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ANALYSIS OF ACCIDENT FATALITY FACTORS AND DISASTER MANAGEMENT IN NIGERIAN AIRPORTS

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ABSTRACT

This research tends to evaluate the safety and security measures in Nigerian airports with emphasis on the major international airports - Abuja, Lagos, Port Harcourt and kano. Primary data were collected and frequency distribution analyzed with the use of STATA12.0 software. From the results, 77% of travelers opined that the safety and security screening at the airports came below expectations and thus dissatisfied. Approximately 21 percent considered the safety and security measures as moderate while about 2 percent of travelers considered the measures as satisfactory. Secondary data sourced from accident data base of the Bureau of Accident Investigation was subjected to probit analysis. The probit analysis revealed that the Z values for all variables (Human factor, Act of God, Mechanical and Collision) falls within the acceptance range - 1.96 and 1.96 and as such are not significant at 0.05 levels. This is evidenced by the Z values of 0.190, -0.386, -0.202, and -0.257 respectively. However, at 95% confidence interval, the lower and upper bound values were -0.978 and 1.187 for human factor error, -3.215 and 1.690 for Act of God; -2.545 and 1.690 when the probability of accident and security issues is uncertain; then -3.328 and 1.965 when the probability of accident and security issues is certain. This shows that mechanical/engine failure and human factor error and collision had more contributions to the probability of air accidents than Act of God as evidenced by their deviations from the predicted probability values. This is further explained by the probit model for the estimated dependent variable y = {1 p≥0.5 and {0 p<0.5 as: p = -0.681 + 0.105HUMFA -0.053ACTOG and p = -0.428 + 0.105HUMFA – 0.053ACTOG. This implies that while accidents and other security issues arising from Human factor error increases, accidents due to Act of God decreases. It

implies that the relative median potency needed to obtain a 50% probability of air mishap incidence is the ratio of the two factors: - 0.670 / - 0.507 = 1.321. The study concludes that mechanical/engine failure and human factor error were most prominent causative factors to air accidents in Nigeria.

Key Words: Safety, security, probit, fatality.

Introduction

The Nigerian Airways in its hay days had about 19 aircrafts, 9000 staffs which included 250 pilots, flight and maintenance engineers (Sotunde, 1990). The growth and development of aviation in Nigeria mirrors the Nation's political growth, as air transportation grew as an instrument of colonial bureaucracy. This later had a negative influence on the structure and development of the industry, as a result of it being dominated by public sector.

The problems of poor services have consistently characterized the Nigerian Aviation industry, with the different stakeholders accusing one another for the inefficiency in service delivery. Even with new investors entering into the sector and adopting the TQM ideology, which no doubt given the industry a face lift, there still persists an array of complaints by passengers making use of these services. This research^ aims to find out the quality level of local airlines in Nigeria and the problems with the implementation of TQM and also will assess the effect of TQM implementation on the airline industry. The deregulation of the airline industry in most part of the world marked the beginning of a new realm of competition in the industry. The deregulation ensured that airlines set fares and service levels based on the market situation (Rhoades and Waguespack, 1999). In trying to gain competitive advantage, airlines try to outshine their competitors by providing quality services that meets or exceeds the expectation of customers. Thus, customer satisfaction in the airline industry is never ending as they face numerous challenges and competition daily. This makes Quality management critical to the airlines as they strive to continuously improve their services to meet customers' expectation (Department of Transport, 2011). Today, the Nigerian aviation industry is on a pace to curbing the frequency of accidents and finding ways to manage the disaster of air crashes in Nigeria. This study therefore tries to evaluate the significance of the probability that human factor error affects safety and security measures at Nigerian airports.

