


# Image Cover Sheet

<b>CLASSIFICATION</b>  UNCLASSIFIED	<b>SYSTEM NUMBER</b> 500392 
---	---

**TITLE**  
A METHOD FOR INVESTIGATING THE HUMANS FACTORS ASPECT OF CANADIAN FORCES  
AIR ACCIDENTS

**System Number:**  
**Patron Number:**  
**Requester:**

**Notes:**

**DSIS Use only:**  
**Deliver to:** FF





# A Method for Investigating the Humans Factors Aspect of Canadian Forces Air Accidents

► Helen L. Wright  
 ►► Robert Banks

## ABSTRACT

In the past, the Canadian Forces system of air accident investigation did not include a consistent or effective method for exploring human factors. A new approach has integrated three components:

- a detailed human factors framework;
- a computer interface and database; and
- an on-site human factors consultant.

The framework will be employed as a laptop computer-based checklist for use by the investigating flight surgeon. It will also serve as a database for long-term research in human factors. A computerized taxonomy reduces many of the disadvantages posed by traditional "checklists" and has the advantage of being flexible, can interact with the user, and provides reporting templates. In addition to this investigation tool, a human factors consultant assists the investigation team on-site to further integrate human factors findings into the investigation process. The combination of detailed human factors framework and on-site consultant has been relied on in six major investigations. Formal validation has not been done, but subjectively it is clear that these changes have had a positive impact on the human factors investigation and have created a stronger base for review and analysis.

## RÉSUMÉ

Dans le passé, le système d'enquête sur les accident aériens que préconisaient les Forces canadiennes ne faisait pas état d'une méthode uniforme ni efficace d'étudier le facteur humain. Une nouvelle méthode a donc été adoptée et comprend les trois éléments suivants :

- Un cadre détaillé du facteur humain
- Une interface et une base de données informatiques
- Un expert-conseil sur place responsable du facteur humain.

Ce cadre servira de liste de vérification saisie dans un ordinateur portatif, mis à la disposition du chirurgien de bord qui

► B.Sc., Aerospace Life Support Sector, Defence and Civil Institute of Environmental Medicine, North York, Ontario M3M 3B9

►► B.Eng., MD, Aerospace Life Support Sector, Defence and Civil Institute of Environmental Medicine, North York, Ontario M3M 3B9

DCIEM No. 96-P-29

## INTRODUCTION

Over 83% of the cause factors assigned in Canadian Forces (CF) air accidents are attributed to personnel.<sup>1</sup> While the importance of human factors in flight safety is recognized, modern, innovative approaches to accident investigation have been slow to evolve. Recently, the Directorate of Flight Safety (DFS) and Defence and Civil Institute of Environmental Medicine (DCIEM) developed a new approach to human factors investigation.

A Flight Safety Board of Inquiry will normally be convened for occurrences involving A-category (aircraft destroyed or beyond economical repair) or B-category (aircraft must be shipped to contractor for repair) damage, missing persons, fatalities, or serious injury. The Board is composed of a president (normally a pilot) and at least three members: an engineer, a pilot, and a flight surgeon. Typically, members will approach the accident with no previous investigative experience. The flight surgeon member is expected to conduct the human factors investigation. CF flight surgeons receive approximately one week of human factors and air accident investigation training during flight surgeon training. Trained and experienced DFS staff support the investigation, but the Board is expected to reach conclusions independently.

DCIEM reviews all Air Accident Investigation Reports (AAIRs), including the separate Medical Report. A human factors report is generated that reviews and expands on human factors aspects of the investigation. The DCIEM working group has a wide range of resources available and may consult with other DCIEM staff or outside experts. Despite this opportunity for expert analysis, it has become apparent in the course of this review process that productivity of the human factors review depends on the quality and content of the AAIR.

Previously there was no systematic method of human factors information collection, reporting, or data storage. The investigators typically have little or no experience or training in accident investigation or human factors. As a result, interpretation and analysis of human factors aspects of past accidents has been inconsistent — hence, there is little basis for long-term research.

To address shortcomings in experience and provide access to expertise, a structured procedure was designed. The procedure aimed to modify the existing method and enhance three phases of CF investigation: Board of Inquiry investigation; post-investigation review; and prospective human factors studies.



effectue l'enquête. Il doit aussi servir de base de données pour les recherches à long terme sur le facteur humain. La taxinomie informatisée élimine plusieurs des inconvénients que pose la «liste de vérification» traditionnelle. Elle a pour avantage d'être souple, facile pour l'utilisateur et propose des modèles pour l'établissement de rapports. En plus de cet outil d'enquête, un expert-conseil en facteur humain aide l'équipe d'enquête sur place à mieux intégrer à l'enquête en cours, les résultats des recherches sur le facteur humain. Cette combinaison d'un cadre précis du facteur humain et d'un expert-conseil sur place a servi à des enquêtes importantes à six reprises. Il n'y a pas eu de validation formelle, mais sur le plan subjectif, il est évident que les changements ci-dessus ont eu des effets bénéfiques pour les enquêtes sur le facteur humain et ont permis d'effectuer des examens et analyses plus solides.

