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RETHINKING HUMAN ERROR IN AVIATION ACCIDENTS: REGULATORY AND STANDARD PRACTICES IN THE NIGERIAN AVIATION INDUSTRY

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Abstract

Aviation accidents reports, the world over have attributed air mishaps to either a single causative factor, but oftentimes a combination or interplay of several factors. A recurring cause of such accidents is human error or more described with particularity as pilot error. Advances in aircraft manufacturing processes has seen to a drastic reduction in aviation accidents as a result of mechanical malfunctions in aircraft. This reduction has however led to an increase in accidents attributed to human factors or more precisely pilot error. In appropriate terms, human factors should not be circumscribed to crew error alone. This is because human factor as a causative agent in aviation accidents evinces an interplay of a systematic sequence of facts ultimately pointing to the error and the consequential accident. This paper examines in extenso the concept of human error in aviation accidents against the backdrop of extant provisions, regulations and standard practices in the aviation industry.

INTRODUCTION

Aviation in itself is not inherently dangerous. But to an even greater degree than the sea, it is terribly unforgiving of any careless incapacity or neglect[1].

Pilot error (sometimes called cockpit error) is a term used to describe a decision, action or inaction by a pilot or crew of an aircraft that is determined to be the cause of, or a contributory factor in an accident or incidents. The term includes mistakes, oversights, lapses in judgment, gaps in training, adverse habits, and failures to exercise due diligence in a pilots duties[2].

What is human factors? A common definition is that it is the discipline that deals with human machine interface. It deals with the psychological, social, physical, biological and safety characteristics of individuals and groups at the sharp end of organisations and the environmental context in which they perform[3]. Human factors in aviation are involved in the study of human capabilities, limitations, and behaviours as well as the integration of that knowledge into the systems that are designed for them to enhance safety, performance and general well-being of the operators of the system[4].

The role of human factors in aviation has its roots in the earliest days of aviation. Pioneers in aviation were concerned about the welfare of those who flew their aircraft (particularly themselves), and as the capabilities of the vehicles expanded, the aircraft rapidly exceeded the human capability of directly sensing and responding to the vehicle and the environment, to effectively exert sufficient control to ensure optimum outcome and safety of the flight[5]. For several decades, aviation slowly evolved. Improvements in technology, operations and organisational structure came about at a gradual pace slowly improving safety and efficiency of operations to levels far beyond previous generations of flight[6]. Although, human factors were not identified as a scientific discipline at that time, there were serious problems related to human factors in the early stages of flight. The protection of the pilot from the elements, as he set out in his chair facing them headon was merely a transfer of technology. The pilots wore goggles, top coats and gloves similar to those used when driving the automobiles of that period[7].

Human factors as a factor in aviation operations though a consideration in the embryonic stages of aviation, has continued to attract scholarly and technological concerns in the contemporary world of aviation. This concern, ordinarily, should be in recession because of the advances and feats recorded in the world of aviation. Irrespective of the fact that progressive automation of the aircraft is the norm but it is incontrovertible that human factors remain indispensible in the safety matrix in aviation practice.

The indispensability of the human factor can be situated within the fact that the aircraft as a machine is not self-operating and hence the human intervention is necessary in giving whatever technological input there might be in the machine a propelling force. Thus, human factors continually act in interface with technological processes in ensuring safe, orderly and optimal operations of the aircraft in the process of flight.

CONCEPTUAL FRAMEWORK OF HUMAN ERRORS AS CAUSATIVE FACTOR IN AVIATION ACCIDENTS

The importance of human factors, particularly pilot error in aviation crashes has long been recognised. Overall about 80% of aviation crashes and 50% of aviation incidents are attributed to pilot error. As aviation hardware becomes more reliable due to advanced technology, the relative importance of human factors in aviation safety is likely to further increase[8].An accident may result from one or any combination of a vast number of factors[9]. Irrespective of the existence of a multiplicity of causative factors in aviation accidents and incidents, human error, as a primary factor remains inconvertible. Thus, amongst a host of causative factors, humanerror is and remains a recurring decimal in aviation accidents/incident reports all over the world.

Human factors has evolved from its earliest origins to contemporary times and it remains a significant cause for concern amongst aviation accident investigators. It has been claimed that human factors emerged as a significant challenge to flight safety only after the frequency of technical failures diminished in the nearly years of aviation[10]. In consideration of the rate of fatalities in aviation accidents and its peculiarities as distinct from other modes of transportation, experts in the, field of aviation have from earliest times evolved technical cutting edge expertise in the manufacturing process with a view to ensuring safety in aviation practice. Irrespective of these efforts, it was realised that aviation accident reports identified less of technological malfunctions as causative factors in aviation accidents. This realisation led to a rethinking of pilot error as probably a causative factor in the accident/incident process.