- **Statement of research Problem.**

There are several challenges affecting the Nigerian aviation industry such as providing and maintaining the necessary financial resources for airport security upgrades and choosing the types of security upgrades and the allocation of resources over a planning horizon. Minimizing the costs of these upgrades, and maximizing the return on investment are the key objectives that are difficult to attain. Other problems affecting the industry includes human factors, policies, technological developments, political considerations, and operational considerations (Aderamo, 2010). However, the current crisis in Africa's civil aviation industry has been blamed on the absence of coherent air transport policies, excessive bureaucracy and bad management strategies (Aderamo, 2006). With the eventual liquidation of the Nigerian Airways, the civil aviation in Nigeria is faced with more problems than envisaged. The incessant air accidents and consequent loss of lives and properties is indeed night mare. This study tends to bridge the gaps by evaluating the significance of the probability that human factor error affects safety and security measures at Nigerian Airports.

- **Research aim**

This study aims at evaluating the significance of the probability that human factors error affects the safety and security measures at Nigerian Airports. The study tends to ask the question "Is the probability that human factor error affects safety and security measures at Nigerian airports significantly certain?"

- **Hypothesis**

Based on the statement of problem, objectives of study and research questions, the hypotheses are postulated as follows:

$H0_1$: The probability that human factor error affects safety and security measures at Nigerian airports is not significantly certain.

4.1 Significance of study

The basic tenet on which this study based is to develop theoretical and practical strategies for improved safety and security measures in the Nigerian Aviation Industry. This study shall provide an alternative paradigm for closer scrutiny of the procedures in which the Nigerian airspace safety and security measures can be executed with better efficiency and high profit returns. The quantitative estimates and trend analysis will serve as a guide for policy makers and other stakeholders in the aviation industry. The study further provides insight to disaster management planners such as National emergency management agency (NEMA) on ways to prepare for disaster scenarios in Future.

- **Conceptual framework**

5.1 The Risk Concept

Svein (2005) asserts that the concept of risk stands central in any discussion of safety. Referring to a given system or activity, the term 'safety' he noted is normally used to describe the degree of freedom from danger, and the risk concept is a way of evaluating this. The term 'risk' is however, not only used in relation to evaluating the degree of safety and the risk concept can be viewed differently depending on the context. Engineers tend to view risk in an objective way in relation to safety, and as such use the concept of risk as an objective safety criteria. Among engineers the following definition of risk is applied:

$R = P.C$

Where

P = the probability of occurrence of an undesired event (e.g. a plane crash) and

C = the expected consequence in terms of human, economic and / or environmental loss.

Risk is often calculated for all relevant hazards, hazards being the possible events and conditions that may result in severity. For example, a hazard with a high probability of occurrence and a high consequence has a high level of risk, and a high level of risk corresponds to a low level safety for the system under consideration. The opposite will be the case for a hazard with a low probability and a low consequence. Safety is evaluated by summing up all the relevant risks for a specific system (Svein, 2005).

5.2 Demand Theory

The demand for sea transport is unarguably a derived demand (Ibe, 2011). Therefore, the diversification of the economy increases mobility and invariably increases the demand for air

transport. The need arises for proper implementation of the Civil Aviation Act to facilitate trade and development in Nigeria.

The airline business uses the market mechanism to regulate supply and demand. Demand for freight transport is determined by demand for physical commodities in a given location. Because of the uneven distribution of natural resources and specialization of production, some areas experience an oversupply of certain commodities, whereas other areas suffer from a deficit (Garrick et al, 2010). This geographical imbalance gives rise to the fluctuation in demand for freight transport (Department for Transport, 2011). The determinants of demand for air transport and airline demand include variables, other than freight rates, that affect the amount of air transport buyers are willing to buy at some point in time. Sultan and Simpsom (2000) posits that the five key determinants of air transport demand are political factors, the world economy, airborne commodity trade, average haul, and transport costs.

This is supported by the neo- classical demand analysis which includes the assumptions of utility analysis, the law of diminishing marginal utility and the proportionality rule. The utility analysis is based on a set of following assumptions (Jhingan, 2003):

- The utility analysis is based on the cardinal concept which assumes that utility is measurable and additive like weights and lengths of goods.
- Utility is measurable in terms of money.
- The marginal utility of money is assumed to be constant.
- The consumer is rational who measures, calculates, chooses and aims at the maximization of utility.
- He has full knowledge of the availability of commodities and their technical qualities.
- He possesses perfect knowledge of the choices of commodities open to him and his choices are certain.
- He knows the exact prices of various commodities and their utilities are not influenced by variations in their prices; and
- There are no substitutes.

