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Human Factors Investigation of Civil Aircraft Accidents : An Indian Perspective

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The medical investigation of any aircraft accident consists of identification of the human factors concerned with the accident. The International Civil Aviation Organisation (ICAO) has laid down guidelines regarding investigation of these human factors. This paper presents a comparative study of the human factors analysis in civil aircraft accidents in India vis-a-vis ICAO's guidelines. Suitable recommendations regarding organisation of an ideal aeromedical investigative set up are made.

Introduction

International Civil Aviation Organisation (ICAO) emphasise that the broad purpose of aircraft accident investigation is primarily to indicate what caused the accident rather than who caused it which should rightly be for others to decide. This paper is a presentation of some observations and suggestions of the authors based on their experience of investigating a few major civil aircraft accidents and the emphasis is once again on not who is at fault but what can be done to improve the existing aircraft accident investigative machinery with particular reference to the human factors analysis.

ICAO Guidelines on Aircraft Accident Investigation

Standards and recommended practices for aircraft accident inquiries have been laid down by ICAO in Annex 13 to the Convention on International Civil Aviation. These have been totally accepted by India without any differences. Thus an investigator-in-charge (designated as the Inspector of Accident in India) is appointed as soon as an aircraft accident is notified. He will be assisted by various Working Groups, the number of groups and the number of personnel assigned to each group varying with the type and complexity of each accident. The various groups are :

Operations,
Weather,
Air Traffic Services,

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Witness Statement,

Flight Recorder,

Structures,

Power Plants,

Systems,

Maintenance Records,

Human Factors, and

Evacuation, Search, Rescue and Fire Fighting groups.

The areas of reponsibility of these groups are self-explanatory. The present discussion will be confined to the activities of the human factors group.

Human Factors Group

This group is responsible for the aeromedical and crash injury aspects of the aircraft accident investigation. Some of the aspects of the accident to be covered are :

(a) The possibility of crew incapacitation, the general physical and psychological conditions of the crew members and the environmental factors which might have affected the crew.

(b) The identification of the crew, their location at the time of the accident, and, by review of their injuries and pathological examination of the cockpit, what they were doing at the time of the impact.

(c) The possibility of psychological factors among passengers that might have contributed to the accident.

(d) Matters involving autopsies of crew and passengers, as appropriate, not only to identify the victims and to assist in legally determining the cause of death, but to obtain all possible medical evidence which may be of assistance in the technical investigation.

(e) The evacuation and survival aspects, the design factors (as related to human engineering) which may have contributed to the cause of the accident, the injury or death of aircraft occupan and the crashworthiness of the aircraft.

ICAO recommends that the head of the Hun Factors Group should be a specialist in aviati medicine with experience in aircraft accident inve tigation. In fatal accidents a pathologist, idea with experience in aviation pathology or at least forensic pathology, should also be included in t group. If the pathologist has experience in aviati pathology, he may well be appointed as head of t group depending on the type of accident bein considered and other Human Factor consideration The importance attached to aviation pathology ICAO is evident from the recommendation that th Investigator-in-charge of a major fatal aircraft acc dent should consider requesting other countries provide an aviation pathologist if one is not avai able in the country which is investigating th accident.

Contribution of the Human Factors Investiga tion

The areas where human factors investigation can make valuable contributions are :

(a) Reconstruction of the circumstances

(b) Human engineering and survival, and

(c) Identification

Reconstruction of the circumstances leading to the accident

The most important aspect of the medical investigation is to ascertain if pilot incapacitation preceded the accident. A partial or complete incapacitation of the operating crew may be the actual cause or a contributing cause to an accident. Some causes of sudden incapacitation are :

Myocardial infarction,

Cerebrovascular accident,

Other major illnesses,

Carbon monoxide and aerial application chemical intoxication,

Hypoxia,

Alcohol intoxication,

Sleep (fatigue, hang-over),

Drugs and minor illness, etc.

