A SYSTEM FRAMEWORK FOR THE DESIGN OF AIRCRAFT MISSION SYSTEMS FROM AN OPERATOR'S PERSPECTIVE

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Abstract

Mission systems onboard combat aircraft provide the required mission capability to meet the slated operational requirements. Operational success of combat aircraft missions is thus mission system sensitive. The technological advancements in mission systems to meet the enhancement of mission capability of combat aircraft, are not in pace with the crew capabilities in operating these systems. There exists a gap in the design process to address the mission system advancements from an operator's perspective. To establish enhanced mission capabilities of combat aircraft, the capabilities of mission systems and that of the operator needs to be synergistically matched. In this paper, a research framework for the development of new mission system design philosophy, from operator's perspective is presented. The design philosophy considers the operational requirements and technological and operators thresholds as a baseline for design.

1 Introduction

Battlefield digitisation has placed higher emphasis on "Mission Automation" aspects of combat aircraft design, to enhance the degree of mission accomplishment [1]. Mission automation is achieved in design by synergic integration of mission systems on board a combat aircraft. Hence the major focus in combat aircraft designs [2] have steered towards incorporating "Mission Systems" to provide a set of pre-determined capabilities to meet the operational requirements. The design and operation of mission systems are thus critical for the achievement of operational requirements [3].

Sinha et al. [4] purports that the technological advancements of the mission systems needs to be in pace with the operational threshold of the crew. Therefore, in addition to the operational requirements, mission system design needs to consider the human and technological thresholds. Human factors in aviation have been addressed in various forms [5 & 6]; but are mainly focused on the flying aspects and seldom address the operation of mission systems as an additional workload factor on the operator. The design requirements of mission systems to meet the operational requirements, and the operator's capabilities are disparate factors. A new approach is required to develop a mission system design philosophy from an operator's perspective. The design philosophy needs to facilitate a holistic analysis of the requirements by integrating the operational and technological aspects synergistically [7]. In this paper a systems approach is adopted to develop a research framework for the development of design philosophy – one that incorporates human thresholds to holistically analyse mission system design.

2 System Methodology

The mission capability of combat aircraft is governed by mission systems onboard. The design of a payload is therefore critical to mission accomplishment. A system methodology was developed by Sinha, et al. [4] for the design of optimum 'multi-mission payload'. This methodology comprises of an analysis of mission systems. Holistically, the mission system design analysis needs to be multi-dimensional from the perspective of mission, technology and operator [2]. The multi-dimensional analysis will provide the base for the design of ideal mission systems. Thus, the design philosophy from an operator's perspective needs to consider the following:

- **Operational requirements:** Study the increase in operational requirements of combat aircraft, to identify the mission capability demands;
- **Mission systems:** Study the mission systems that offer these capabilities;
- **Technology threshold:** Study the mission systems to identify the thresholds of technology;
- **Operator threshold:** Study the operational requirements of the technology from the perspective of human threshold;
- **Systems Concepts:** Apply system concepts for a holistic analysis of operational requirements, operator threshold and technological threshold;
- **Design philosophy:** Develop a design philosophy of mission systems from an operator's perspective based on the holistic analysis; and
- **Case study:** Demonstrate the application of the design philosophy on a specific mission system.

3 System Framework

Having identified the factors that need to be considered for mission system design analysis, the system framework for the development of a design philosophy from an operator's perspective is formulated. The framework representing the various phases of the research is presented in Figure 1. The key features of the framework are as follows:

- **Operational and Environmental Needs:** An understanding of the fast changing requirements that drive the technology will provide the base parameters to be considered in the design of mission systems. The timeframe of mission system design also needs to keep in pace with the changing operational environment which in turn affects the operational requirements [1].

- **Operator's Needs:** The threshold at which the crew can function effectively governs the operator's needs. An understanding of the human factors that effect crew performance capability is necessary to provide the correct inputs to the design of mission systems. Human factors in aviation have been addressed in various forms [5]; but are mainly focused on the flying aspect and very seldom address the operation of mission systems as an additional workload factor on the operator. Human factor needs to be considered in the operation of combat aircraft and will form the additional parameter that should be considered in the design of mission systems from an operators' perspective.

