while driving 6.Improvement in road technology
Driving Risk	1.Overconfidence in driving is a powerful source of bias in the perception of risk 2. Subjective perception of risk. 3.Over speeding is an involvement in risk behaviour 4. Fixate move on stationary object is risk behaviour.
Driving Distraction	1. Eating/ Talking 2. Reading road bill board 3. Dialing/answering call 4. Taking off jacket 5. Wiping/looking at dash
Traffic Accident	1.I have driving license before I started driving 2.I have only one accident since I started driving with my driving license 3.I have more than one accident since I have been

3.0 Results and Discussion

A. Analysis of bus accident investigation report from (1993 to 2012)

Commercial bus is considered a major mode of transportation in most developing countries. The investigated year 1993 to 2012 from the database shows that commercial bus accident increases on yearly bases and this is due to a number of factors ranging from road users to road infrastructures as shown in Fig. 1.

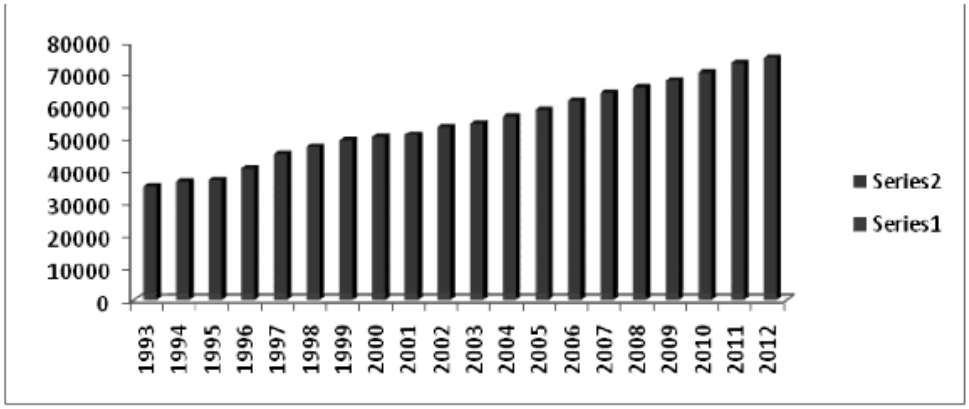

Fig. 2 shows Express bus and stage bus having high total number of all category of accident since they are the types of bus mostly on the road for commercial activities. The higher accident rate among commercial bus stems from their operating characteristics of drivers performing the usual driving task and stress that are associated with commercial drivers compared to other type of driving. Express bus and stage bus is the most common type of bus that has the highest rate of accident among various categories of buses as shown in Fig. 2.

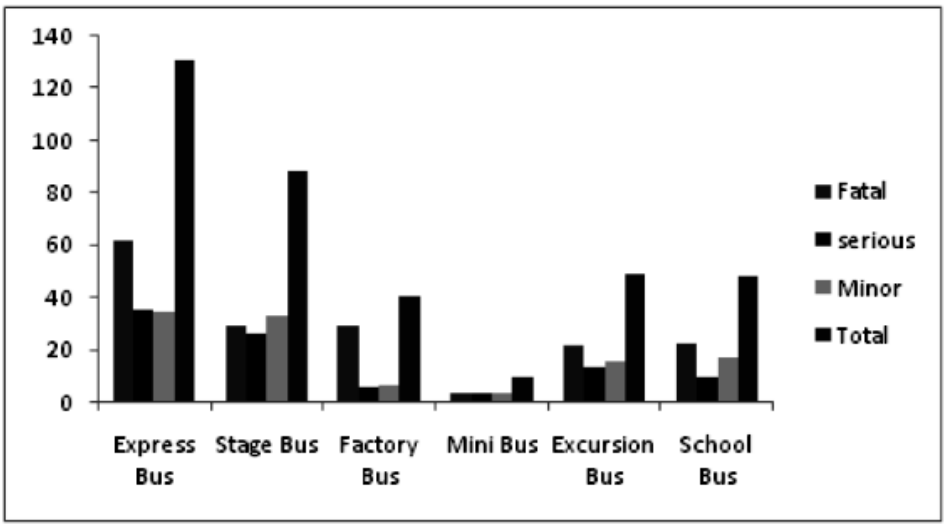

Fig. 2. Categories of Buses Involved in Road Accident

It was clearly shown that broken windscreen shows the highest cases of bus accident due to mechanical failure, as shown in Fig. 3.