Placing pilot error as a cause of an aviation accident has often been controversial[11]. Human factors as a conservative factor in aircraft accident was resisted by aircraft manufactures at the early stages of aviation. However, there was a paradigm shift with the major disaster of Tenerife in 1977 when two 747s collided and 583 people perished.

This singular event caused elements of the aviation industry to begin to make tentative moves towards understanding the problem[12]. Thus, the Tenerife factor provided an impetus for the recognition of human factor as a causative factor in aviation accidents and consequently greater attention was being paid to it[13].

The causes of pilot error includes psychological and physiological human limitations. Various forms of threat and error management have been implemented into pilot training programs to teach crew members how to deal with impending situations that arise throughout the course of a flight[14].Errors committed within the broad category of human factors remain the leading causes of aircraft accidents[15]. Crew error plays a central role in many airline accidents. Uncovering the causes of such error is one of investigators' greatest challenges because human performance, including that of expert pilot, is driven by the confluence of many factors, not all of which are observable in the aftermath of an accident[16].

HUMAN FACTORS AND THE INTERFACE WITH TECHNOLOGY IN AVIATION OPERATIONS

With technological advancement in the aviation industry there is the need to explore safety issues within the context of the interface between computer controlled flights and human operations. This is with the objective of ensuring that there is no conflict between the control panels[17]. The role of technology must be- and must continue to be that of a service provider. It must be limited to providing the resources and information required for flexible an effective action and warn the pilots of dangerous developments. The aircraft designer must therefore, if necessary, even dispense with technical advances in order to ensure that the aircraft remain operable, comprehensible and thus controllable by the human being. Under no circumstances can technology be permitted to filter or block out information much less take action on its own[18].

There is the need to disconnect human contributions from mechanical contributions. The rules of the ICAO that govern aircraft accident investigations prescribe exactly that. They force accident investigators to separate human contributions from mechanical ones[19].

An interrogation of the salient features inherent in the interface between human factors and technological advancement in the world of aviation must take into account the continuing automation of tasks hiherto performed by man. The industrial revolution and the diminishing efforts of the human capital in the production process is a bye-product of advances in technology. These advances have become manifest in virtually all facets of human endeavour. The aviation industry has had its fair share in the growth of technology. This scenario has excited debates with respect to drawing an equilibrium between the mechanical operability of aircraft which has become known as auto pilot and human input in aviation operations. Salient questions have arisen with respect to the phenomenal question of human factors and the interface with technology in aviation operations. Questions such as ensuring that there is a synergy between human input in aviation and technological control of aircraft have continued to excite industry stakeholders. In operationalizing this interface, there is the need to ensure that there is no disconnect between the crew and the commands issued by technological apparatus in aircraft.

OPERATIONALISING THE SCHOOLS OF THOUGHT ON HUMAN FACTORS IN AVIATION ACCIDENTS

Because most aviation accidents have been attributed historically to deficiencies in the performance of the flight crew, it is especially important to understand what makes pilots vulnerable to error[20]. The dialectics of human error as a conservative influence in aviation accidents has given impetus to the emergence of two schools of thought on the subject matter of human error. There is the old view of human error and the new view. The old view is to the effect that human error is the cause of a mishap in this case, “human error” under whatever label-loss of situational awareness, procedural violation, regulatory shortfalls, managerial deficiencies is the conclusion of an investigation. On the other hand, the new view of human error sees human error as a symptom of a deeper trouble. In this case human error is the starting point for accident investigation. The probe will seek to unearth how human error is systematically connected to features of people’s tools, tasks and operational/organisational environment[21].

Cognisable from the foregoing, is the fact that the old school looks at human error *strictu sensu* from the human perspective while the new school of thought goes beyond the superficial and attempts to construct a paradigm between human errors which are subscribed within the prism of a systemic problem which manifests within the vehicle of the human error[22].

The 20th Technical Conference of IATA which was held in Istanbul during November 1975, and which was entirely devoted to human factors is seen by many as a turning point in the official recognition of the importance of human factors in air transportation.

Amongst members of its steering group were names of international repute in aviation human factors. Yet inspite of this input of expertise, attention of participants was stretched to cover a wide range of topics from medication and pilot psychiatric screening to windshear on approach and flight data recording[23]. The postulation of the old school of thought on human error, it is submitted, is shallow and does not address the deep rooted causes of aviation accident from the human factor perspective. This school of thought to say the least is anachronistic and its perspective areotiose and does not, or is not amenable to the contemporary objectives of aviation accident investigation. In contemporary times, it is the nuances of the new school that guides aviation accident investigators in unearthing the human factor in aviation accident investigation.

HUMAN ERROR AS CAUSATIVE FACTOR IN AVIATION ACCIDENT IN NIGERIA

In the aviation industry, the world over, the sole objective of the investigation of an accident or serious incident is the prevention of accidents and incidents and the purpose of such an investigation shall not be to apportion blame or liability[24].Modern accident investigators avoid the words "pilot error" as the scope of their work is to determine the cause of an accident, rather than apportion blame. Furthermore, any attempt to blame pilots does not consider that they are part of a broader system which in turn may be at fault for their fatigue, work pressure or lack of training.