Every commodity or in this case shipment possesses utility for the consumer. In other words, marginal utility of a commodity is the loss in utility if one unit less is consumed. Therefore, so long as total utility is increasing, marginal utility is decreasing. When total utility is maximum then marginal utility is zero and this is the point of satiety or satisfaction for the consumer. However, when total utility is decreasing, marginal utility is negative. This point marks disutility or dissatisfaction of the consumer and hence there is no point having the commodity (Jhingan, 2003). The relationship between marginal and total utility is very important as Nnadi and Falodun (2003) asserts that a commodity may have a very low marginal utility but a high total utility which invariably affects its price; since in reality the factors which determine the price of a commodity are its marginal utility and supply.

5.3. Supply Theory

Garrick et al. (2007) posits that supply of air travel is measured in terms of tonnage, which refers to the available capacity for carrying cargo and passenger from one or more airports to some or more airports by air. Airlines that are trading in the air transport market constitute the active air transport supply while flights even though airworthy but not trading in the air transport market, constitute available air transport supply. This implies that active air transport supply and available air transport supply make up the total air travel supply.

CWO (2009) asserts that the unit for estimating the quantity of air travel services produced or available is the capacity- ton- mile per unit of time. Thus, to estimate the supply of air travel

services, both the cargo and passenger carrying capacity and the travel distance must be considered. Above all, the air travel market regulates supply and demand. It is worthy to note that aircraft owners or charterers, travelers, bankers and various regulatory authorities are key factors that determine the supply of flights. While ship aircraft owners decide whether to order new jets, buy second hand jets or scrap old jets; travelers influence aircraft owners by booking flight space to transport their cargo. While bankers influence capital investment as lenders to finance aircraft purchases, regulators affect fleet capacity through safety or environmental legislation. Hence in the long run, deliveries of new jets and scraping of old jets determine the rate of fleet growth.

5.4 Current accident cases in Nigeria.

Tope,(2012) revealed "Six years after a Nigerian 18-seater Dornier 228 Air Force transport plane, carrying 15 senior army officers and three crewmembers crashed leaving only three survivors that sustained serious injuries on September 17, 2006, 2012 will go down in history as the year that recorded the most recurrence of plane crashes in the country since the first recorded incident, which happened on January 22, 1973, when Royal Jordanian Airlines flight 707, carrying 171 Nigerian Muslims returning from Mecca crashed in Kano, killing five crewmen. Just before Sunday, June 3, the nation was thrown into mourning again as a Dana Airlines Flight 9J 992 carrying 153 passengers on board crashed into Iju-Ishaga, a densely populated residential area of Lagos, killing all passengers on board. In Ghana, a Nigerian cargo plane, attempting to take off from the Kotoka International Airport in Accra, Ghana, crashed few hours earlier on Saturday night, killing 10 people and injuring an unspecified number of others. The plane smashed through the airport's fence before slamming into cars and a bus loaded with passengers on a nearby street. On December 10, 2005, a Nigerian Sosoliso Airlines DC-9 crashed in Port Harcourt, killing all 103 on board. Most on board were school children going home for Christmas. On October 22, 2005, a Nigerian Bellview Airlines Boeing 737 airliner with 117 people on board crashed and disintegrates in flames shortly after take-off from Lagos. All on board killed. On May 4, 2002 a Nigerian EAS Airlines' BAC 1-11-500 with 105 people on board crashed and burst into flames in a poor, densely populated suburb of Kano killing 76 on board and 72 on the ground, a total of 148 dead.

6.0 METHODOLOGY

6.1 Sources of Data

Data collection is simply the ways information is gathered. Primary Data and secondary data collection are two ways of collecting information.