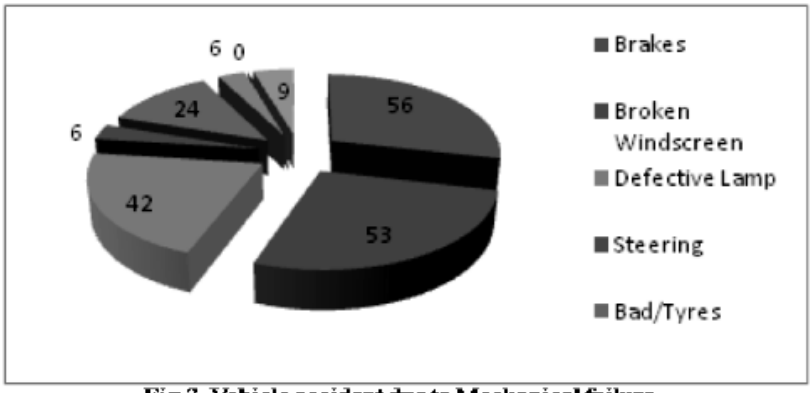

Fig.3. Vehicle accident due to Mechanical failure

B. Human Factor Analysis

In this study, there are 150 respondents consisting of 148 males and only 2 females, the respondent were in the age range from 25 to more than 55 years old. Majority (52.7%) were in the age category of 36 to 44 years old, 8% were in age category of 25 to 35 years old, 27.3% were of age category 45 to 54 years old while 12% were more than 55 years old as shown in Table 2. Questionnaires are standardized. It is not possible to explain any points in the questions that participants might misinterpret like in the case of accident history and nature of accident that have different bias response of 73 and 69 under 'never' response.

As shown in Table 3, there is significant relationship between driving risk and driving hazard ($r=0.631, p<0.01$), relationship exist between driving risk and driving distraction ($r=0.619, p<0.01$). In a similar manner driving hazard has a significant relationship with driving task ($r=0.631, p<0.01$), also driving hazard with driving distraction ($r=0.579, p<0.01$).

Relationship equally exists between driving distractions and driving task ($r=0.619, p<0.01$), similarly there is relationship between driving distractions and driving hazard ($r=0.579, p<0.01$). Therefore, the hypothesis (H1,H2 & H3) was accepted, the three variables affect traffic accident. Factor analysis of KMO and Bartlett's test of sphericity conducted on the three measuring variables shows, task with KMO= 0.786. Hazard KMO-0.827 and distraction KMO-0.721, while Reliability Cronbach's Alpha for the three variables is 0.824 higher than the minimum recommended value of 0.7. This finding is in good agreement to that of Abang and Von (2011) [3] that established relationship between working relationship, schedule and accident with ($r=0.486, p<0.01$ and $r=0.601, p<0.01$).

In this study there are 150 respondents consisting of 148 males and only 2 females as shown in Table 2. The respondent were in the age range from 25 years old to more than 55 years old majority (52.7%) were in the age category of 36 to 44 years old, 8% were in age category of 25 to 35 years old, 27.3% were of age category 45 to 54 years old while 12% were more than

55 years old. There were 134 (89.3%) married bus drivers, 9 (6%) divorced and 7.0 (4.7%) single with 145(96.7%) having driving education with training and 5(3.3%) without education with their training. 30(20%) of the respondent has more than 20years driving experience with 125(83.3%) drives 4 to 6 days per week while 97(64.7%) of the respondent prefers day journey. 73 (48.7%) never has accident while 77 (51.3%) have had accident once, twice, thrice and even more than four times.

