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An investigation of air accidents in Nigeria using the Human Factors Analysis and Classification System (HFACS) framework

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A B S T R A C T

Increasing air traffic growth has been achieved along with substantial improvement in safety globally. While air traffic is equally growing in Nigeria, safety levels do not appear to be growing side by side. This was gleaned from the spate of accidents and fatalities recorded in the last couple of decades. The study therefore set out to assess safety performance in Nigeria's air transport industry by comparing accidents and fatality rates with global average levels during the period 1985–2008. A content analysis of the accident reports was done using the Human Factors Analysis Classification System (HFACS) as a conceptual framework; this was augmented with results of industry experts assessment of the Nigerian aviation industry. Their assessments were also discussed in the context of the conceptual framework. Accidents and passenger fatality rates in Nigeria were higher than global average figures for most of the years included in the analysis period. Findings on aircraft ages show that these are also higher than world average levels. The aviation industry experts' assessment presented various challenges which include inadequate airport facilities, absence of timely meteorological information and dearth of skilled personnel in Nigeria's aviation industry. The content analysis of the accident reports using the HFACS shows that skill based errors; physical environment and inadequate supervision are the most frequently occurring categories influencing accident occurrences. The Chi-square and Fishers's test used to analyze significant relationships in the HFACS categories obtained in the accident reports showed five pairs of significant associations between adjacent categories. Based on these associations, Supervisory Violations:-Crew Resource Management:- Decision Errors path is deemed the most potent for accident occurrences. Findings from the research point to the need to address personnel skill, physical environment issues (mostly weather related) and supervisory competence.

1. Introduction

Globally, air transport industries have a strong tradition of giving top priority to safety due to the life critical nature of its operations. The aviation industry is therefore regarded as a safety critical industry. Fortunately, in addition to improved traffic growth, productivity and cost reductions, a substantial improvement in the safety of air travel has been achieved globally in the last couple of decades. The number of passenger fatalities per 100 million passenger kilometers flown has fallen from 0.08 in 1980 to 0.03 in 1990 down to 0.02 in 1999 (ICAO, 1981, 1991, 2000). Over the years 2000–2007, passenger death risk on scheduled flights in developed nations like the U.S., Japan and Ireland was 1 in 14 million, for emerging nations, death risk per flight was 1 in 2 million; while in less economically advanced developing-world countries (includes much of Africa) the death risk per flight was 1 in 800,000 (Barnett, 2010).

Global accident rates in the last decade have also been low and averaged about four accidents per million flights (ICAO, 2011a). For International Air Transport Association (IATA) member airlines, aviation accidents have become even rarer with the probability of one occurrence in 2.4 million flights. This translates to over 7000 years of accident free travel for a passenger who boards a flight each day IATA (2012).

Statistics on global accident rates therefore conceal regional disparities between developed and developing nations; and because developed nations account for the largest shares of air passenger traffic globally, increased safety trends gleaned from declining global accident and passenger fatality rates reflect more, the performance of developed countries air transport industries. Table 1 demonstrates this fact; it shows the number of accidents per million departures for regions and the world (2006–2011).

Table 1 shows that air accident rates over the period 2005–2011 have been higher in Africa than in other regions of the world. Africa

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Table 1
Accident rates (World and Regions).

	Oceania	N/America	LAC	Europe	Asia	Africa	World
2005	5.7	3.6	7.5	3.2	4.6	**12.3**	4.4
2006	3.4	3.0	6.9	4.1	4.2	**15.3**	4.1
2007	4.5	2.7	7.0	4.7	4.5	**13.9**	4.2
2008	4.5	3.0	11.5	4.3	4.5	**12.7**	4.8
2009	3.5	2.5	6.5	2.9	5.5	**13.7**	4.1
2010	6.9	3.2	6.6	3.5	3.4	**19.3**	4.2
2011	4.7	3.5	5.7	5.5	2.9	**7.9**	4.2

The significance of bold is to draw attention to Africa as a region and to highlight higher than average global figures that was pervasive throughout the period.
Source: ICAO, 2011a.

consistently recorded higher accident rates than world averages. Findings from Barnett's study show that passengers who fly in developing world countries (such as Africa) face 13 times the risk of being killed in an air accident as passengers in the developed world (Barnett, 2010). In 2010, Africa accounted for three per cent of global airline traffic but had 14 per cent of the world's aviation accidents; this contrast with Oceania which equally accounted for three percent of global air passenger traffic but recorded only 4 percent of the world's aviation accidents in the same year (ICAO, 2011b). Effective state safety oversight capabilities, as measured by the Universal Safety Oversight Audit Program (USOAP) of ICAO shows average effective implementation values of USOAP protocols to be lowest for Africa (41 percent) and Oceania (47 percent). These are the two regions which fall below the worldwide average of 60 percent (ICAO, 2011b).

