

Human Systems Integration: Design Engineering Concepts and Paradigms

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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 paper focuses on the importance of design and integration in the product development stages as well as understanding the impact on the user population.

Keywords: Aircraft Accident Investigation, Aviation Safety, Culture, Ethnography, Human Factors Engineering (HFE), Human Machine Interface, Language, Maintainability, System Safety

INTRODUCTION

Cooking popcorn using a skillet was a common method used to eat popcorn. The skillet was heated by a stove, which popped the kernels at a certain temperature. It was essential to constantly monitor the kernels as they popped on the skillet to ensure the proper heat was applied to the stove in order to pop all of the kernels. A common method used to determine an acceptable temperature was adjusting the stove to a desirable temperature. In order to accomplish this task, the human would rotate a ganged knob on the stove. The numbers on the knob provided the user with various heating temperatures. Understanding the affect of certain heating temperatures was essential in order to cook the kernels. If the temperature was

too low all of the kernels may not cook. On the contrary, if the temperature was too high, the popcorn may burn. Providing constant oversight cooking popcorn utilizing a skillet was difficult and may not be considered the best method for cooking popcorn.

However, enhancements in technology created an easier and more reliable method for cooking popcorn with the invention of the microwave. Since the inception of the microwave system in the 1940s, cooking popcorn is easier and considered a dependable method. Technologically advanced microwave systems have provided the user with the ability to monitor the popcorn status through a Liquid Crystal Display (LCD). The human presses buttons on the microwave so that the data is inputted in to the system. An electronic signal transfers the

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data into a digital text format, which is displayed, on the LCD. The digital text provides data to the human indicating the time to cook the popcorn. These visual cues, in addition to auditory cues such as an alarm indicating the popcorn has completed the cooking phase, provide the user with a more accurate representation of the status of the popcorn. The microwave may seem to be a simple design to many people. However, scientists and engineers developed the conceptual framework for the design of the microwave system. Understanding the functionality of a system and how the system operates in certain contextual environments is the definition of the term most often referred to as 'Situation Awareness'; additionally, understanding how the human interacts with the hardware and software functional interfaces are critical features of situational awareness and are necessary when developing any system.

In today's multimodal industry, transportation systems are designed so that they are safe and compatible for the user. Vehicles are equipped with Supplemental Restraint Systems (SRS) in order to prevent injury to vehicle occupants. Vehicle rear view camera systems are utilized to provide an awareness of obstacles through a panoramic view. Modern vehicle navigation systems have been designed to provide the user with data related to current and future driving conditions. Some of these conditions are as follows: traffic data, worldwide maps, weather. This information is utilized to assist the human with interfacing with the environment. Many of these system functions were developed to provide the human with situation awareness in the operational environment. A common goal for the development of these systems was to improve human performance, with an emphasis on safety while driving. To improve human performance, 'Transportation Safety Systems' were developed. These systems incorporate various situational awareness cues to communicate with the user. For example, traffic advisories provide the user with current and future conditions in order to prepare the operator for the environment in which he/she may encounter. Many of these systems

are also designed to assist in the reduction of highway vehicle incidents and accidents. Some vehicles are equipped with warning devices that alert the driver of a vehicle in their blind spot. The integration of these types of systems provides a better perspective of the situation, while providing the human with visual and aural cues to make the best-informed decision in their environment.

Historically, the aviation industry has obtained knowledge from the design and operation of aircrafts. Airlines provide aviation safety and aircraft operational performance data to the government and manufacturers. These data are utilized to provide an overview of how well the airline is operating in various circumstances. Although airline data is utilized to measure aircraft operational performance and continuous operational safety, occasionally incidents and accidents may occur within the lifetime of an aircraft. Aircraft accident investigations provide recommendations of the causal factors of aircraft crashes. These data provide the industry with information for safety research improvement strategies.

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 transportation 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 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

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