ICAO and its member states therefore adopted the Reason Model in 1993 in an effort to a better understanding of the role of human factors in aviation accidents[25].

In aviation accident investigation, the foundation is usually to determine the potential cause of the crash. The checklist should include pilot error, insufficient training, a medical condition, alcohol or drug abuse, insufficient rest or operational error[26].

In the Nigerian aviation industry, some of the accidents have been attributed to human error[27]. Human error has been documented as a primary contributor to more than 70% of commercial airplane hull loss accidents. While typically associated with flight operations, human error has also recently become a major concern in maintenance practice and air traffic management[28]. It has grown increasingly popular as the commercial aviation industry has realised that human error, rather than mechanical failure underlines most aviation accidents and incidents. If interpreted narrowly, human factors are often considered synonymous with crew resources management (CRM) or maintenance resources management (MRM) [29].

The Accident Investigation Bureau (AIB) attributed both the Sosoliso and the ADC crashes to human error[30]. With respect to the Bellview Airlines crash, the AIB report was not categorical because of the alleged destruction and consequent inability to retrieve the voice data recorder (VDR) and the flight Data Recorder (FDR) from the debris/wreckage of the crash. However the report pointed to some causative factors which could have aided the crash: the state of the aircraft and, obliquely the health and professional status of the pilot. The report said the pilot was insufficiently trained for the B737 aircraft besides being fatigued due to "excessive workload" The investigation also revealed that the aircraft had technical defects[31].

In retrospect, the Bellview Airline crash could be attributed to human error[32]. The same causative factor was attributed to both the Sosolisoair crash[33] and the ADC airline crash[34].

The AIB report on the Wings Aviation Beechcraft 1900D plane crash was also attributed to a mix of factors, principal amongst which was the fact that the flight crew deviation from initial filed flight plan to Bebi, poor Cockpit Resources Management (CRM) and the crew's inability to respond promptly to several Enhanced Ground Proximity Warning System (EGPWS) warnings. Another factor that contributed to the crash, AIB noted, was the fact that Air Traffic Control (ATC) at Enugu could not notice the deviation of the aircraft from the initial filed flight plan route and also the fact that the pilot descended the aircraft to 5,000 feet outside Enugu control airspace without considering the minimum safe altitude of 11,200 feet as specified in the Jepperson chart of the area[35]. The conclusion to be drawn from the Beechraft 1900D crash is that human error played a major role in the tragedy[36].

A CHECKLIST OF SOME ADJUNCTIVE FACTORS IN HUMAN ERROR ISSUES IN AVIATION ACCIDENTS/INCIDENTS

here exist some adjunctive factors subsumed within the wider context of human factors in aviation accidents/incidents. These factors are sub-sets in the human factor matrix.

PILOT FATIGUE

The first factor is pilot fatigue. The International Civil Aviation Organisation (ICAO) --- fatigue as "A psychological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase or workload. The phenomenon places great risk on the crew and passengers of an airplane. Because it significantly increases the chances of pilot error. Fatigue is partialarly prevalent among pilots because of unpredictable work hours, long duty periods, circadian disruption and insufficient sleep. Regulators attempt to mitigate fatigue by limiting the number of hours pilots are allowed to fly over varying periods of time[37].

The AIB report on the Bellview crash, alleged that the pilot suffered fatigue due to "excessive workload". The Nigerian Civil Aviation Regulations (NCARs) vide the provisions of Part 18 (Operations) of the Regulations stipulates the respective duty and rest periods for flight crew members, cabin crew members, flight operation officer/aircraft dispatcher.

The objective of the time limitations provided for under the Regulations is meant to ensure that flight personnel are insulated from the effects of fatigue[38].

The provisions of Regulations 8.12 provides for the dual concepts of duty periods and rest periods for crew members. Under the provisions of the Regulations, personnel are considered to be on duty if they are performing any tasks on behalf of the Air Operators Certificate (AOC) holder. Such tasks could be either scheduled, requested or self-initiated[39].

The deleterious effects of fatigue on crew members have elicited serious regulatory interventions by aviation authorities, the world over. The prominence given to fatigue related issues is a corollary of the need to address fatigue related issues in the human factor concept in aviation accidents/incidents. Thus, under the provisions of Regulations 8.12.1.2 (3) No AOC holder may schedule:

1. A flight crew member for more than 14 hours of duty except as prescribed by the Authority
2. A cabin crew member for more than 14 consecutive hours of duty, except as prescribed by the Authority.

3. A flight operations officer/aircraft dispatcher for more than 10 consecutive hours of duty within a 24 consecutive hour period, unless that person is given an intervening rest period of at least 8 hours at or before the end of the 10 hours duty except in cases where circumstances or emergency conditions beyond the control of the AOC holder require otherwise.