### APPROACH

The difficulties inherent in human factors investigation are common to other organizations and many different approaches have been proposed.<sup>2,3,4</sup> These range from checklists to task or systems analysis, and there is considerable variation in the level of detail and the user expertise required. A survey of existing systems and methods did not reveal any ready-made solution that would fit the CF requirement.

Our approach encompassed three integrated components:

- a detailed outline that is a framework and practical guide for the investigation;
- a computer database to address the utility of that framework and to provide information storage and retrieval; and
- an on-site human factors consultant to assist with accurate analysis in the initial stages.

### Framework

A framework was needed to guide the investigator and to ensure standards and consistency between investigations. A detailed catalogue system, or taxonomy, was recognized as a direct way of helping investigators process the available performance data and recognize the multitude of possible casual

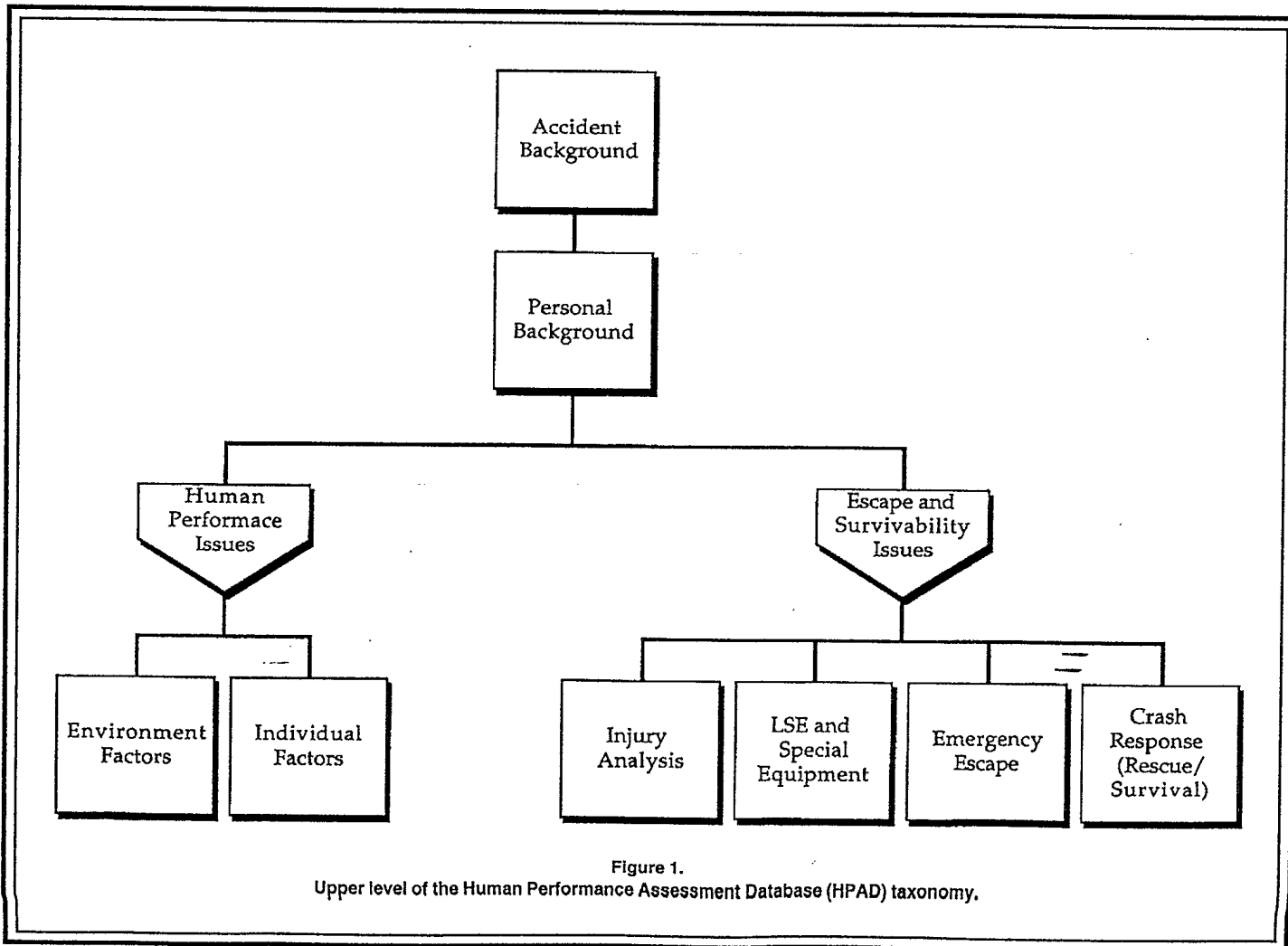


Figure 1. Upper level of the Human Performance Assessment Database (HPAD) taxonomy.



interactions. Such a framework does not stand alone. Just as a knowledge of aviation and military operations is required to apply this framework, so is an understanding of theories on human performance and error.

An extensive taxonomy was developed for this application covering environmental and individual factors, injury analysis, life support equipment, emergency escape, and crash response (Figure 1). It was designed to focus flight surgeon investigation and data collection by touching on all aspects of aviation performance. It offers an extensive series of hierarchical categories, followed by sub-categories as necessary. It characterizes the human factors in a logical manner and then provides for amplification of the specific circumstances.

### Computer-based

A computer-driven format was selected. The computer format allows the framework to be very detailed without becoming unwieldy. Since the computer format is flexible, it can be customized to each investigation. The Human Performance Assessment Database (HPAD) protocol leads the investigator through the information in a temporal or step-by-step logical progression while facilitating retrieval of the information in an intuitive or topic-oriented format.

The computer-based taxonomy was designed for laptop use during the on-site investigation. The flight surgeon records the results of the investigation directly into the laptop database as the investigation progresses. The HPAD taxonomy is provided as an annotated framework that the investigator moves through in a series of guided topics. This information is then used by the investigator to hypothesize probable areas of follow-up. In addition to HPAD's function as an investigation tool, this information provides the basis for later analysis, and eventually will be used for prospective studies as part of a relational database of aircraft accident information.

