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# A SYSTEMATIC APPROACH TO ADDRESSING HUMAN FACTORS CONSIDERATIONS IN THE DESIGN OF FLIGHT DECK COMPONENTS

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The FAA Aircraft Certification Job Aid for Flight Deck Human Factors is a decision-support tool for addressing human factors considerations during the flight deck design portion of the aircraft certification process. The current version presents decision-support information related to the review of flight deck displays, controls, and systems. This tool provides a systematic approach for assessing human factors considerations related to the design of flight deck components.

## **Background**

Most airplane certification projects for components of the airplane flight deck involve many decisions that are related to human factors principles. The FAA would like to have human factors considerations addressed as effectively and thoroughly as other considerations when making certification decisions. In addition, they would like to provide the resources for certification team members at all stages of the certification process to identify and possibly resolve any human factors issues that arise. There are Human Factors Specialists who are available to help with projects, but their workload precludes their availability for all day-to-day considerations within a project.

## **Challenge**

There are many unique challenges that arise when reviewing designs for human factors considerations in a regulatory environment. One of the primary challenges is to know which human factors considerations should be addressed for any particular review or certification project. We have developed a decision-support tool for the FAA to meet these challenges. It is called the FAA Certification Job Aid for Flight Deck Human Factors (Job Aid).

## **Approach and Solution**

The Job Aid is designed to provide quick and easy access to regulatory and human factors information that may be used by certification personnel for identifying and addressing human factors considerations for flight deck design. The current version of the Job Aid provides information addressing all human factors considerations related to the design review of displays, controls, and systems in the flight deck

of large transport category aircraft. The set of human factors considerations provides a comprehensive way to address flight deck human factors in any certification project.

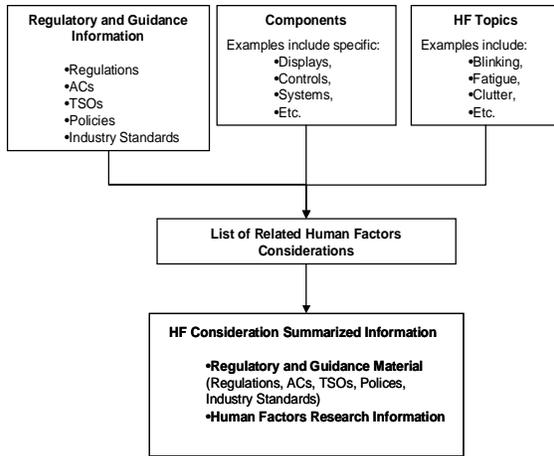
## *Approach to Job Aid Design*

In developing the Job Aid, the certification personnel were interviewed and observed to determine when they would need human factors information and what their typical approach would be to acquire that information. It was determined that they needed human factors information when they were doing the following three tasks:

1. Reviewing related FAA regulations and guidance material,
2. Researching information related to a specific component (control, display, system, or equipment), and/or
3. Researching a specific human factors topic, such as clutter or the use of color coding.

The Job Aid has been structured to allow the certification team members to access information from any one of these three paths. When the user selects a particular regulatory or guidance document, component, or human factors topic; they will be provided with a list of related human factors considerations. This list of human factors considerations provides a systematic method of evaluating design and can serve as a general checklist during certification tasks.

Figure 1 depicts the design and structure of the Job Aid elements and their relation to each other.



**Figure 1.** Representation of the organizational structure of the Job Aid interface and information.

#### *Development of Human Factors Considerations*

The biggest challenge in developing the set of human factors considerations was to define a set of considerations that could be used and understood by all the intended users of the Job Aid, and that would apply to current and future designs without the requirement of updating them as technology and innovation changes are made. The human factors considerations were developed by first reviewing the regulatory documents to identify the topics and organization of concepts related to human factors described. The terminology used in the human factors considerations was drawn from that used in the regulatory documents so that the concepts and descriptions included in the human factors considerations would be familiar to the Job Aid users.

Separate sets of human factors considerations have been developed related to display design, control design, and system design. The human factors considerations address the design issues of the component in isolation as well as design issues related to the integration of this component within the full flight deck environment. The Job Aid provides summaries of regulatory and guidance material as well as human factors research literature for each human factors consideration.

Examples of display-related human factors considerations are

- Information is visually accessible
- Information is understandable

- Timing of information presentation is appropriate
- Display appropriately attracts attention

Examples of control-related human factors considerations are

- Necessary controls are provided
- Control design prevents inadvertent operation
- Control function and method of operation are understandable
- Control is usable with related controls and displays

Examples of system-related human factors considerations are

- Pilot is provided necessary control over the system
- System operation or monitoring does not require excessive attention
- System logic and behavior are understandable
- System design minimizes potential for injury

After users are presented with a list of human factors considerations related to the document, component, or topic they have selected, the next step is to access the detailed information summaries that are provided for each human factors consideration.

#### *Organization of Summarized Information*

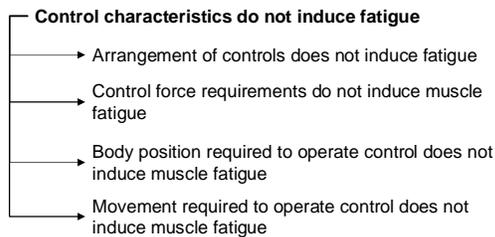
Due to the depth and breadth of the information provided for each human factors consideration, effective organization of the information is essential to making the information accessible to the users. For each human factors consideration, separate summary documents are included for a number of different types of documents. FAA regulatory and guidance documents have been summarized with separate summaries for Part 25 regulations, Advisory Circulars, Technical Standard Orders, Human Factors Policies, and Industry Standards. In addition, for each human factors consideration, a summary of non-regulatory research-based human factors information has been developed.