These factors are much more significant in light aircraft accidents with single crew. In multi-crew aircraft sudden pilot incapacitation from disease or drugs as a cause of a major accident is less likely unless it occurs during the critical phases of flying such as take-off or landing. In a large aircraft with multiple crew, conditions likely to affect the whole crew in particular carbon monoxide or other noxious fumes that may have contaminated the cockpit, may be found to be the cause of crew incapacitation.

A full examination of the crew, cabin attendants and passengers may reveal evidence as to the sequence of events, the stage of flight and the degree of emergency anticipated The pattern of injuries may indicate clearly the type of accident-fire in flight structural failure in flight, sudden or gradual deceleration at impact etc. An examination of the passengers may be the prime method of demonstrating sabotage as an accident cause.

Human Engineering and Survival Aspects : The human factors investigation concerns the human engineering aspects such as design of cockpit controls and instrument displays which predispose to pilot error. Emotional aspects of the pilot's make up prior to the accident which promote unsafe flight activities are also explored. Studies to determine human failure include history of the flight, personal and medical history of the crew, autopsy, toxicological and crash injury analysis. All these provide medical evidence which is of great value in relation to human engineering and survival. The relevance of the the type of harness restraint in use, the provision or lack of other items of safety equipment and the injury producing potential of the controls, instruments and other cockpit structures are evaluated by the Human Factors Group. In transport aircraft accident the group will be searching for evidence of injury resulting from seat structures with or without adequate harness restraint and the missile effect of contents of the cabin. Adequacy or inadequacy of walkways, exits and survival equipment will also be studied. It is vital to aviation safety environment that the relationship between the injured tissue, the structure, protective devices and emergency escape procedures be established by crash injury analysis.

Identification : The accurate identification and location of bodies and their separate parts is of vital importance in reconstructing the sequence of events resulting in a fatal accident. identification is therefore pre-eminently a tool of investigation but it also has major medico-legal significance and judicial application.

Human Factors Investigation in India

A study of accidents involving Indian registered aircraft during the period 1960-1981 reveals that of the total 519 aircraft accidents, 402 (77%) were human error accidents. Except for 2 or 3 major fatal aircraft accidents, none of these accidents were investigated by any aeromedical expert. Even after this period, upto now only about another 3 or 4 accidents have been investigated by Human Factors Groups as envisaged by ICAO, i.e. the Groups having contained at least a medical member if not an aeromedical expert. Whether aeromedical investigations would have made any difference to the final outcome of those inquiries and thus contributed to air safety in general will remain conjectural.

At present an aviation medicine specialist is available to the Civil Aviation Department as the Assistant Director of Medical Services (Civil Aviation) from Air Headquarters who is located at the Office of the Director General of Civil Aviation. His services are being utilised only in inquiries on major public transport aircraft accidents that too in fatal accidents only. Thus a large number of aircraft accidents do not get the benefit of a proper aeromedical investigation even though the required expertise is readily available. It is surprising that

inspite of the very high incidence of human error as cause of aircraft accidents in India, the civil aviation authorities do not insist on aeromedical investigation of all accidents where Human Factors might have been relevant.

As already stated, a few fatal air crashes in the past have been investigated by Human Factors Groups consisting of medical officers or aeromedical experts. Our experience with some of these inquiries has shown the following areas where improvements are indicated :

(a) At present inspite of the best efforts, there is a time delay of over 48 hours before the medical member and other members are able to reach the crash site and initiate various specialised investigations. This delay is essentially due to inadequate communication and operational readiness.

(b) Consequent to the above delay, the medical member may reach the scene of accident only to find that some dead bodies have been disposed off or autopsies already completed. Considering the valuable information obtainable by application of the specialised techniques of aviation pathology known to the aeromedical expert, the above loss may be very significant.

(c) Crash injury analysis often suffers because the search and rescue teams fail to record the exact location of dead bodies and injuries of the victims in relation to the aircraft-wreckage. The first responsibility following an aircraft accident is always to give immediate assistance to the injured by whatever means can be made available. In the event that life cannot be saved in that particular accident, the next responsibilities are to save lives in future accidents and to save lives by trying to prevent future accidents. This is the principle underlying the whole investigation of the accident and there is an urgent need to indoctrinate all personnel involved in various civil aviation activities on their role in aircraft accident investigation.