6.1.1 Primary Data

Primary data is the information gathered directly by the researcher, when secondary data is not available or is unable to contribute meeting research objectives (Saunders, 2007). The collection of primary data involves the use of research instruments, such as questionnaires and interview schedules that have been constructed exclusively for the purposes of a specific study. For the purposes of this research, primary data were collected by questionnaire and interviews. The essence for this was to weigh the different views of groups in each airport and airline studied in the research. The main concern of a researcher is to ensure that the results of the research are accurate and applicable. Therefore, once the instrument used for the conduction of the research is ready, then the reliability and validity of the measures are established (Saunders , 2007). Data was gathered by structured pre-validated questionnaire. Questions were designed so that

responses would identify professional experiences in safety and airport security indices. The following categories of data were addressed in each section of the questionnaire:

1. Demographic data of the respondents such as Gender, Age, Marital Status, Educational Background, etc.
2. Management Factors.
3. Human Factors.
4. Airport/Airline Facilities.
5. Safety/Security Factors.

6.2 Methods of Data Analysis

Two methods of data analyses shall be employed in this research. They are: Frequency Distribution as well as Ordinal Logit Regression (Ologit) and Probit Analyses. These analyses shall be carried out using statistical software called STATA 12.0 and SPSS 20.

7.0 Result and Discussion

Table 1: Sample Size Distribution of Airport and Airline in each Airport

S/N	AIRPORTS	AIRPORT	AIRLINEE	Total Sample Size	Airport %	Airline%	Total Sample size%
1	Nnamdi azikiwe inter,airport, Abuja	70	31	101	30.97	26.50	29.45
2	Port Harcourt inter Airport	43	47	90	19.03	40.17	26.24
3	Murtala Muhammad inter. airport, lagos	45	27	72	19.91	23.08	20.99
4	Mallam aminu kano inter, airport, kano.	68	12	80	30.09	10.26	23.32
	Total	226	117	343	100.00	100.01	100.00
	Percentage	66	34				

Source; field data 2015

Table 1 above shows the sample size distribution and percentages of airports and airlines that are operational based on the selected airports respectively. While more samples were sent to the Abuja and Kano airports while more airlines were sampled at Port Harcourt and Abuja Airports respectively. Furthermore, figure 4.5 shows the pictorial representation of the samples on the selected airports and airlines. It shows that the airports had more respondents than the airlines sampled.

Figure 1 Percentages chart on total sample size in the airports

Table 2 frequency distribution of Accident causes from 2000-2014

Year	Total No. of Accidents/year	Mechanical failure	Act of God	Human Factor	Collision
2000	3	0	1	2	0
2001	6	3	1	2	0

2002	4	2	1	1	0
2003	5	3	0	2	0
2004	7	2	1	3	1
2005	14	5	2	7	0
2006	9	4	1	4	0
2007	5	1	0	3	1
2008	2	0	0	1	1
2009	5	2	3	0	0
2010	8	2	2	4	0
2011	3	1	0	2	0
2012	5	4	0	1	0
2013	8	3	1	3	1
2014	4	2	0	2	0
TOTAL	88	34	13	37	4

Source: Source: Computed from Accident Data base of Nigerian Civil Aviation Authority4.2.1 7.2 Probit Analysis

Table 2 above shows the incidence and factors responsible for air mishaps in Nigeria from year 2000 to 2014. The table reveals that the highest number of accidents was recorded in 2005 with 14 incidences out of which 5 were caused by mechanical/engine failure, 2 were Act of God and 7 were caused by human factor error. The lowest number of accidents occurred in the years 2008, 2000 and 2011with 2, 3, 3 incidences respectively. Human factor error and Mechanical/ Engine failure was the most critical factors causative to accidents that occurred within the aforementioned years while Act of God was the lowest causative factor.

The table will further be subjected to empirical analysis to reveal the relationship between the variables otherwise known as factors and the aggregate of the incidents per year. The analysis will give parameter estimates that will further aid in testing the hypotheses formulated earlier in this study. The data did not capture the time of occurrence which should have been a part of the factors to be analysed to see if the time of the day has any significant contribution on air mishaps in Nigeria.