At the other extreme, the Regulations also provide for rest periods. The minimum rest period is considered to be 8 consecutive hours. The minimum rest period for flight crew members shall be 9 consecutive hours unless otherwise prescribed by the Authority. With respect to rest periods, an AOC holder has discretionary powers with respect thereto. Thus, the AOC holder may exercise the option to reduce a crew member's rest period within the limitations prescribed under the implementing standards IS:8.12.1.3. What can be deduced from the foregoing is that the exercise of discretionary powers by AOC holders in the regulation of rest periods for crew members is subject to the limitations prescribed under the implementing standards[40].

The exercise of discretionary powers is thus not subject to the whims and caprices of an AOC holder. This provision to say the least, is salutary when considered against the backdrop of the propensity of business owners for mercantilism, and more particularly profit at the expense of other ancillary considerations.

The AOC holder is under an obligation to relieve the flight crew member, flight dispatcher, or cabin crew member from all duties for 24 consecutive hours during any 7 consecutive day period[41]. Time spent in transportation, not local in character, which is required by the AOC holder to position crew members to or from flights is not considered part of the rest period. Similarly, time spent in transportation on aircraft (at the insistence of the AOC holder) to or from a crew member's home station is not considered part of a rest period[42].

Under the provisions of paragraph 7 of NCAR 8.12.1.2. No AOC holder may assign, nor may any person perform duties in commercial air transportation unless that person has had at least the minimum rest period applicable to those duties as prescribed bythe Authority or accept an assignment to any duty with the AOC holder during any required rest period.

The Regulations also provides for maximum number of flight time hours. Thus, no person may schedule any flight crew member and no flight crew member may accept an assignment for flight time in commercial air transportation, if that flight crew member's total flight time will exceed 8 hours in any 24 consecutive hours[43].

It is noteworthy to state that significant premium is placed on duty and the corollary rest periods for flight crew members to the extent that it is mandatory for each AOC holder to maintain current records of each crew member and flight dispatches documenting their compliance with the applicable flight time, duty and rest limitations prescribed under the Regulations[44].

MEDICAL CONDITION OF CREW MEMBERS

The second factor subsumed within the context of human error is the medical condition of flight personnel. In this regard, inference is held to the Bellview pilot who was said to have a medical condition during the subsistence of his employment with the airline. The NCAR provides for the medical fitness of flight crew members[45].

Regulations 8.5.1.4 of Part 8 (operations) of the NCAR prohibits anyone from acting as Part in Command (PIC) or as a crew member when he or she is aware of any decrease in his or her medical fitness which might render him or her unable to safely exercise the privilege of his/her licence[46]. Similarly, a flight shall not be commenced if any flight crew member is incapacitated from performing duties by any cause such as injury, sickness, fatigue, the effects of alcohol or drugs. A flight shall also not be continued beyond the nearest suitable aerodrome if a flight crew member's capacity to perform functions from causes such as fatigue, sickness or lack of oxygen.

INTOXICATION

The NCARs also prohibits the use of psychoactive substances, including narcotics, drugs or alcohol vide the provisions of Regulations 8.5.1.5[47]. Under this provision no person may act or attempt to act as a crew member if a civil aircraft –

(a) Within 8 hours after the consumption of any alcoholic beverage;
(b) While under the influence of alcohol; or
(c) While using any psychoactive substance that affects the person's faculties in any way contrary to safety.

Furthermore, where there is reasonable basis to believe that a person may not be in compliance with the regulations prohibiting the use of psychoactive substances and upon the request of the Authority, that person shall furnish the Authority (NCAA) or authorise any clinic, doctor, or other person to release to the Authority, the results of each blood, urine or any other tests specified by the Authority, for presence of alcohol or narcotic substances up to 8 hours before or immediately after acting or attempting to act as a crew member[48]. Any test information provided to the Authority under the provisions of the Regulations may be used as evidence in legal proceedings[49].

However, it should be borne in mind that rarely are flight crew members are arrested or subject to disciplinary action for being intoxicated on the job. In 1990, three Northwest Airlines crew members were sentenced to jail for flying while drunk. In 2001 Northwest fired a pilot who failed a breathalyser test after a flight. In July 2002, both pilots of American West Airlines Flight 556 were arrested just because they had been drinking alcohol. The pilots were fired and the FAA revoked their pilot licences. At least one fatal airline accident involving drunk pilots occurred when two Aero Flight 311 crashed at Koivulahti, Finland, killing all 25 on board in 1961 which underscores the role that poor human choices can play in air accidents[50].

