Human Factors in the Design and Evaluation of Air Traffic Control Systems

Submitted by superadmin on Mon, 10/22/2012 - 14:45

HP Activity Categories:
Design of working environment and human-machine interfaces [1]

Resource Type:
Guideline

Abstract:

This document presents human factors issues that should be considered in the design and evaluation of air traffic control (ATC) systems and subsystems.

The guideline provides information to FAA product teams about important human factors related issues that should be raised and addressed during system design and system evaluation. The tool consists of 2 parts; 1. A handbook describes how different human factors areas apply to Air Traffic Control (ATC). This should help the HF practitioner identify relevant HF issues for the system design and evaluation process. 2. An application package allows the construction of checklists to support the system selection and evaluation process.

References

Developer and source:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161 USA
Order Number: PB97-116933WTS

Final Report
DOT/FAA/RD-95/3
DOT-VNTSC-FAA-95-3

Volpe National Transportation Systems Centre
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Cambridge, MA 02142 USA

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800 Independence Avenue, SW
Washington, DC 20591 USA

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Year of development / publication, updates etc:
General Description

Purpose:

The guideline provides background material on the capabilities and limitations of humans as information processors and discusses issues in: ATC automation, computer-human interface, workstation design, workload and performance measurement, controller team formation and activities, and human factors testing and evaluation. The goal of this material is to help air traffic controllers and other operations specialists identify potential problems by alerting them to known design flaws and providing them with information as to why some design options may be undesirable or operationally unsuitable. This document presents design goals based on human factors principles, standards, and guidelines. Some of these design goals are idealistic in an ATC operational setting. They are presented so that the operations specialists can identify key human factors issues and understand the implications of compromises, and where they must be made.

Type (e.g. observation, questionnaire, interview, checklist, measurement instrument, etc.):

Handbook and checklist

Technical description of method or tool etc

Description of the content/study:

This handbook and checklist are designed to assist the teams chartered by the FAA in accomplishing their objectives by pointing them to human factors questions that should be asked during system design and evaluation. It provides background material on the role of human factors in the acquisition process, the capabilities and limitations of humans as information processors and the evaluation of displays and controls. It also includes discussions of issues of particular interest to air traffic control, such as the benefits and limitations of automation, and methods of workload assessment. Application of the information presented in this handbook will help to minimize the probability of human error in human-system interactions and increase the efficiency of human-system performance.

Most chapters in this document conclude with a list of checklist items. These items are compiled in the accompanying document Human Factors Checklist for the Design and Evaluation of ATC Systems. The goal of these checklist items is to point air traffic controllers and other operations specialists to questions that they may wish to consider in their evaluation of new systems or subsystems, or a new component of an existing system. The numbers in parentheses at the end of each checklist item refer to the section of the handbook that discusses the issue.

The checklist can only examine individual components of a system and point to broader issues (such as how these components fit together, the uses of automation, etc.). In many cases, the ability of the checklist to identify potential problems will be entirely dependent on the person using the checklist.

Technical requirements for using the method, tool, etc:

n/a

Measure/Response Type:

n/a

Results obtained and interpretation:
Evaluation

Advantages:

It provides good guidance for ensuring that an evaluation is well-designed from a human factors perspective, along with guidance on human factors planning.

Disadvantages:

The checklist can only examine individual components of a system and point to broader issues. The ability of the checklist to identify potential problems is dependent on the person using the checklist.

Alternative Methods:

Human Factors Case (Eurocontrol)

Usability (ease of use, efficiency, effectiveness)

This document can be used by the users easily to achieve specified goals within the relevant HF issues for the system design and evaluation processes with high effectiveness, efficiency and satisfaction in each specified context of use.

Ease of use:
high

Efficiency:
high

Effectiveness:
high

Constraints concerning conditions of use:

It is useful to be as specific as possible about what the constraints are and how they might impact the system development and implementation. For example, there may be an assumption that no additional staffing will be required (e.g., that the system will be operated and maintained with existing air traffic and airways facilities personnel). If so, this should be viewed as a constraint. Therefore, detailed assessments will be required to determine training requirements, impacts on current functions, etc. Such assumptions are likely to affect job design, workload, etc. Time available for training is another resource constraint that could affect operator, maintainer, or certification tasks and system design. Availability of simulation capabilities may provide a constraint to the testing and analysis.

Reliability:
not available

Validity:
not available

Required effort (to conduct & to analyse):
Medium to high.

**Level of HF expertise needed (required user qualification)**

The material of the handbook and the application package is provided solely for guidance and is intended to be used by air traffic specialists as they see fit.

High: high level of expertise required, only for experts, lots of training required
Other expertise needed (required user qualification):

Air Traffic Management competence and expertise. Operations specialists may wish to use some of the items as a basis for identifying human factors issues that should be formulated into appropriate requirements and specifications. In order to do this, a knowledge of the system will be necessary to relate the checklist items to a specific system attribute or function.

**Cost Information**

Very low: (<100 €) low costs to purchase or free license, no special devices necessary
Experiences of use by SESAR partners (including references):
not available
Reported and/or published experiences of use (including references):
n/a
Applicability to lifecycle phase (E-OCVM):
It is applicable for lifecycle phase V3 as ?pre-operational validation?.
Application Area:
It is used and already applied in aviation. Application of the information presented in the handbook will help to minimize the probability of human error in human-system interactions and increase the efficiency of human-system performance.
Keywords:
Human factors, air traffic control, air traffic control systems, ATC automation, performance measurement,
Short Description:
This document presents human factors issues that should be considered in the design and evaluation of air traffic control (ATC) systems and subsystems. It is concerned with issues like ATC automation, computer-human interface, workstation design, workload and performance measurement, controller team formation and activities, and human factors testing and evaluation.