Table 3 Parameter Estimates for Probit Analysis

	Parameter		Estimate	Std. Error	Z	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
PROBIT[a]	Human Factor		.105	.552	.190	.850	-.978	1.187
	Act of God		-.530	1.370	-.386	.699	-3.215	2.156
	Intercept[b]	0	-.428	2.117	-.202	.840	-2.545	1.690
		1	-.681	2.647	-.257	.797	-3.328	1.965

a. PROBIT model: PROBIT (p) = Intercept + BX (Covariates X are transformed using the base 2.718 logarithm.)

b. Corresponds to the grouping variable collision.

Table 3 above shows that the Z values for all variables (Human factor, Act of God, Mechanical and Collision) falls within the acceptance range - 1.96 and 1.96 and as such are not significant at 0.05 levels. This is evidenced by the Z values of 0.190, -0.386, -0.202, and -0.257 respectively. However, at 95% confidence interval, the lower and upper bound values were -0.978 and 1.187

for human factor error, -3.215 and 1.690 for Act of God; -2.545 and 1.690 when the probability of accident and security issues is uncertain; then -3.328 and 1.965 when the probability of accident and security issues is certain. This shows that Mechanical/engine failure and human factor error and collision had more contributions to the probability of air accidents than act of God as captured by their deviations from the predicted probability values. Therefore we accept the null hypotheses that the probability that human factor error affects aircraft facilities with respect to safety and security in Nigeria is not significantly certain; and that the probability that Act of God contributes significantly to air mishaps in Nigeria is not certain.

Therefore, the probit model for the estimated dependent variable

$y = \{1\ p \geq 0.5\ \{0\ p < 0.5$ becomes:

$p = -0.681 + 0.105HUMFA - 0.053ACTOG$……i

and

$p = -0.428 + 0.105HUMFA\ 0.053ACTOG$……ii

Table 4 Covariance's and Correlations of Parameter Estimates

		Human Factor	Act of God	Natural Response
PROBIT	Human Factor	.305	-.670	.264
	Act of God	-.507	1.878	-.737
	Natural Response	.155	-1.074	1.131

Covariances (below) and Correlations (above).

Table 4 shows the covariance and correlation of Parameter estimates. It reveals how human factor error and Act of God impacts the probability of fatal accidents in Nigeria. Human factor error is negatively correlated to Act of God at a natural response rate of 0.264 with the value of -0.670 while at a natural response rate of -0.737, is correlated to Act of God with the value of -0.507. Therefore, about 50% of air mishaps and other security issues arising from Human factor error have a negative relationship with Act of God (- 0.670) and 50% of accidents and security issues arising from Act of God were also negatively related (- 0.507). This implies that while accidents and other security issues arising from Human factor error increases, accidents due to Act of God decreases.

Therefore the relative median potency needed to obtain a 50% probability of air mishap incidence is the ratio of the two factors: - 0.670 / - 0.507 = 1.321.

8.0 Conclusion

We therefore, conclude that human factor error affects safety and security measures at Nigerian airports. This is evidenced by the probability values and relative potency ratios which are in line with the first objective of this study which is to evaluate the significance of the probability that human factor error affects safety and security measures at Nigerian airports.

8.2 Recommendations

The aviation community must pursue the following course of action in light of the evolving nature of security threats:

- The civil aviation authorities and law enforcement agencies in Nigeria should strengthen security and screening checks at the airports to meet global benchmarks. This is imperative in the wake of Boko Haram terrorism in Nigeria.
- Government and policy makers should make laws enforcing owners and operators in Nigeria to purchase and operate new aircrafts than second hand ones.
- Routine maintenance should be carried out at the airports, especially on the infrastructures including the run ways.

- Establish a governmental and industry framework to coordinate national aviation cyber security strategies, policies, and plans.
- Government should consider a total reform of the aviation industry in Nigeria including the concession of the major international airports.

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