ERROR OF JUDGMENT/HUMAN NEGLIGENCE

Another error within the context of the human factor is the error of judgment by the flight crew members or the captain. This is essentially, as identified by AIB as the cause of the Dana Air Crash of June 3, 2012. The pilots failed to turn on the fuel system leading to a shutdown of the aircraft's two engines and consequently to the crash[51].Human factors incidents are not limited to error by pilots. Failure to close a cargo door properly on Turkish Airlines Flight 981 in 1974 caused the loss of the aircraft however design of the cargo door latch was also a major factor in the accident.

In the case of Japan Airlines Flight 123, improper repair of previous damage led to explosive de-compression of the cabin, which in turn destroyed the vertical stabilizer and damaged all four hydraulic systems which powered all the flight controls[52].

An indispensible factor in flight operations is the services rendered by ground equipment in ensuring seamless and safe operations by airlines. In the process of an interface between ground equipment and aircraft, there may be contact between both. Aircraft are occasionally damaged by ground equipment in the Airport. In the act of servicing the aircraft between flights a great deal of equipment must operate in close proximity to the fuselage and wings. Occasionally, the aircraft gets bumped or worse[53].

Damage may be in the form of simple scratch in the paint or small dents in the skin. However, because aircraft structures (including the outer skin)play such a critical role in the safe operation of a flight, all damage is inspected, measured and possibly tested to ensure that any damage is within safe tolerances. A dent that may look no worse than common "parking lot damage" to an automobile can be serious enough to ground an airplane until a repair can be made[54].

The three pieces of ground equipment that most frequently damage aircraft are the passenger boarding bridge, catering trucks, and cargo "belt loaders". However any other equipment found on an airport ramp can damage an aircraft through careless use, high winds, mechanical failure and so on[55].

The key to ensuring that ground damage to aircraft does not imperil the safety of air navigation is through a process of reporting of such incidents to the relevant authorities for remedial actions to correct damages arising to aircraft as a result of contact by aircraft with ground equipment. The reason why most incidents of ground damage are largely unreported is because personnel involved in the provision of ground handling services are often scared of punitive administrative sanctions for damages arising to aircraft as a result of negligent conduct traceable to them. However to ensure the safety of aviation operation ground handlers should be encouraged to file reports of damages to aircraft arising out of ground operations for the purpose of corrective measures and consequential safety of aviation operations[56].

DELIBERATE CREW ACTION

Although most air crews are screened for psychological fitness, some have taken suicidal actions. In the case of Egypt Air Flight 990, it appears that the first officer deliberately crashed into the Atlantic Ocean while the captain was away from his station in 1999 off Nantucket, Massachusetts. In 1982, Japan Airlines flight 350 crashed while on approach to the Tokyo Hameda Airport killing 24 of the 174 on board. The official investigation found the mentally ill captain had attempted suicide by placing the inboard engines into reverse thrust while the aircraft was close to the runway. The first officer did not have enough time to countermand before the aircraft stalled and crashed[57].

Deliberate crew action, however remains controversial, when viewed or considered as to whether it is a sub-set within the concept of human error. This is because the action is one that is executed against the backdrop of deliberation-what in criminal jurisprudence is called *mense rea*. Deliberate Crew action leaves no gap as the crew in question must have carefully conceived and executed his action bearing in mind the eventual consequence in the form of fatalities and loss of the aircraft. However, to some scholars, it can still be pigeon-holed within the prism of human factor as an umbrella term in contra-distinction to human error. It is not human error because there is no room for error considering the fact that the action is both contemplative and deliberative on the part of the crew. It is however human factor because being deliberate, it is executed by human actors.

UNCOORDINATED CREW ACTION

Another element subsumed within the concept of human factor is uncoordinated crew action. Uncoordinated crew action occurs when crew members are working in dissonance with one another thereby acting in an uncoordinated member. For instance, the failure to ensure that all members of the crew are acting in a co-ordinated manner can lead to confusion (adverse mental state) and poor decisions in the cockpit. Crew resource management as it is referred to here, includes the failure of both inter and intra cockpit communication as well as communications with ATC and other ground personnel. This category also includes those instances when crew members do not work together as a team, or when individuals directly responsible for the conduct of operations fail to coordinate activities, before, during and after a flight[58].

CONTROLLED FLIGHT INTO TERRAIN (CFIT)

Controlled flight into Terrain occurs when an airworthy aircraft is flown under the control of a qualified pilot, into terrain (water or obstacles) with adequate awareness on the part of the pilot of the impending collision[59].

Controlled flight into terrain is a class of accident in which an undamaged aircraft is flown, under control, into terrain[60]. CFIT describes an accident in which an airworthy aircraft, under control, is unintentionally flown into the ground, a mountain, water, or an obstacle[61]. CFIT accidents typically are a result of pilot error or of navigational system error. Some pilots, convinced that advanced electronic navigation systems such as GPS and inertial guidance systems (inertial navigation system or INS) coupled with flight management system computers, or over reliance on them, are particularly responsible for these accidents, have called CFIT accidents "computerised flight into terrain". Failure to protect instrument landing system in critical areas can also cause controlled flight into terrain[62].