The study by Barnett in 2010 specifically notes that Nigeria has one of the poorest safety records in the world. In Nigeria, the occurrences of air disasters were quite regular between 2003 and 2008, with eleven accidents and incidents involving 335 fatalities (Samiplus, 2008). Major air accidents have equally been recorded in 2010 and 2012 for Nigeria.

Against the background of issues highlighted, this study has the overall objective of analyzing the trend of aviation accidents in Nigeria and to examine the causal factors using a human factors approach. The study attempts to fill some of the gaps in air transport research emanating from developing countries. These have been lean in the pool of global air transport research; It also highlights critical safety issues in the industry for further research and policy action, such issues are often more fundamental than that which obtains in developed countries. A background on air transport industry operations in Africa and specifically Nigeria, enables us to situate the safety challenge issues appropriately.

2. Air transport in Africa

Sequel to two decades of slow progress, Africa's economic growth performance has improved substantially since the start of the 21st century. The continent's growth story is however punctured by the fact that commensurate development in the form of positive structural economic change, increase in number of jobs and higher disposable income have not often been associated with the salutary growth figures emanating from the continent. As such, many African economies still depend heavily on commodity production and exports with little value addition and few forward and backward linkages to other sectors of the economy. Major deficits in physical, institutional and policy infrastructure have further contributed to the continent's development challenge.

In spite of the unfriendly economic context within which Africa's air transport businesses operate, the region has witnessed some growth in its air transport industry. African airlines passenger traffic grew by 12.9 percent while cargo went up by 23.8 percent in 2010 compared to the previous year. African airlines passenger load factors also increased from 67.8 percent in 2004 to 70.2 percent in 2008. It however reduced to 69.1percent in 2010 and was lower than the global industry average of 75.7%. In the first quarter of 2011, African airlines passenger traffic grew by 7.20% (Chingosho, 2011). As noted by Rhoades (2004), 'traffic increases, international funding and support of safety initiatives, airline privatization and liberal bilateral agreements have all combined to produce potential new growth and development in African civil aviation which has historically lagged far behind that of the rest of the world'.

As with other regions of the world, air transport has become vital in Africa's socio-economic development. It is equally critical for international trade, tourism and for regional integration. Africa's aviation industry supports about 6.7 million jobs-equivalent to $67.8b in economic activity (IATA, 2013). The industry connectivity links the continent to global markets and opens up economic opportunities. However, the majority of people with transport needs are excluded from the use of airlines and airline services because these services prove to be expensive given prevailing low levels of disposable income among Africans. Due to the fact that the use of air transport is restricted to the few in the middle and high income brackets therefore, the industry does not enjoy a market share large enough to foster the catalytic effects that the air transport industry is normally capable of achieving in an economy.

Currently, about 10 percent of Africans travel by air (ADB, 2012); but given the current rate of economic growth and an emerging middle class, high demands for air transport are envisaged. The African Development Bank (ADB) group forecasts for the period 2010–2015 that Africa will be the third fastest growing region in the world in terms of international traffic with an average growth rate of 6.1 percent compared to the global average of 5.8 percent. The trend is expected to persist in the coming years due to pervasive factors of increasing urbanization and the emergence of the middle class. Given this expectation, the need to improve safety levels in the region has become crucial.

It should be noted that there are wide differentials among African countries with respect to growth indices in air transport. South Africa, Mauritius, Kenya and Ethiopia for examples have been successful in establishing strong and viable air transport industries. The common features in these model countries are heavy investments in air transport infrastructure and objectively implemented liberalization policies including participation in alliances and code-share agreements which increase commercial freedoms for the nation's main airlines. Flag carriers in these countries are thus more competitive and also exhibit enviable safety records in the continent.

Nigeria has however been less successful in the establishment of a solid and vibrant air transport industry. In some airports, basic infrastructures such as perimeter fences are lacking, and for some, access roads are in poor conditions. There have also been recurring issues of poor Air Traffic Control (ATC). Moreover, airlines debt profiles are unsavory and in many cities, users decry the state of airport facilities. While the country's airline deregulation process appears to have been properly implemented, the subsequent liquidation of its national carrier was linked intricately with politics. The fall outs of this process remain largely unresolved. This sub-optimal operating environment invariably impinges on safety levels observed in the nation's aviation industry.

3. Methods

3.1. Data and sources

The study made use of data on air accidents which involved Nigeria registered aircraft during the period 1985–2010. The year