Chapter 4
Mission Performance Model

ABSTRACT

Mission Performance Models (MPM) are important to the design of modern digital avionic systems because the flight deck information is no longer obvious. In large-scale dynamic systems, necessary responses to the incoming information model should be a direct correspondence. A Mission Performance Model is an abstract representation of the activity clusters necessary to achieve mission success. The three core activity clusters are trajectory management, energy management, and attitude control and will be covered in detail. Their combined performance characteristics highlight the vehicle’s kinematic attributes, which then anticipates unstable conditions. Six MPM are necessary for the effective design and employment of a modern mission-ready flight deck. We describe MPM and their structure, purpose, and operational application. Performance models have many important uses including training system definition and design, avionic system design, and safety programs.

INTRODUCTION

In the analog era it was easy to determine what information to send to the crew station for obvious reasons—it was the technical parameters that the technology generated. In today’s digital era equipped with significant computational power, convergent technology applications have become the major design driver. The challenge now is optimizing the positive effect of convergent technologies and their concomitant

DOI: 10.4018/978-1-4666-8673-1.ch004
cooperative information streams so that innovative information packages can be processed and delivered to the modern flight deck with the goal of enhancing the effectiveness of flight operations (Billings, 1991). But if flight deck information is no longer limited by analog stand-alone devices, how does one determine such necessary operational information? Clearly something new is needed that observes the flight deck environment from a different, more operational perspective. The solution is found in Mission Performance Models (MPM).

Dietrich Dorner in his important book *The Logic of Failure* asserts that when dealing with complex systems we need to arrange incoming information into an orderly, coherent picture representing a model of reality. This must be a conscious effort; otherwise we are relegated to the impossible task of deciphering formless collections of data about random aspects of a situation or event, which merely adds to the confusion of the situation. In large-scale, dynamic systems, necessary responses to the incoming information model should be a direct correspondence: thus the justification of the creation of a corresponding response model. Such response models are MPM. MPM are abstract representations of the activity clusters necessary to achieve mission success. In aviation the three core activity clusters are trajectory management, energy management, and attitude control.

Trajectory, attitude, and energy are three interrelated elements and must work together in an optimum way so as to achieve mission success. The combined performance characteristics then are to highlight the vehicle’s kinematic attributes which then can anticipate the onset of unstable conditions, leading to effective recovery initiatives.

MPM were first developed when the aviation industry decided that technology, by and large, should no longer dictate curriculum content for pilot training, but instead the content of the curriculum should be informed by the mission (Smith, 1993). The challenge facing this design effort is to determine what would constitute mission realistic training. In similar fashion, if one desires to build intelligent airborne systems that automatically adapt themselves to changing operational conditions, then what kind of analytic process could facilitate this effort? Again, the use of MPM appear to be the answer (Abu-Taieh, Sheikh, & Jafari, 2012).

MPM provide the cockpit design team with a template for the serious and compelling purpose of analytically determining system requirements. Importantly, this template represents a set of organized principles to help the design and flight test teams determine specifically what mission essential information needs to be displayed to the flight crew for each phase of flight and each of the five levels of danger that the flight crew may encounter (Endsley, 1988, 1995; Helmreich, Chidester, & Foushee, 1995). The overall mission performance model will be presented first, followed by five specific performance models pertaining to important elements of air operations.
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