The term controlled flight into terrain, was coined by engineers at Boeing in the late 1970s. The pilots are generally unaware of the danger until it is too late[63]. Controlled flight into Terrain (CFIT) or in simple terms, when crews unwittingly fly their aeroplane into the ground, remain still the single most contributor to and causative factor of aviation accidents[64].

Nigeria in recent times, has had her own fair share of aviation accidents which investigation reports traced to the incidence of controlled flight into terrain. The Beechcraft 1900D aircraft which crashed on March 15, 2008 on its way from Lagos to Bebi Airstrip in Cross River State was attributed partly to controlled flight into terrain as a result of pilot error[65]. Also the OAS helicopter, registration number 5N BKA which crashed on July 29, 2011 at Osun State was attributed to pilot error[66].

CONCLUSION

Human error as a causative factor in aviation accidents is symptomatic of the disconnect between man and technology in aviation operations. The human aspect in the operations of aircraft continues to be scaled down as advances in technology continue. Human error or pilot error is multifaceted in nature and is often a resultant effect of the interplay of several factors ranging from such problems as psychological or physiological. Medical conditions have also been identified as contributory factors in the human error issue Controlled Flight into terrain also plays a significant role in the problem of human error.

It is gratifying to note that industry's concern is shifting towards human error as a significant challenge as a causative factor in aviation accidents and incidents. These concerns have elicited responses by stakeholders at the local and international sphere towards evolving measures aimed at tackling such problems as abuse of psychotropic substances by crew members and fatigue amongst several other issues. The Nigerian aviation industry has also exhibited a demonstrable level of commitment in addressing the problems of human error and its associated causative factors through the provisions of the Nigerian Civil Aviation Regulation (NCARs).

It is apposite to state that the NCARs is being constantly revised with a view to ensuring that it accords with contemporary developments in the industry.

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13. The investigation concluded that the fundamental cause of the accident was that the captain took off without the take-off clearance.
    Other major factors contributing to the accident were:
    - The sudden fog greatly limited visibility. The control tower and the crews of both planes were unable to see one another.
    - Simultaneous radio transmission, with the result that neither message could be heard.

    The following factors were considered contributory but not critical

    - Use of ambiguous non-standard phrases by the KLM Co-pilots ("we're at take-off") and the Tenerife Control tower ("ok")
    - The Pan Am Aircraft had not exited the runway at c-3
    - The airport was (due to rerouting from the bomb threat) forced to accommodate a great number of large aircraft, resulting in disruption of the normal use of taxiways.
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22. AyodeleGattaThe Impact of Aviation Laws on air Safety in NigeriaPh.D unpublished Thesis: ObafemiAwolowo University: Ile – Ife, 2015 p. 552
23. Frank H. Hawkins and Henry W. Orlady (eds) Human Factor in Flight 2nd Edition U.S.A Burlington Ashgate Publishing Ltd 1993. P.19.
24. See section 29(12) of the Civil Aviation Act, 2006
25. Investigation Human Error: Incidents, Accidents and Complex systems. Ashgate Publishing 2004
26. Gary C. Robb "Aviation Litigation" sourced from http://aviation lawyers.com/Aviation_Litigation. html on 27/2/2008
27. Investigation into the crashed Dana Air Flight which crashed at Iju_Ishaga, a Lagos suburb on June 3, 2012 killing about 156 persons was attributed to human error. It was reported that the inability of the pilot, Caption Peter Waxtan (An American) to turn on the fuel pumps of the aircraft led to the failure of the two engines and the eventual crash. Reports indicated that 17 minutes into the flight, Waxton noticed

some problems with one of the aircraft engine and a little later, the second engine of the McDonnel Douglas MD-83 aircraft went off and it lost altitude before it crashed a few minutes to landing at the MurtalaMuhammed Airport, Lagos. The Captain did not follow standard procedure and the airplane flamed out. See ChineduEze "Dana Air Plane Crash Blamed on Human Error" "Thisday" Wednesday, 13 February 2013 p.1 & 8.

