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Exploring Safety Aspects of Aviation Industry

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Abstract

Safety plays a vital role in aviation industry. Safety in aviation industry turns into a major issue in frequent nations today. The objective of this paper is to develop a thorough understanding of various factors influence aviation safety and study their persuade. To achieve this, a literature review followed by classification schemes and Meta Analysis was performed. A number of journals were studied that yielded 44 variables affecting aviation safety. An information framework was developed using these variables. The variables along with the information framework served as the basis for developing the classification schemes. So this paper tried to explore the different safety aspects for the aviation industry. From the literature different research streams and research issues are discussed which affects the safety of the aviation industry. The results show various trends of aviation safety parameters. In the end results are discussed and future areas of research are identified.

Keywords: Aviation Safety, Meta-analysis, Dimensions, Information Framework.

1. Introduction

Safety plays a paramount role in aviation industry. Safety in aviation industry turns into a major issue in numerous nations today. Truly, aviation safety has been based the reactive investigation of past mishaps and the acquaintance of restorative movements with avert the repeat of the aforementioned occasions. Historically, aviation safety has been built upon the reactive analysis of past accidents and the introduction of corrective actions to prevent the recurrence of those events. With today's extremely low accident rate, it is increasingly difficult to make further improvements to the level of safety by using this approach. Therefore, a proactive approach to managing safety

has been developed that concentrates on the control of processes rather than solely relying on inspection and remedial actions on end products. This innovation in aviation system safety is called a Safety Management System (SMS), an expression indicating that safety efforts are most effective when made a fully integrated part of the business operation. It is now generally accepted that most aviation accidents result from human error. It would be easy to conclude that these errors indicate carelessness or incompetence on the job, but that would not be accurate. Investigations are finding that the human is only the last link in a chain that leads to an accident. These accidents will not be prevented by merely changing people increased safety can only occur when the underlying causal factors are addressed. The aircraft accidents have many reasons. Many factors influencing aircraft have been found out by many researchers after deep study of many major aircraft accidents. These factors may be of internal factors of the aircraft or external conditions of the environment in which the aircraft operates. Though we cannot completely avoid the accidents we can reduce it by carefully knowing the factors resulting to it and take prior precautions to avoid the accidents. This forms the main motive of our study.

1.1 Need of Aviation Safety

The aircraft accidents have many reasons .There are many threats in aviation industry like environmental impact, human factor and technical factors. Many factors influencing aircraft have been found out by many researchers after deep study of many major aircraft accidents. These factors may be of internal factors of the aircraft or external conditions of the environment in which the aircraft operates. To maintain the current low level of air accident fatalities aviation safety is must. It is important to advance from a reactive framework where regulations are changed as a consequence of experience towards ace dynamic framework which endeavours to suspect potential safety hazards so as to decrease the probability of a mishap.In order to explore the useful phase of the aviation safety in our study we collected a total of 144 articles published from many journals. From the study of the articles we sorted a list of 44 variables. After we perform a meta-analysis on the extracted variables.

1.2 Future of Aviation Industry

According to the analysis of Mineata (1997), when today’s accident rate is applied to the traffic forecast for 2015, the result would be the crashing of an airliner somewhere in the world almost every week. Braithwaite, Caves, and Faulkner (1998) stated that in order to achieve safety and reduce accident rate, we must quantify risk and balance it with appropriate safety measures. Long-term challenges and possible outcomes are to be identified for the air transport industry. As the industry continues to grow, it must address issues of capacity, environment, safety, security and financial sustainability.

2. Literature Review

The articles selected for the purpose of literature review cover wide areas of aviation safety. Various researchers in past studied the effect of various variables in different situations which are concerned with the aviation safety.

Shyur (2007) studied that the Statistics indicates more than 70% of aviation accidents are related to human errors and 56% of worldwide hull lose accidents are caused by flight crew errors. It has also been claimed that all accidents have some forms of human error attached to their causes (Braithwaite et al., 1998). Estimation of the human error related risk in a given time interval that a particular airline would be expected to have, upon adjusting for the airline's corresponding safety performance indicators, could help to identify situations in need of heightened level of surveillance by the safety inspectors. The deadliest aviation-related disaster of any kind, considering fatalities on both the aircraft and the ground, was the destruction of the World Trade Centre in New York City on 11 September 2001, with the intentional crashing of American Airlines Flight 11 and United Airlines Flight 175. The World Trade Centre crashes killed 2,752. Giovanni Andreatta, Lorenzo Brunetta and Guglielmo Guastalla (2000) studied traffic network congestion leading toward ground holding policies that are quotient and gave concept of free flight H. J. Hörmann (2001) studies the cultural, organizational and behavioural aspects of crew members on aviation safety. Rick A. Matthews and David Kauzlarich (2000) performed a case study on the crash of ValuJet Flight 592.. Yu-Hern Changa, Hui-Hua Yang(2011) studied the cabin safety perceptions of passengers from their emergency evacuation experiences. Sameer Singh, Maneesha Singh(2002) discussed some technologies for the detection of explosives and application of computers for the analysis of data & images generated from security equipment.

