

AN INTELLIGENT SYSTEM FOR THE PRE-MISSION ANALYSIS OF HELICOPTER EMERGENCY MEDICAL SERVICES

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Abstract

Helicopter medical emergency services are vital in life saving. These services operate under adverse conditions. Mission analysis for appropriate decisions by crew is critical in such an operational environment. The decision is crew judgment based. To provide a pragmatic decision support for the crew, an intelligent system needs to be developed. In this paper, research on pre-mission analysis is re-visited to progress the development of an automated pre-mission analysis system.

Introduction

Helicopter emergency medical services (HEMS) are a critical service to local, regional and rural communities of Australia. HEMS capability on such life-saving missions is based on timely response by appropriate paramedics and equipment on-board, followed by transit to a tertiary care centre.

HEMS missions are unpredictable and depend on a range of factors. The different emergencies calls are round-the-clock, all weather, and over any terrain. Statistics have shown HEMS operations to be over-represented in rotorcraft accidents [1][2]. Two of the main causes of accidents are inadvertent flight into instrument meteorological conditions and fuel starvation; both of which are avoidable. Loss of HEMS rotorcraft and its crew has critical impact on the community. A remedial action is required to mitigate the risks inherent in HEMS operations.

Presently the pre-mission analysis that assesses the viability of a HEMS response is conducted by the crew – thus susceptible to human error. A software-based decision support system has been proposed to assist the crew with pre-mission analysis, for enhancement of operational safety [3][4]. The assistance in the form of a ‘decision support system’ will make the pre-mission analysis more robust, ensuring that the crew does not overlook precursors to accidents.

Decision Support Tools

Due to the high costs associated with accidents in modern aviation, risk assessment and mitigation are a primary concern to operators. A risk assessment tool was developed by the Flight Safety Foundation (FSF) to determine the susceptibility of a flight to Controlled Flight Into Terrain (CFIT) accidents [5]. This tool uses statistical data on CFIT accidents/incidents to provide a quantitative assessment of CFIT risk. Presently, this system exists in the form of a checklist and is freely distributed by FSF.

Another work relevant to this field of research deals with ‘Associate’ systems. In particular, the Urban Helicopter Associate System (UHAS) is intended to be a decision aiding tool for urban settings, such as those required by law enforcement and emergency services, with the purpose of reducing the rate of mishaps [6]. Boeing and Applied Systems Intelligence have developed a real-time functional prototype of UHAS jointly.

Scope of Current Research

The decision support system to be developed for HEMS mission analysis will be a knowledge-based system, partially automated. The system is modeled on Air Ambulance Victoria’s (AAV) current operation structure, and as such will be distributed across physical locations. Elements of the system will be present at Flight Control, at each HEMS base, and on-board the helicopter during each mission.

The system will be developed, tested, and validated at Air Ambulance Victoria before application at other HEMS organisations. The core components of the system will be generic, while the databases and the subsets of the ‘expert’ knowledge will be customised to the specific organisation.

The two main functions of the system are:

- To determine whether the mission should be accepted or declined, based on the viability of the mission and the capabilities of the HEMS operation; and
- To determine the most appropriate response team for the mission to achieve optimal performance.

System Framework

Research on HEMS at the Wackett Aerospace Centre resulted in the formulation of a broad framework for pre-mission analysis [3,4]. This framework is re-considered from the perspective of an intelligent system. The re-designed framework is presented in Figure 1.

The re-designed system framework indicates the iterative nature of the system, the static and dynamic nature of the required inputs, and the key role of the human operator in the ‘enhanced’ operational safety process. The functions of the key modules are as follows:

- **Situation Assessment:** This module is the hub of communications between the various elements in the system. This module manages the data quality (currency, consistency, and validity);
- **Information Management:** This module will adapt the information displayed to the user based on the type of mission, phase of mission, and irregularities in the operation;
- **Error Management:** This module will assess the current situation and compare it with the mission plan. The user will be alerted of any inconsistencies and will be recommended remedial actions; and
- **Mission Planning:** This is the core module in the system. It will determine which responses are possible, optimal, compliance with standard operating procedures (SOPs), and have significant risks associated.