28. Chika GoodluckOgazi "How human Factors affect aviation Safety" "The Guardian" Friday, June 29, 2012 p.46.
29. ibid
30. Editorial "Beyond the AIB Report" "Thisday" Wednesday, February 27, 2013 p.15.
31. Ibid. Curiously enough and against all known rules of professional and forensic requirements, the AIB admitted that the report on the Bellview crash was not utterly reliable and the Airline consequently reacted by a virtual dismissal of the said investigation reports. In addition, some aspects of the report conflicted with an earlier report handed to the Nigerian Civil Aviation Authority in 2009. The earlier report confirmed that the aircraft had "mechanical anomalies" which ordinarily could not have prevented continued flight.
32. The AIB report on Bellview crash alluded to the pilot's incompetence in handling a B737-Interestingly the Captain (Pilot) history revealed his age as 49 years old and had been hired by Bellview after he had been working at a dairy for about 12 years. Medical history also revealed that the pilot had been shot in the head during a robbery attempt during the break from flying.
33. The Sosoliso crash was facilitated by an interplay of different causative factors; Human error was attributed to it cognisant of the fact that the pilot was "reportedly racing against a thunderstorm" nearing the airport. See Jon Gambriel "Untold Story of Sosoliso, ADC, Belview plane crashes" "The Nation" Monday, February 20, 2012 pp 5-6.
34. The human error in the ADC crash as reported in the AIB investigation report revealed that the pilot's incorrect actions stalled the plane. See Jon Gambrielop.cit.
35. ChineduEze "NAMA, NCAA, Airline sing discordant tunes" "Thisday, the Sunday Newspaper" April 3, 2009 pp. 114-115.
36. See also Joseph Ushigiale "Untold Story of Beechcraft 1900D Air Crash" "Thisday" The Saturday Newspaper" April 25, 2009 pp 54-57 for a summary of AIB's investigation reports on the crash.
37.
38. See generally Regulations 8.11 of the Nigerian Civil Aviation Regulations 2015
39. Regulation 8.12 of Part 8 (operations) of the NCARs 2015 provides for rest periods, duty and flight time for flight personnel in commercial Air Transport. Section 8.11 of Part 8 (Operations of the NCAR 2009 which provides for rest periods, duty and flight time for flight personnel in Commercial Air Transport.
40. NCARs 8.12.1.2 (1)
41. ibid
42. ibid. The obligatory nature of this provision can be situated within the draftsman's use of the word "shall" in the provision
43. NCAR 8.12.1.2. (5) & (6)
44. See generally NCAR 8.12.1.4 for provisions regulating maximum number of flight time hours.
45. NCARs 8.12.1.7
46. NCAR 8.5.1.4 of Part 8 (operations) of the NCAR, 2015
47. This provision introduces the criminal element of awareness (*mensrea*). Awareness, in regard to this provision can only be proved beyond reasonable doubt in consonance with the dictates of criminal liability where the PlC was duly issued a medical certificate in that behalf. .Still further, a crew member

who has not been medically certified unfit may, acting in self-denial assume the position of PlC against the provisions of NCAR 8.5.1.4.

48. Regulation 8.5.1.5 of Part 8 (Operations) of the NCAR, 2009. Psychoactive substances have been proved scientifically to impair judgments. Accordingly flight crew members should be insulated from the effects of such substances capable of having deleterious effects on flight crew members with the potentials of precipitating an accident. See generally Shari Stamford Krause Aircraft Safety: Accident Investigations, analysis and Applications Second Edition Great Britain: McGraw-Hill, 2003 p.3 where the author submitted that Good Judgment and thus good decision making are mental skills that every pilot can learn. There is indisputable evidence from accident reports, safety studies and exhaustive academic research that illustrate breakdowns of judgment skills, by pilots in accident flights. Some pilot experience momentary lapses in their skills brought on by isolated cases, fatigue or stress. Others exhibit a more pervasive and consistent lack of judgment skills caused by disruptive or submissive personality traits or by social influence.
49. NCAR 8.5.1-5. The use of breathalysers for detecting drunk piloting comes into issue here.
50. Legal proceedings as used in the Regulations should be construed to mean judicial panel/investigative panels constituted in the aftermath of an air mishap. It should not be taken to mean, for purposes of prosecution of a crew member consequent on an air mishap. This position is reinforced by the fact that aviation accident investigation is for purposes of determining the causes of aviation accident with a view to averting a recurrence rather than for purposes of prosecution or apportionment of liability in aviation accidents. See Section 29 (12) of the Civil Aviation Act, 2006 with regards to this position of the law.
51. See https://en.wikipedia.org>wiki>Aero_Flight sourced on the 4th day of October 2018
52. The Air Florida 90 Crash of 1982 is similar to the Dana Air crash. Both of them being occurrences activated by a lack of perception on the part of the pilots. According to Shari Stamford Krause Aircraft Safety: Accident Investigation Analysis & Applications. Ibid the 1982 crash of Air Florida Flight 90 is a profound illustration of how the lack of perception on the part of both of the captain and first officer resulted in poor judgment and ultimately a fatal decision. Flight 90, a B737 was exposed for over two hours to a nearly continuous moderate to heavy snowfall as it waited for departure from Washington National airport. The crew failed to turn on the engine anti-ice which allowed ice to form on the engine compression inlet (Pt. 2). On a few occasions, the first officer questioned an intermittent fluctuation of the engine pressure ratio (EPR) instrument setting, including the comment "I don't know why that's different" (EPR Settings). In this case, the captain never exhibited any perception skills. The first officer, however was generally aware of a problem and continued to observe the EPR fluctuations but was unable to detect and understand the nature of the problem. The flight crew failed to demonstrate the four essential skills of perception awareness, observation, detection and understanding and therefore unable to recognise and solve the problem.
53. See https://en.wikipedia.org>wiki>Aero Flight sourced on the 4th day of October 2018.
54. http://en.wikipedia.org/wiki/Air safety.
55. ibid. An example of the seriousness of this problem was the December 26, 2005 depressurization incident on Alaska Airlines Flight 536. During ground services a baggage handler hit the side of the aircraft with a tug towing a train of baggage carts. This damage the mental skin of the aircraft. This damage was not reported and the plane departed. Climbing through 26,000 feet (7,925 metres) the damaged section of the skin gave way due to the growing difference in pressure between the inside of the aircraft and the outside air. The cabin depressurized with a bang, frightening all aboard and necessitating a rapid descent back to denser (breathable) air and an emergency landing. Post landing examination of the fuselage revealed a 12in x 6in (30cm x 15cm) hole between the middle and forward cargo doors on the right side of the airplane.

