Image Cover Sheet

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TITLE

THE ANALYSIS OF HUMAN FACTORS IN AIRCRAFT ACCIDENTS

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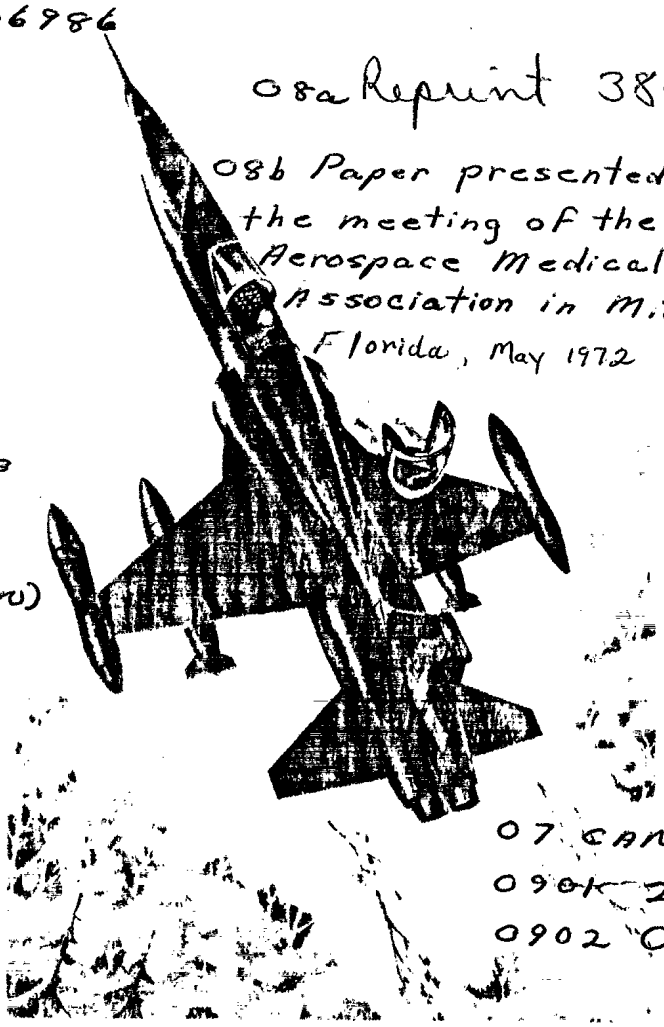
04a The Analysis of Human Factors in Aircraft Accidents



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INTRODUCTION

Canada's new Defence and Civil Institute of Environmental Medicine (DCIEM) was formed in April 1971 from the former Canadian Forces Institute of Environmental Medicine and the Defence Research Establishment Toronto. The new Accident Investigation Group was then given the opportunity in July of that year to develop, from first principles, a systematic approach to the analysis of human factors in aircraft accidents. That systematic approach is best described by using a model (fig 1). The value of constructing a model of this type lies in its ability to present an overall picture of the analysis of human factors – a picture which shows how the components interact with one another. Our model, then, is one which attempts to consolidate and assimilate the knowledge and experience of all those people and agencies involved in aircraft accident investigation and prevention. This article is intended to communicate some of the thoughts which led to the development of our model. Let us first consider what we mean by the human factor in aircraft accidents.

The three elements of aviation, the man, the machine and the environment, are not easy to separate because Man is involved in all of them. Man designs and makes aircraft, services and repairs them and controls their flight. Man is responsible for predicting the weather and for deciding the relative favourability of conditions for flight. Clearly, the human factor, not the machine component or the environment, plays a predominant role.

In aircraft accident prevention, our prime concern has become the Man because today the largest percentage of all accidents are caused, in part at least, by so-called human factors.

Now, keeping one eye on our model diagram, let us follow the various components.

OBJECTIVE

The key point in the development of any model is a clear statement of the objective. We concluded that our objective must be the elimination of the human factor as a cause of aircraft accidents. We chose as our objective "elimination" as opposed to "reduction" to avoid any suggestion that the reduction of human factors causes by whatever margin would be an acceptable goal.

PREDICTABILITY

The best way to eliminate the human factor as a cause of aircraft accidents is to use the three E's of aviation safety, Education, Engineering and Enforcement. You can educate the operator better, engineer the aircraft better and enforce the rules and regulations better.

Each of these solutions, however, depends upon our knowledge of or our ability to predict aircraft accidents. Elimination of a particular factor as a cause of aircraft accidents depends upon predictability. If we can predict that when a certain factor is present, there is a high probability that an accident will occur, then we are in a position to do something about it.

