

# Chapter 48

## Aircraft Development and Design: Enhancing Product Safety through Effective Human Factors Engineering Design Solutions

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### ABSTRACT

*Effective Human Factors Engineering (HFE) has provided the aerospace industry with design considerations that promote aviation safety in the development of complex aircraft systems, as well as the operators and maintainers that utilize those systems. HFE is an integral aspect within the systems engineering process. Measuring the effectiveness of Human Systems Integration (HSI) in the research & development stage is critical for the design of new and modified systems. This chapter focuses on how providing effective HFE design solutions enhances product design and system safety. Providing the customer with safe and reliable products augments mission capabilities throughout the product lifecycle.*

### INTRODUCTION

Multi-modal transportation such as aviation, marine, rail, transit, cycle, pedestrian, and motor vehicles all provide the general public with choices for determining which mode they prefer to utilize. The cost of travel, safety, and trans-

portation reliability are all factors the public uses to determine their travel choices. From a safety perspective, federal agencies have provided the general public with safety statistics for all modes of transportation.

The National Highway Traffic Safety Administration (NHTSA) released data on fatal car crashes in 2008. According to the Fatality Analysis Reporting System (FARS) of the NHTSA, there were

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more than 34,000 people killed in vehicle crashes in the U.S. (Administration, 2008). The Bureau of Transportation Statistics (BTS)-Transportation Statistics Annual Report-2008 report indicated that there were 4,654 fatalities as a result of pedestrians struck by highway vehicles, and 16,520 passenger car occupant fatalities in 2007 (Statistics, 2008). The public continues to manage their personal risks regarding travel choices and determining which mode of transportation is the safest.

Studies conducted by the National Transportation Safety Board (NTSB), a U.S. independent federal agency that investigates transportation accidents, have shown that commercial aviation transportation is a vital asset to the U.S. economy and is one of the safest modes of transportation. According to former NTSB chairman Marion C. Blakey, "The U.S has long depended on aviation, not just as a means of point-to-point travel, but as the hinge on which the door of commerce depends to stay open". "Literally, aviation keeps America open for business" (Blakey, 2007, p.1). Aviation accidents declined between 2008 and 2009. The NTSB conducted a study that demonstrated a reduction of aviation accidents in 2009—where "The total number of U.S. civil aviation accidents decreased from 1,658 in 2008 to 1,551 in 2009". "Total fatalities also showed a decrease from 566 to 534". "On-demand Part 135 operations reported 47 accidents in 2009, a decrease from 58 in 2008". "The accident rate decreased to 1.63 per 100,000 flight hours in 2009 from 1.81 in 2008". The NTSB have also been able to pinpoint that the "the majority of these fatalities occurred in general aviation and scheduled part 121 operations" (Board, 2010, p.1).

Even though commercial aviation transportation is considered a safer way of traveling, incidents and accidents continue to occur within the industry. From an international aviation perspective, high accident rates in Africa and Indonesia continue to be a critical factor in the general public's perception of air transportation safety. Consequently, federal agencies across the globe

have made substantial progress in determining influential factors that cause aviation incidents and accidents. In particular, the goal has been to reduce the rate of occurrences and provide the public with a positive image of aviation safety.

The military and civilian air transportation sectors have developed robust strategies of aviation safety management. Federal government officials, manufacturers, airlines, and independent consultant agencies have implemented aviation safety management methods for the continuous surveillance of safety in flight operations and maintenance. These methods were created to reduce the rate of incidents and accidents through various systematic processes. These systematic processes were developed to manage the 'common threads' in incident and accident causation.

After the crash of ValuJet flight 592 on May 11, 1996, the U.S. implemented the Air Transportation Oversight System (ATOS). The ATOS is an inspection system that was designed to systematically manage safety in flight operations and maintenance in the airline industry. Other reliable methods have all provided the airline industry with structured systematic ways of managing aviation safety. Some of these methods are as follows: Aviation Safety Action Program (ASAP), Maintenance Safety Action Program (MSAP), Dispatch Safety Action Program (DSAP), Safety Management Systems (SMS), and the Aviation Safety Information Analysis and Sharing System (ASIAS). Accident investigation, empirical, and theoretical research continues to provide data useful for determining the causal factors of incidents and accidents.

Aircraft design, weather, and human factors have been a constant trend of incident and accident causation throughout the history of the air transportation system. On February 12, 2009, Colgan Air flight 3407 crashed outside of Buffalo, NY with no survivors. The probable cause of this crash was "the captain's inappropriate response to the activation of the stick shaker, which led to an aerodynamic stall from which the airplane did not

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