56. http://en.wikipedia .org/wiki/Air safety
57. There is a paradigm shift in the reportage of aviation accidents/incidents as it has become compulsory to report them unlike in the past when accidents and worse particularly incidents could go unreported. The Minister responsible for aviation matters is required vide the provisions of section 29 (11) (a) of the Civil Aviation Act, to make regulations requiring notice to be given of any such accident or incident.
58. See https://en.wikipedia.org Egypt_Air_Flight_990 sourced on the 4th day of October 2018.
59. Douglas A. Wiegmann& Scott A. ShappellA Human Error Analysis of Commercial Aviation Accident using the Human Factor Analysis and Clarification System (HFACS) February 2001. Office of Aviation Media Investigation. Washington DC 20591 Virginia US Department of Transportation. Federal Aviation Administration.
60. See NCARs 7.1.12 (Definition Section) of Part 7 (Instrument and Equipment)
61. http://em.wikipedia.org/wiki/Air safety
62. htt://wikipedia.org/wiki/CTIT safety
63. ibid
64. ibid
65. Ruwantisa I.R Abeyratne "Prevention of Controlled Flight into Terrain: Regulatory and Legal Aspects" in University of Denver Transportation Law Journal 27 Transp L.J p.159
66. According to ChineduEze "NAMA, NCAA, airlines Sing Discordant Tunes" "Thisday" The Sunday Newspaper, April 5, 2009 pp. 114-115;

    On March 14, 2009, the Accident Investigation Bureau (AIB) made public a preliminary report on the crash of the aircraft owned by Wings Aviation. The three-member crew was killed in the accident. The AIB said that the crew of the aircraft deviated from its initial flight plan, which estimated that the aircraft which left MMA at 6:36am would arriveIkrop at 8:06am. The report stated that the crew ignored several warnings by Enhanced Ground Proximity Warning System (EGPWS) and subsequently crashed. The Commander, the report stated, did not promptly initiate terrain avoidance action when the EGPWS sounded "Terrain" Terrain "Pull up" The report Stressed that the Enugu Control tower of NAMA descended the aircraft to 5000 feet outside its area of control, not considering that the aircraft was not flying the filed flight plan route and the minimum Safe Altitude (MSA) of the area reported by Jeppersen (International air mapping) chart as 11,200 feet. In other words, while the aircraft was in the airspace outside the

    control of Enugu Control Tower, the controller directed the pilot to descent 11,200 feet. The AIB investigation revealed the causal factors responsible for the crash to include lack of situational awareness which led to a controlled flight into terrain; the inability of the members of the crew to identify their position while navigating to their planned destination. AIB also identified as contributory factors to include flight crew's deviation from initial filed flight plan to Bebi, poor Cockpit Resource Management (CRM) and the crew's inability to respond promptly to several EGPWS warnings.
66. According ChineduEze "Late Kuteyi had flown the crashed Chopper over 200 ties" "Thisday" Friday, August 2011 p.31 the helicopter was flight worthy and was manufactured in 2005 and was fitted with Mode 406 Emergency Locator Transmitter (ELT) and had obtained airworthiness certificate less than two months before the crash. The pilot was highly experienced and had flown in the Philippines military and had his Civil Aviation Certification with over 5000 flying hours to his licence on helicopters before joining OAS helicopter. The pilot held both the NCAA and the Civil Aviation Authorities of the Philippines (CAAP) licenses.

    In addition, bad weather was identified as the cause of the OAS helicopter crash. According to ChineduEze "NCA: Bad weather caused OAS Chopper's Crash" "Thisday" August 2, 2011 p.7 the NCAA through its erstwhile DG, Dr. Harold Demuren said that the weather at Ife Odan hills (site of the crash) must have blurred the vision of the pilot who was on aVisual FlightRule (VFR) and that situation explains why the helicopter hit the tall hill and crashed in what was described as Controlled Flight into Terrain (FCIT)