- **Existing Systems:** Mission systems onboard combat aircraft provides the required mission capability to meet the slated operational requirements. In order to cater for changed demands of mission capabilities, mission systems

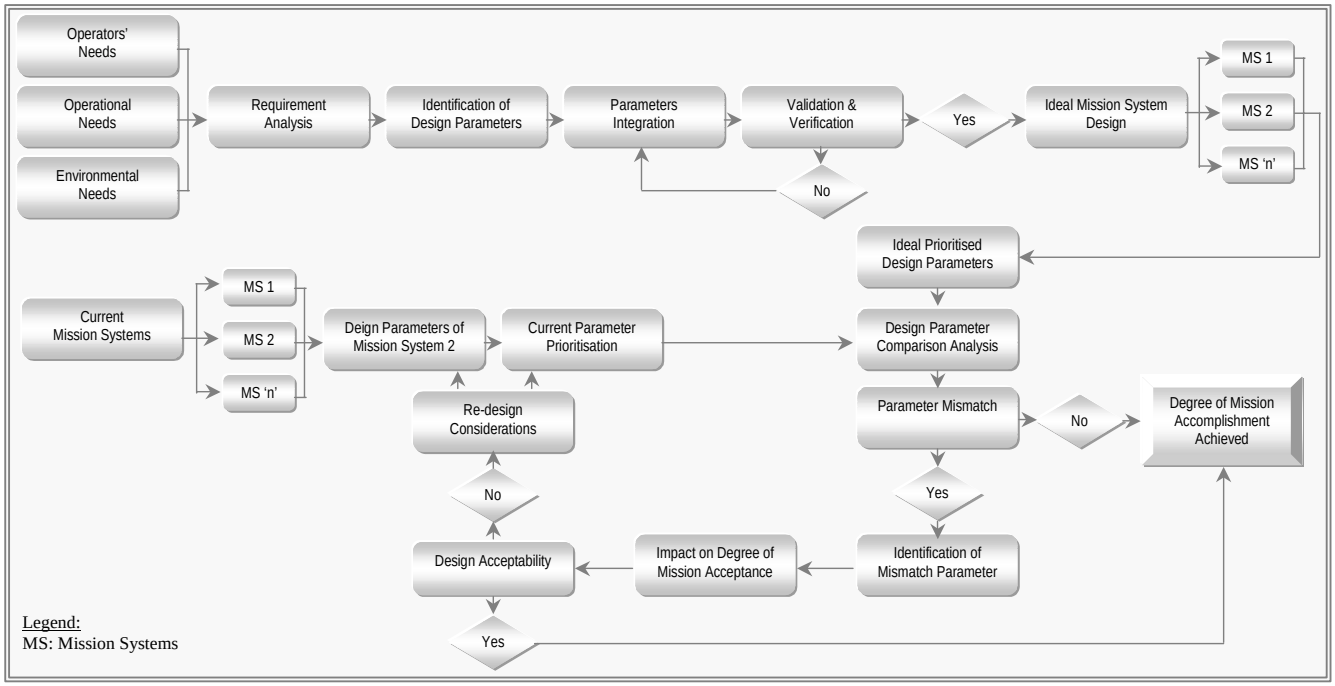

Figure 1. System Framework for the Development of Design Philosophy from Operator's Perspective

onboard undergo technology updates [2]. This results in mid-life upgrades of aircraft by state-of-the-art mission systems. The current systems will have to be analysed to determine the necessity of such upgrades based on the operational performance capability.

- **Comparative Analysis:** The existing systems and the ideal design configuration discussed above will be compared to identify the design parameters that need to be addressed. The design process will focus on crew threshold in the effective operation of these advanced systems.

- **Degree of Mission Accomplishment:** The ultimate aim of all mission systems is to achieve optimum degree of mission accomplishment. The design process therefore needs to consider an appropriate balance between operator and technological thresholds as a critical design parameter. Based on this benchmark, the mission system will be analysed for degree of requirements met.

4 Results and Discussion

The system framework resulted in the development of a process for mission system design from a system perspective. The process comprises of analyses of the following: (a) Operational requirements of combat aircraft; (b) Technology threshold of mission systems; and (c) Operators' threshold. The process will provides a new a design philosophy for mission system with an appropriate focus on the operator.

5 Conclusion

The system framework for the development of a new mission system design philosophy from an operator's perspective provides a promising avenue for research. The holistic analysis will make the process rigorous and resulted in a pragmatic design methodology.

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