TABLE 2 Demographic Factors Of Driver's Response

Variables	Frequency	Percent	Variables	Frequency	Percent
1.Gender			**2. Age**		
Male	148	98.7%	. . .	12	8%
Female	2	1.3%	. . .	79	52.7%
			. . .	41	27.3%
			—	18	12%
3. Marital			**4. Education**		
Married	134	89.3%	Driving Education	145	96.7%
Divorced/Widowed	9	6.0%	No driving Education	5	3.3%
Single	7	4.7%			
5. Accident History			**6. Nature of Accident**		
Never	73	48.7%	Never	69	46%
Once	43	28.7%	No Injury	43	28.7%
Twice	17	11.3%	Injury	34	22.7%
Thrice	8	5.3%	Severe	2	1.3%
4 times	9	6.0%	Fatal	2	1.3%
7.Driving Experience			**8. Driving per week**		
Less than 1year	1	7%	Every day	20	13.3%
1 – 3 years	8	5.3%	4 – 6 days	125	83.3%
4 – 6 years	36	24%	2- 3 days	4	2.7%
7 – 10 years	32	21.3%	Once per week	1	0.7%
11 – 15 years	43	28.7%			
more than 20 years	30	20%			
9. Vehicle Age			**10. Type of Journey**		
1- 3 years	22	14.7%	Day Journey	97	64.7%
4 – 6 years	108	72%	Night Journey	53	35.3%
7 – 10 years	16	10.7%			
11 – 15 years	04	2.7%			

Table 3 shows correlation coefficient result that driving hazard, driving distraction and driving risk were the dominant factors that contribute to bus accident. Therefore 63.1% driving hazard and 61.9 % of driving distraction can explain the contribution of driving risk toward accident and is significant at 0.000.

TABLE 3 Pearson Product Moment Correlation Coefficient's Results

	Driving Risk	Driving Hazard	Driving Distraction
Driving risk			
Pearson Correlation	1	**0.631**	**0.619**
Sig (2 - tailed)		0.000	0.000
N	150		150
Driving hazard		1	**0.579**
Pearson Correlation	**0.631**		
Sig (2 - tailed)	0.000		0.000
N		150	150
Driving Distraction	**0.619**	**0.579**	1
Pearson Correlation			
Sig (2 - tailed)	0.000	0.000	
N	150	150	150

C. Measurement Model Assessment

Fig. 4 shows the measurement model to establish the fitness of the three constructs to ensure their measurement fit with the sample n= 150. The results of the measurement model conducted using structural equation model (SEM) proved that three constructs task, hazard and distraction measures commercial bus traffic accident, we therefore accept hypothesis (H4) that driving task, driving hazard and driving distractions measures traffic accident. The model revealed significant Chi – square statistics where χ^2 = 201.453 with 84 degree of freedom, the model fit indices for the total sample in the initial CFA run produce the following indices: GFI = .903, CFI = .918 and RMSEA = .091, CMIN/DF = 2.233. These agree with the recommended value of model fit by Byrne, 2001. This excellently made the model fix for measuring human factors assessment of commercial bus safety.

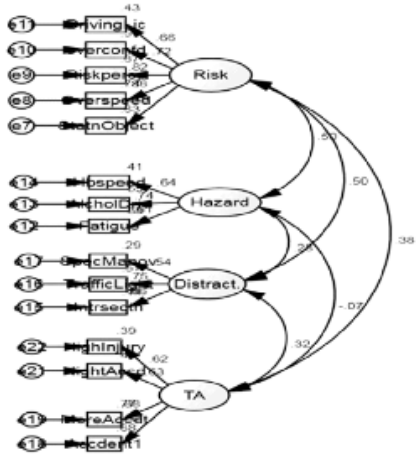

Fig. 4. Measurement model of the relationship between human factors

4.0. Conclusion

Stakeholders plays an important role in the prevention of commercial bus traffic accidents especially commercial transport company with the results of this study that revealed driving task, driving hazard and driving distractions contribute greatly to bus traffic accident.

This study has provided valuable insights regarding traffic accident under three major identified human factors (driving hazard, driving distraction and driving risk) that influence commercial bus traffic accident. The model revealed significant Chi - square statistics where ? 2 = 201.453 with 84 degree of freedom, the model fit indices for the total sample in the initial CFA run produce the following indices: GFI = .903, CFI = .918 and RMSEA = .091, CMIN/DF = 2.233. This knowledge is important so as to reduce the rate of accident among commercial bus drivers with empirical evidences with the following recommendations Hazard Perception Test (HPT) should be conducted for bus drivers every year, hazard Perception Training Video and Control, be given to the bus drivers in form of seminar, driving secondary task must be reduced or eliminated for better driving performance, to avoid distraction portable music devices while driving must be discouraged, fleet safety managers should educate their drivers and discuss the importance of being attentive and not engage in distracting tasks or behaviour.

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