3. Research Methodology

The research methodology adopted to conduct our study revolves around the technique of Meta-analysis. To apply this tool, data was collected related to aviation safety which was the focus of our study. A literature survey was conducted to explore the field of aviation safety throughout its time span. The survey yielded 144 articles were helpful in determining the constituents of automation. Next an in depth study of these research articles was done to search for exploratory variables which defined the constituents of aviation safety. In total, 44 variables were used to develop information framework. These variables were grouped under five primary dimensions which described the nature of contribution made by them in the field of aviation safety.

This information framework formed the basis of our classification schemes used in our study. Having completed the classification of the literature, Meta analysis was performed. It is an important tool for systematic review that provides us with the benefits of generalizing the study while also surfacing the variations and deviations in the field of research. Next, the results are displayed in form of tables and bar graphs. Further, conclusions have been drawn from the study conducted and scope of further study has been identified.

It should be noted that while conducting the literature survey, only research articles which were relevant to the field of study were included as opposed to all the research papers of the journals considered. Further, only those journals which had a high impact factor were included in the study. Although the study cannot be claimed exhaustive, it can be concluded that the study forms a basis for thorough understanding of the field of study.

4. Simple Meta Analysis

The analysis was based on the mode of study of the study performed, the year of publication, the contribution of journals selected for the study, distribution of articles among various dimensions, variable wise distribution and distribution according to classification scheme.

4.1 Distribution of articles by mode of study performed

In the frequency distribution shown in the table 4.1. The articles have been distributed into the three categories according to mode of study performed. First is the conceptual based in which theoretical explanations is given. In the second Category of classified articles the studies have been carried out based on the physical experimental setups. Finally in third category of articles, analytical models have been provided in order to support the work. It is also noticed that the Airspace & Aircraft Factors are dominating in the first and third category and Technical factor in the second. Miscellaneous factors have least contribution among all the modes.

Table 4.1: Distribution of articles according to mode of study performed.

Nature of Dimensions	**Theoretical Concept based articles**		**Physical Experimental based articles**		**Analytical Model (Method) based articles**	
	Number of Articles	**Percentage of articles**	**Number of Articles**	**Percentage of articles**	**Number of Articles**	**Percentage of articles**
Environmental factor	18	12.50	7	4.86	13	9.03
Human Factors	27	18.75	5	3.47	11	7.64
Airspace & Airports	35	24.31	10	6.94	32	22.22
Technical Factors	32	22.22	21	14.58	28	19.44
Miscellaneous factors	10	6.94	7	4.86	10	6.94

4.2 Distribution of articles according to year of publication

This distribution has been shown in the figure 1. To create this distribution, a class interval of two years is selected because any article takes about 1 to 2 years on an average to publish in a reputed/international journal. However, due to lack of sufficient literature prior to the year 2000, a larger interval is considered. The distribution clearly shows that two interval i.e. 2001-02 and 2009-10 contributes to the greater number of articles. With advancement in technologies, vast amount of research has been done in this field which has opened new areas for researchers to explore.

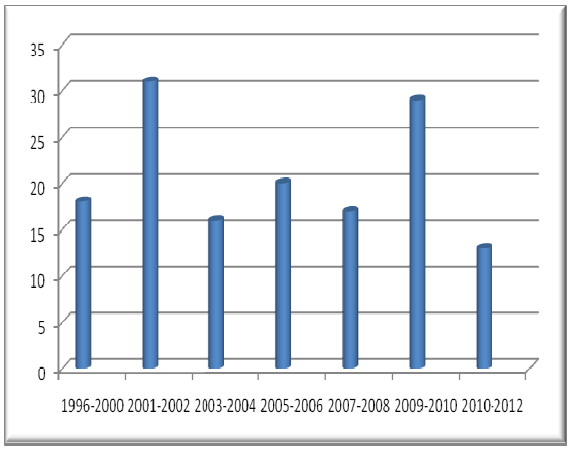

Fig. 1: Distribution according to year of publication

4.3 Distribution of articles Journal wise

The distribution of articles is shown in table 4.2. In our literature review a total of 144 articles were collected from different journals. This distribution was created to identify the contribution of each journal in the area of our research in terms of number of related articles published in the journal towards the particular dimension. It is to be noted that only the journals having impact factor >= 1 have been taken for this distribution.