To help users further focus their search for information, the concepts described in the detailed human factors consideration summaries are organized into sections based on the type of

information given. The summarized information is organized into the following sections:

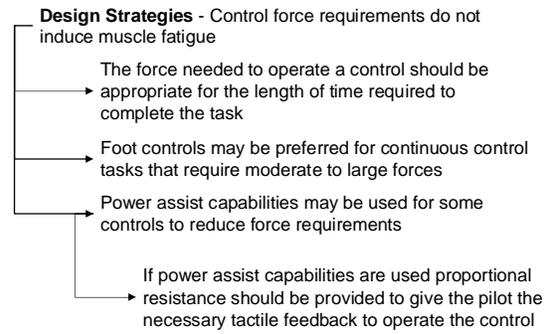
- General Description,
- Design Strategies and Examples,
- Measures (design measures and pilot performance measures), and
- Trade-offs.

*General Description.* The General Description section includes a description of *all* design topics related to addressing the human factors consideration. The General Description section includes subtopic headings so that the user will be able to use this list as a comprehensive checklist for that human factors consideration. An example of a human factors consideration general topic and its subtopics is shown in Figure 2.



**Figure 2.** Example of a human factors consideration topic and subtopics.

*Design Strategies and Examples.* This section is also organized by the subtopics presented in the General Description section. It presents strategies that have been used to address each of the design subtopics. These strategies provide various options that may be used to address the particular subtopic of the human factors consideration along with their advantages and disadvantages. Specific examples of effective implementations of design strategies are also provided. Figure 3 shows an example of the design strategies for one of the subtopics presented in Figure 2.

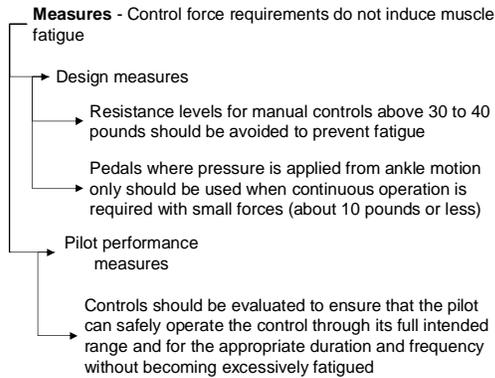


**Figure 3.** Example of design strategies for a human factors consideration subtopic.

*Measures.* This section provides information related to measuring the effectiveness of the design strategies implemented related to the human factors consideration topic or subtopics, as appropriate. The measures section consists of both design measures and pilot performance measures. Design measures refer to aspects of the design that may be measured to determine if they appropriately address the topic or subtopic. Examples of design measures might include character size measurements and display luminance values required to ensure adequate readability of display information.

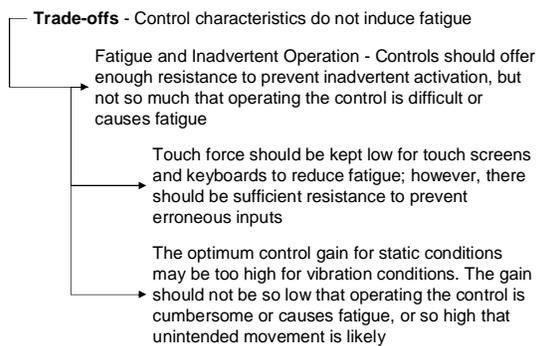
The pilot performance measures section consists of aspects of pilot performance that can be measured to determine the effectiveness of the design related to the topic or subtopic. Examples of pilot performance measures include the pilot's speed and accuracy when completing tasks associated with using a flight deck component.

Figure 4 presents measures associated with the subtopic presented in Figures 3.



**Figure 4.** Example of measures related to a human factors consideration subtopic.

*Trade-offs.* This section provides descriptions of trade-offs that must be considered when making design decisions related to the topic or subtopics. The trade-off may be between two topics or subtopics in the same human factors consideration or it may be between a topic or subtopic in one human factors consideration and one related to another human factors consideration. Design decisions are never made in isolation and this section is meant to help the certification team members balance their decisions taking the whole design into consideration. Figure 5 presents the trade-offs associated with the human factors consideration topic presented in Figures 2, 3, and 4.



**Figure 5.** Example of trade-offs for a human factors consideration topic.

### Implementation and Use of the Job Aid

As certification personnel systematically review the related human factors considerations, they are able to copy relevant text excerpts from the summaries and paste the information into a working document that can be used to compile relevant information from multiple human

factors considerations and allow them to communicate issues and facilitate decision-making with the other certification team members and the applicant. The Job Aid does not provide direction on the certification decisions to be made, but it provides many related aspects of human factors information for the trained certification team members to use along with their other information to make their decisions.

The key to the effectiveness of the Job Aid is that it links the important aspects of human factors design review throughout the certification responsibility areas of the FAA. With this approach, the Job Aid can be used by all FAA certification team members to identify human factors considerations even if they only review small elements of a flight deck design.

Evaluation of the Job Aid as it is being used has shown that the human factors considerations are understandable and usable by engineers and other certification team members who have had little or no training in the science of human factors. The Job Aid has helped educate certification personnel who do not have human factors expertise and has allowed them to more effectively communicate with the Human Factors Specialists within the FAA. The Job Aid that is currently deployed in the FAA includes information for human factors considerations related to displays, controls, and systems. Future versions will include human factors considerations related to equipment, tasks and procedures, and testing assumptions. The current version focuses on certification projects for transport category aircraft; future versions will also include information related to small airplanes and rotorcraft.

### Acknowledgements

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