### Consultant

The third element of the protocol is the inclusion of an on-site human factors consultant on the Board of Inquiry. The Board of Inquiry should have ready access to timely, expert advice from a broad range of professions. Such access is available through a human factors on-site consultant who has access to appropriate expertise at DCIEM. This expertise allows analysis of the complex operational data as it relates to the experimental and theoretical literature on human behaviour.

The Board of Inquiry flight surgeon is responsible for the human factors investigation. The consultant advises the Board. The HPAD tool has been designed for flight surgeon use. The consultant arrives with the HPAD laptop and provides advice on the method of investigation and use of the laptop. The flight surgeon completes the bulk of the investigation in co-ordination with the rest of the Board.

## DISCUSSION

The combination of detailed taxonomy/investigation procedure and on-site consultant has been relied on in six major investigations since December 1994. Formal validation has not been done, but subjectively it is clear that the consultant approach has had a positive impact on the relevance, thoroughness, and scope of the human factors investigation and has created a much stronger base for review and analysis. In one outstanding example, evidence of the "push-pull effect" has resulted in a major research program (see "A New Understanding of the Effects of +G" this issue, pp. 143-145). The investigation team was able to immediately recognize the significance, collect applicable information, and liaise with the appropriate experts at DCIEM.

The computer interface is still in development and has not undergone trials by novice investigators. Since the current consultant is completely familiar with the taxonomy, this has not decreased the support to the investigation teams. Critique of the long-term utility of this system is not yet possible. \*

## REFERENCES

- <sup>1</sup>David, J.F. (1992). "The Human Factor Problem in the Canadian Forces Aviation," *Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques* (Chapter 1), Neuilly-sur-Seine, France, NATO-AGARD, AGARD-CP-532.
- <sup>2</sup>Feggetter, A.J.W. (1991). "The Development of an Intelligent Human Factors Data Base as an Aid for the Investigation of Aircraft Accidents," *Proceedings of the 6th International Symposium on Aviation Psychology*. Columbus, OH: The Ohio State University, pp. 624-629.
- <sup>3</sup>Friedman, L., Leedom, D.K., and Howel, W.C. (1991). "A New Approach Toward Diagnosing Military Aircraft Accidents," *Military Psychology*, 3(2): 113-126.
- <sup>4</sup>Levey, R.A. (1992). "A Method for Investigating Human Factor Aspects of Military Aircraft Accidents," *Aircraft Accidents: Trends in Aerospace Medical Investigation Techniques* (Chapter 1), Neuilly-sur-Seine, France, NATO-AGARD, AGARD-CP-532.

500392