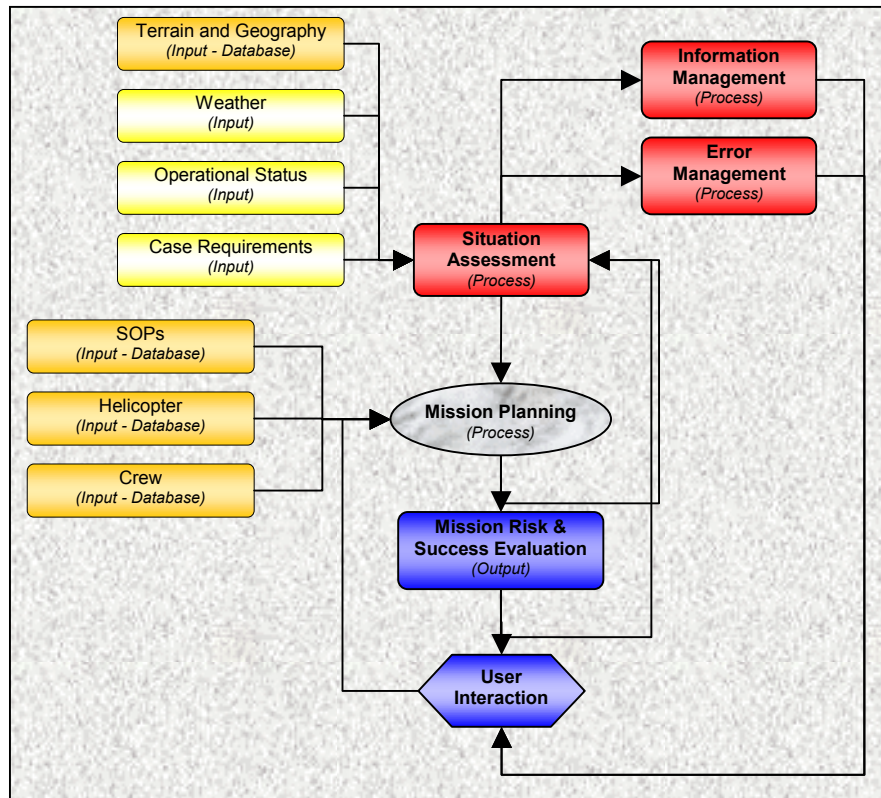


Figure 1 System framework for HEMS pre-mission analysis system

The functions of associated components of the key modules are as follows:

- **SOPs Database:** This is the encapsulated knowledge from experts (pilots, paramedics, flight controllers, and crewmen) in the field of HEMS operations. This will be developed through extensive consultation with staff at AAV; and
- **Mission Risk and Success Evaluation:** The output of the system is an assessment of risk and success capability. The system will detail the basis for all assessments and will recommend possible remedial actions if required.

Issues and Challenges

There are several issues and challenges of research in the detailed development and implementation of this system. Some of these are as follows:

- **Knowledge representation methodology** to accurately encapsulate the expert knowledge of AAV staff in a manner that can be efficiently modified in future and applied to other HEMS organizations;
- **Mobile data acquisition/interchange** is essential for the accurate operation of the system. The system will need to cope with the impact that distance and terrain will have on it;
- **Robust operability** is essential for the systems acceptance into life-critical operations such as HEMS. This involves robustness in each element of the system, including hardware and software; and
- **Simplified modifications/upgrade methodology** is required as HEMS operations are constantly evolving with the addition of new equipment, new techniques, and new operational policies. Without the facility to upgrade the system easily, the system would become obsolete.

Concluding Remarks

The re-designed system framework provides an avenue to address the issue of safety in HEMS operations. The partially-automated process will perform a robust analysis to provide time-critical support for HEMS decision-making. Though there are issues and challenges yet to be addressed, a via media is to be identified and developed through extensive research.

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