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Digital Functions of Aircraft Engineering with Respect to Human Factor Principles: Challenges Ranging from Manufacturers to Payload †

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Abstract: Aircraft are considered to be today one of the most impressive engineering marvels of mankind ever made. While servicing commercial and/or private air transport, milestones of state-of art-technology are being achieved one after another, regularly, on all aspects of their engineering ranging from design, manufacturing, production, till air operations, maintenance and technical training. On these engineering aspects, digitization plays a key role since nowadays, its absence would make rather impossible the safe flight of these marvels on air. This study demonstrates the impact of digitization on these aspects and the interaction of Artificial intelligence (AI) on digitized aircraft systems, aiming to the ultimate goal of systems' operations being humanly governed, yet human error-free, under the Human Factors (HF) principles and methodology.

Keywords: aircraft digitization; human factors; modular avionics; NDI and NDT; flight safety

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1. Objectives

The study's objective is to demonstrate that digitization on aircraft is of paramount significance, as well as the inter-relationship between digitization, human factor (HF) principles, and the applied digitized functions and techniques ranging from manufacturers to payload, with respect to their effect on flight safety [1,2]. Additionally, the role of Artificial Intelligence (AI) is a challenge already underway in the industry aiming at the integrated embedding of AI on aircraft digital functions, free of human errors [2].

2. Methodology

Literature review synthesis (LRS) with bibliographic secondary data analysis. Literature review refers to a related bibliography, including aviation regulations, aircraft manufacturing data, aircraft engineering handbooks, manuals and training books.

3. Results

By converting analog information into a digital/PC-readable format, digitization handles massive amounts of information on the computerized aircraft systems as a mandatory element of their manufacturing, operation, maintenance, and training [1,3–6]. HFs, as conceptual aviation principles related to human performance, when applied to digitization functions, minimize errors that jeopardize flight safety [7]. AI, defined as the simulation of human intelligence in machines in terms of learning, reasoning, and perception, when combined with HF is challenged to be embedded in aircraft digital systems, functions, and processes, resulting in their safe performance [1,7].

4. Implications

Digitally engineered aircraft models related to static–aerodynamic loads produce fail-safe structures, having a potential failure possibility of 1×10^{-9}–1×10^{-16} [1,6]. In the

world of aircraft digital avionics, computers exchange data, free of e-malicious attacks, under HF-based human interaction, resulting in error minimization [5–7]. When training is complete, aircraft interactive models reveal engineering secrets, resulting in integrated knowledge [4].

The challenge of AI, when totally integrated into aircraft, will leverage aircraft digitization for its functions to be performed by AI maths algorithms under human governance [6,8].

5. Originality Value

Originality is profound, since the study demonstrates the inter-relationship between aircraft digitization and HFs for the above-mentioned purpose of human error capturing and minimizing, mainly during aircraft manufacturing and maintenance [1,3,7,9]. Additionally, due to the emphasis that aviation regulations, either for aircraft production or operation, maintenance, or training, include mandatory HF considerations, warnings, cautions, and practices already predefined in aviation legislation, hence, have to be followed as laws which are sought solely by Aviation Authorities [2,10].

6. Contribution

The scientific contribution emphasis of this study proves that, for a totally safe aircraft Commercial Air Transport (CAT) flight, digitization has to be combined with HFs, providing the necessary leverage for incorporating state-of-art technology, including the design, production, air-operations, maintenance, and technical training. Additionally, AI has to be totally embedded in aircraft digitization, along with HFs, as proven flight safety tools, enabling human error-free functions under human control and governance.

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Conflicts of Interest: The author declares no conflict of interest.

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