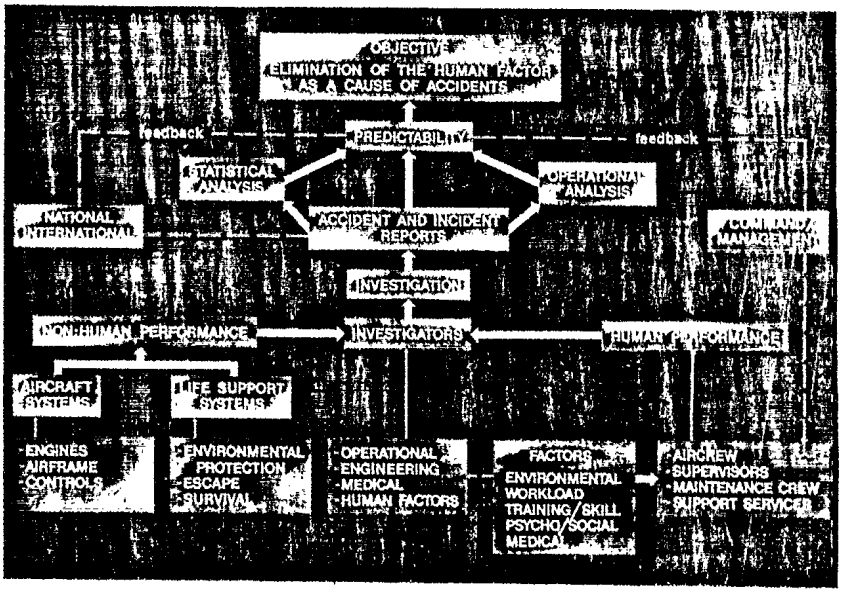

Figure 1

ANALYSES

Predictability can be obtained in two basic ways. The first, *Statistical Analysis*, looks at many accidents or incidents over a period of years in an attempt to isolate critical problem areas. For example, statistical analysis of general aviation accidents might show that 80% of all accidents involved pilots who have had a minimum of *x* hours flying time in the previous six months. Statistical analysis also permits the identification of trends in minor accidents or incidents which may have the potential to cause a major accident.

The second method, which we have termed an *Operational Analysis*, is based on the thorough analysis by experienced professionals, of individual accidents. Such an analysis exposes faulty human engineering, improper operating procedures or medical factors that have potential to cause future accidents.

THE INVESTIGATION

The analysis of accident and incident data must be based upon accurate information. In the Canadian Forces, the first time all data related to a given accident are brought together is in the accident reports Board of Inquiry, CF210, an Occurrence Report (CF215) or a Physiological Incident Report (CFMO 42.03). These reports form the basis of all future analyses, both statistical and operational.

The production of a good accident report presupposes a thorough investigation. An investigation could be completed in a mechanical fashion using a check-list, but an effective investigation depends upon trained *investigators* operating intelligently as a team. The investigators are the essential core of any accident analysis system. The investigation team invariably includes representatives of the operational, engineering and biomedical/human factors professions. Other specialists may also be added to a particular investigation when required. These investigators examine both human and non-human performance in an attempt to identify cause factors.

Non-human performance refers to engineering oriented components. These include aircraft systems, such as environmental protection, escape and survival systems.

Human performance that the investigators must examine includes factors affecting the activities of the aircrews, the supervisors, the maintenance crews and the support service staffs such as air traffic control, meterology and food services.

Discussions with accident investigators and analysts in the U.S., Europe and Canada have revealed the absence of a unified approach to the gathering and analysis of human factors accident data, and this is our prime area of concern at DCIEM. Just as an engineering investigation examines the operating condition of all aircraft components at the time of, and prior to the accident, in a thorough and systematic fashion, a human factors investigation must examine all relevant human activity and judge the performance quality in just as thorough and systematic a fashion. This examination must consider environmental factors, workload, human skills and training, as well as equipment design, operating procedures and the psycho-social and medical histories of the personnel involved.

The total investigation team, not just the biomedical specialists, must be familiar with the human factors and how they might have interacted with the other aspects of the accident. This will contribute to the ultimate quality of the investigation and the accident report.

There is an additional subtle reason why investigators must recognize the significance of specific human factors involved in an accident. That is, that these same factors often affect the quality of the investigation being conducted. An example of this was seen last year in the investigation of an accident that occurred in the Arctic, where environmental factors influenced the quality of the investigation. The same adverse weather which was a factor in the accident, also prevented the investigators from reaching the site for several days and the short day combined with the extreme cold prevented them from examining the wreckage as thoroughly as they might in a less hostile environment.

Training investigators in the importance and nature of human factors and how these factors may contribute to an accident is essential to the development of thorough investigations and reliable and comprehensive accident reports. Without this training, investigators cannot be expected to analyze human factors accurately. This could lead to overlooking relevant causes or to the assignment of invalid cause factors, and a reduction in our potential to predict future accidents.

FEEDBACK

When reliable predictability has been achieved, the information must be fed back into the accident prevention system. The feedback system must provide rapid and useful information to permit the management/command system to institute preventive measures.

The feedback system must also be able to relate to the experience of other investigating agencies both nationally and internationally. Such links would increase the statistical base of all accident analysis organizations. This is particularly important when dealing with new aircraft types in which there is limited accident experience.

WHERE TO FROM HERE?

The developing of this model has permitted us at DCIEM to look at the overall picture of the analysis of human factors in aircraft accidents and to determine where our efforts in support of accident prevention in Canada may best be directed.

In the course of developing this model, we felt that we could be most effective in the following ways:

First, a computerized information storage and retrieval system has been designed to support human factors investigators in the field, to assist DCIEM accident analysts in their review of accident reports, and as a research tool, to manipulate the large amounts of information necessary for statistical analyses. The implementation of this computer system is nearing completion.

Second, the development of improved and systematic techniques for a thorough human factors investigation is necessary and more investigators need to be trained. We are currently developing new analytical techniques and procedures and emphasizing their importance in Flight Surgeon and Flight Safety Officer training.

Finally, our feedback system needs to be exercised and monitored continually to ensure the best application of the collective experience of all those involved in accident analysis.

As a reader of this article, you have become part of the feedback system. Painless wasn't it? Can you assist us?

This article was presented as a paper at the meeting of the Aerospace Medical Association in Miami, Florida in May 1972.

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