Table 4.2: Contribution of each journal (Having impact factor >=1).

S. No.	Dimensions	Contribution of each Journal	Journal included in study
		A=02 B=02 C=02 D=01	A=management science B= Transportation Research Part C C= Environmental Modelling& Software D= safety science

1.	Environmental factor	E=02 F=01 G=02 H=06 I=01	E= Journal of Air Transport Management F= Science, Technology, & Human Values G= Accident Analysis And Prevention H= The International Journal of Aviation Psychology I= Environmental Modeling & Software
2	Human Factors	A=04 B=03 C=02 D=04 E=07 F=03 G=04 H=04 I=30 J=01 K=01 L=01	A= Reliability Engineering And System Safety B= Systems Engineering Procedia C=Aviation, Space, and Environmental Medicine D= safety science E= Journal of Air Transport Management F= Science, Technology, & Human Values G= British Medical Journal H= Accident Analysis And Prevention I= The International Journal of Aviation Psychology J= The Journal of the Operational Management K= Interacting with Computers L= Current Directions in Psychological Science
3	Airspace & Airports	A= 01 B=02 C=02 D=04 E=02 F=04 G=02 H=04	A= The Yale Law Journal B= Transportation Research Part C C= Interfaces D= safety science E= Transportation Science F= Journal of Air Transport Management G= Science, Technology, & Human Values H= The International Journal of Aviation Psychology
4	Technical Factors	A=02 B=02 C=03 D=04	A= Accident Analysis And Prevention B= Reliability Engineering And System Safety C=Systems Engineering Procedia D= The International Journal of Aviation Psychology

		A=02 B=01 C=01 D= 01 E=01 F=02	A= Accident Analysis And Prevention B= signal processing C=Aviation, Space, and Environmental Medicine D= risk management E =Ecological Applications
5	Miscellaneous factors	G=03 H=4 I=01 J= 01 K=03 L=06 M=02 N=06 O=02 R=01	F= frontier in ecology and environment G= The Auk H=Wildlife Society Bulletin I= The Yale Law Journal J=Wildlife Society Bulletin K= Economic and Political Weekly L= safety science M= Transportation Science N= Journal of Air Transport Management O= The International Journal of Aviation Psychology R= Southern Economic Journal

4.4 Distribution of articles among various dimensions

All the articles have been distributed among 5 major perspectives of aviation safety namely Environmental, Human, Airspace & Airport, Technical and Miscellaneous. Here, maximum numbers of articles are contributing towards Technical Factors followed by Airspace and Airport. Miscellaneous factors constitute least number of Articles whereas there is moderate contribution of articles towards Environmental and Human Factors. Thus we can infer that a Technical and Airspace- Airports factor has significant contribution to the research sector pertaining to the aviation safety. It is to be noted that one article may contribute to more than one dimension and the percentage is absolute (i.e. calculated out of 144 articles). This distribution is shown in table.4.3.

Table 4.3: Distribution of articles among Dimension.

Nature of Dimension	Number of Articles	Percentage
Environmental factor	38	26.39
Human Factors	43	29.86
Airspace & Airports	77	53.47
Technical Factors	81	56.25
Miscellaneous factors	27	18.75

5. Conclusion

In this paper we analyzed several factors pertaining to aviation safety. The aim of the paper study was to parametric analysis of aviation safety. The analysis suggests that in

theory the human factors are quite comparable to the airport &technical factors. But, when it comes to the experimental &analytical analysis the technical factors and airport & airspace lay a critical impact. The study also yields that the controllable parameters affect the aviation safety to larger extent. Considering that all these variables are governed by the technological aspects & human management, it's quite explicable. We also unearthed that tangible factors like Air traffic control aircraft technology, design, maintenance etc. play a indispensable role in safety affairs. This suggests that it is possible to certain extent to fathom and exercise the safety concerns in an legitimate manner.

There were many unexplored areas that surfaced during the study as well as during Meta analysis. These are opportunities for the future researchers to work upon. Lack of mathematical model was one such example. Finally, the review cannot be claimed exhaustive but is sufficient to provide a clear understanding of the various aspects of aviation safety. Also it provides a foundation for further research in this field. This analysis can be used as a reference to determine the areas that still need exploring and further study.

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