(d) Even though there are guidelines issued by the civil Aviation authorities regarding the role of police in post crash situations, this information is not well disseminated to all police outposts. This results in avoidable delays and confusion particularly in prompt and thorough postmortem examinations of crash victims.

(e) The aeromedical aspects of autopsy on aircrash victims are not widely known to the police surgeons and other civil medical authorities conducting the autopsy with the result that valuable information may be lost by the time the aviation medicine expert arrives at the scene to render necessary advice and assistance in post mortem examination.

(f) In fatal aircrashes involving passenger aircraft, the Human Factors Group investigating the crash usually includes a medical member from the Airline concerned. It has been our experience that this medical officer is at a disadvantage because on the one hand he, being an employee of the Airline which is an interested party in the outcome of the inquiry, does not get the full confidence of the inspector of accident and on the other hand the Airline management does not expect him to be a party to any report reflecting adversely on the organisation.

(g) A disappointing aspect of the accident inquiries is the inadequate communication and cooperation between the various groups some of them functioning with extreme secrecy unwilling to exchange information freely. The general impression of the civil aviation officials appears to be that the role of medical experts in an accident inquiry is confined to collection of data on past medical history of the crew, autopsy findings, details of injury and to give opinion on the role of alcohol in the causation of the accident. The other important aeromedical aspects such as crash injury analysis, human engineering, survival, crash rescue services etc are not fully appreciated. Even though ICAO has stressed on the importance of cooperation and close liasion between the various groups particularly between Human Factors, Operations, Witness Statement and Evacuation, Search, Rescue and Fire Fighting Groups, the medical members have to

spend valuable time during the inquiry in indoctrinating the other members of the teams on these matters in order to get the relevant data on various non-medical aspects of the crash.

(h) In judicial inquiries it has been our experience that not enough enquiries of aeromedical significance are made since the judge does not have the assistance of an aeromedical expert on his panel.

Recommendations

There is some substance to the frequent demands voiced in the Press etc. for the establishment of a central accident investigation organisation separate from the civil aviation administration. In India, many facilities of civil aviation such as provision of air traffic control services, maintenance of airports, training and licensing of aircrew etc. are the responsibility of the Civil Aviation Department. Thus if the investigation is carried out by the Department officials as is the practice now there can be room for the argument that the outcome of the inquiry may be biased. An independent investigative machinery probably answerable directly to the Civil Aviation Minister as in some other advanced countries, will mean that various aspects of accident inquiry will get uniform and unbiased attention.

In the field of aviation medicine India's achievements are comparable to those of any advanced western country. The expertise available with the Institute of Aviation Medicine and the Aeromedical Society of India is not fully being utilised by the Civil Aviation Department. The Indian Air Force has always been ready to make available the services of experts in aviation medicine and aviation pathology for civil aircraft accident inquiries. There is scope for setting up a full fledged department of Civil Aviation Medicine at the Institute of Aviation Medicine under the joint auspices of the Air Force, Civil Aviation Department, the three Airlines and the International Airport Authority of India. This nucleus could take on all research and training activities in the field of civil aviation medicine with special reference to medical investigation of accidents and improvement of emergency medical care and search and rescue facilities at the various airports. It will be appreciated that some other countries such as the USA have full fledged institutes of civil aviation medicine.

The delay presently experienced in rushing the medical and other members of the inquiry team to the scene of accident can be minimised to a large extent by attending to the operational readiness aspects. Thus it should be possible to nominate a few personnel including medical experts for accident inquiries and to provide them with valid emergency air travel passes etc. so that within a few hours of the notification of the accident they can leave for the crash site by the fastest means.

The aeromedical aspects of aircraft accident inquiry must be given wide exposure among medical police and judicial professions. Suitable administrative measures and use of mass media will help in achieving this dissemination to a considerable extent.

The judicial inquiry teams should preferably have an experienced aeromedical expert as one of the assessors so that much more deliberations on various aeromedical aspects of the accidents could be conducted.

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