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Hazards and Risk Analysis for Helicopter Aerial Work Mission Profiles

D. Tilloca[*] - M. Gajetti[#] - G. Guglieri[*]

[*]Politecnico di Torino – Dipartimento di Ingegneria Meccanica e Aerospaziale
Corso Duca degli Abruzzi 24 – 10129 Torino (Italy)
e-mail: giorgio.guglieri@polito.it

[#]Sirio Airline SpA - FlexJet Group
Viale dell'Aviazione 65 - 20138 Milano (Italy)
e-mail: marco.gajetti@sirio.aero

Abstract

Human factors are considered one of the major contributors to the causes of civil aviation (i.e. general aviation and scheduled flight transport) incidents and accidents. The interaction between man and aircraft therefore implies a series of risks and jeopardizes the safety of operations right from the planning stage. In the rotorcraft field, moreover, there are mechanisms (and consequently hazards) which are more complex than those observed in the fixed wing exemplar cases. As a matter of fact, the versatility of use of helicopters leads to operate in missions of complex fulfilment by the pilots, with the consequent increase of the risks.

Due to the wide range of aerial works that helicopters can carry out, different types of hazards can be embedded into the system (night/day difference, types of aerial work, …). The authors made some hypotheses about how helicopter crews could achieve an aerial work mission although considering the extreme variability of performance of the system formed by the helicopter, the external environment and the pilot, in terms of human factors. For such reasons, the present work firstly aims to present a general overview of typical helicopter missions, in order to outline an exhaustive picture of the potential risks and hazards that may be faced during different flight activities.

Several risks related to flight operations can be assessed and prevented by means of an adequate organizational and operational management. As decision-making in organizations is performed by humans, the human factors impact in aviation extends its range to supervisors, managers and management boards. This subject is hence addressed, as a thorough explanation of the major role assumed by organizational decision-makers and by the concept of *'allocation of responsibilities'* in operational safety.

As the relevance of human factors in safety has been progressively recognized, several methods were developed to identify the aviation incident/accident features, pathogens and their consequent mitigation means. Analysis models such as *SHELL (Software Hardware Environment Liveware)* and *HFACS (Human Factor Analysis and*

Classification System) are described in the present work in order to outline the theoretical background representing the essential guidelines for any kind of safety analysis activity.

In particular, based on these references, the authors developed a method for the identification of possible risks, in order to carry out what is defined as FOSA (*Flight Operation Safety Assessment*). This method allows the helicopter crews or the operator's dispatcher to have a comprehensive view of what could entail an aerial work mission in terms of hazards. Then, a deeper analysis can provide an overview of the major risks contained in the mission, ranked in order of severity and likelihood. Following the guidelines set by the ICAO Digest No. 7, the Risk Assessments can be linked to the SHELL model, which contains a wide analysis of the human factors, classified according to human-machine-environment interactions. The direct link SHELL-HSI-HFACS (HSI - *Human System Integration*) will eventually set the nanocodes that will be useful for future mitigations related to the specific analysis being carried out.

Subsequently, this paper aims to provide a practical demonstration of the aforementioned *case analysis process* considering a case study of a helicopter accident (a training flight fatal accident - Schweizer 269C-1 - G-LINX)[1], in order to evaluate the effectiveness and the accuracy of the results obtained through this methodology, identifying the degree of risk through a comprehensive risk assessment, its link with the SHELL and the related nanocodes in the HFACS model (taxonomy). The final result of such activity is the filing of useful *safety recommendations*, with the aim to contribute to enhance the safety standards for helicopter operations.

Finally, a proposal for the implementation of a *'risk assessor'* as a software package, able to perform a semi-automated analysis of helicopter missions, evaluating potential hazards and the related risk factors, is outlined. The algorithm of such software package should be based on the case analysis process and on risks database inspired by the previously mentioned risk assessment procedures, with the aim of defining an adequate risk scenario and to assist in GO/NO GO mission decision-making.

With reference to the future developments, this work also aims to extend the view to new models used to analyze incident/accident cases and to represent organizations. Such models, based on socio-technical system concept (FRAM - *Functional Resonance Analysis Method*), consider the air operator not only as a system almost-rigidly determined by technical functions, but rather as an organization based on the interaction capacity of management, human factors, administration and technologies, where it is possible to choose the most suitable organizational solution, in order to meet the needs of the intrinsic relationships between safety, effective production, economic efficiency and adequate performance.

[1] https://www.gov.uk/aaib-reports/schweizer-269c-1-g-linx-22-september-2009