



*INTERNATIONAL CIVIL AVIATION ORGANIZATION*

**TWENTY FIFTH MEETING OF THE  
ASIA/PACIFIC AIR NAVIGATION PLANNING AND  
IMPLEMENTATION REGIONAL GROUP (APANPIRG/25)**

*Kuala Lumpur, Malaysia, 8 – 11 September 2014*

**Agenda Item 3: Performance Framework for Regional Air Navigation Planning and Implementation**

**3.6: Other Air Navigation Matters**

**THE INTEGRATION OF HUMAN FACTORS IN RESEARCH,  
OPERATIONS AND ACQUISITIONS**

(Presented by the United States of America)

**SUMMARY**

This paper presents the Federal Aviation Administration's use of Human Factors analysis in the development and operations of Air Traffic Management (ATM) systems. It addresses research on human performance, safety analysis, and system optimization through human factors engineering. It identifies the importance of incorporating the human component throughout system development life cycle.

**1 INTRODUCTION**

1.1 The FAA defines Human Factors as a multidisciplinary effort to generate and compile information about human capabilities and limitations and apply that information to produce safe, comfortable and effective human performance. In the field of Air Traffic Management (ATM), where safety, efficiency, and continuity are critical elements of virtually every area of expertise, people are often both the greatest assets and the greatest source of risk. Human Factors research has indicated that the top 5 safety risks in ATM nearly always involve "Human Error." As airspace air traffic and ATM systems become more complex, the analysis and optimization of the human component becomes essential.

**2. DISCUSSION**

2.1 Why Does "Human Factors" Matter?

2.1.1 The people involved in the ATM are the ultimate solution providers, whether in ATM, systems development and integration, maintenance, or a whole series of other essential roles. Human factors analysis of these roles can improve overall performance, reduce technical risk in system acquisitions, lower lifecycle costs of systems and equipment, improve human interfaces with the system and contribute to economical decisions on controller training, as well as providing other benefits.

2.1.2 In addressing system performance HF analysis examines and optimizes human-computer interaction and usability for both hardware and software. By researching the systems' users, researchers gain better understanding of required aptitudes and abilities, how to develop more effective training, and address the risks associated with fatigue. HF also studies the work environment, finding ways to optimize operating conditions, organizational structures, procedures, equipment configurations and other environmental issues.

## 2.2 ATM Research - Human Performance and Safety

2.2.1 Two of the most fundamental objectives of HF in the FAA are to improve safety and the performance of the people involved in the system. Researchers develop methodologies for gathering data, performing analysis and making recommendations on a wide variety of procedures. HF analysis provides guidance for the implementation of new technologies and improvements to training techniques. Some examples include developing techniques to analyze controller voluntary incident reports as part of Air Traffic Safety Analysis Program (ATSAP) and performing controller impact studies on expanding the use of automated handoff and the use of RNAV/RNP procedures. Some of the outcomes of the research are assessment of changes in controller performance from time on task and guidance for top safety risk mitigations.

2.2.2 One of the most significant patterns identified in HF research is that the top 5 safety risks nearly always involve "Human Error." Historically, the FAA considered human error as a cause of failure, but with HF analysis that view has evolved to see human error not as a cause but as a symptom of system failure. This change in approach has provided impetus for better participation by controllers and other system users, which in turn provides more accurate data resulting in more accurate analyses. One of the significant challenges identified is that safety is not inherent in most ATM systems. The systems themselves are contradictions between multiple goals (safety and efficiency) that controllers must pursue simultaneously.

## 2.3 Human Factors Application in ATM Acquisition Programs

2.3.1 The FAA has integrated HF analysis and engineering into all six stages of its acquisition life cycle; service analysis and strategic planning, concepts and requirements definition, initial investment analysis, final investment analysis, solution implementation and in-service management. HF performs unique monitoring and analysis during each stage and provides guidance throughout the cycle.

## 2.4 Integration of Human Factors Programs into ATM Systems

2.4.1 While FAA has found significant benefits from the implementation of Human Factors analysis in its operations and acquisitions systems, integration was and continues to be challenging. The Human Factors Division uses three concepts to develop better understanding and cooperation with its customers:

- Education; help program and operational managers to understand human factors costs and benefits,
- Leveraging standards and best practices for consistent human factors integration and avoid duplication, and
- Building communications across FAA lines of business on human factors in research, acquisitions, and operations.

2.4.2 The FAA's Human Factors Division also works to normalize HF analysis and protocols on an international level by coordinating activities with EUROCONTROL on safety and

human performance through cooperative work agreements. One example is a joint FAA - Eurocontrol program to develop principles for integrating automation in controller workstations.

**3. ACTION BY THE MEETING**

3.1 The Meeting is invited to:

- a) Note the information contained in this paper; and
- b) Discuss any relevant matters as appropriate.

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APANPIRG/25 - IP/5  
Attachment

Next**GEN**

# Human Factors Research and Applications

Federal Aviation Administration  
ICAO APANPIRG/25  
September 8 - 11, 2014



**FAA**

# Overview

- Definition of Human Factors
- Human Factors Research
- Human Factors in Acquisitions
- Summary

# What is Human Factors?

Human factors is a multidisciplinary effort to generate and compile information about human capabilities and limitations and apply that information to produce safe, comfortable and effective human performance.

Systems, Equipment,  
Software, Facilities

Procedures, Jobs,  
Work Environments

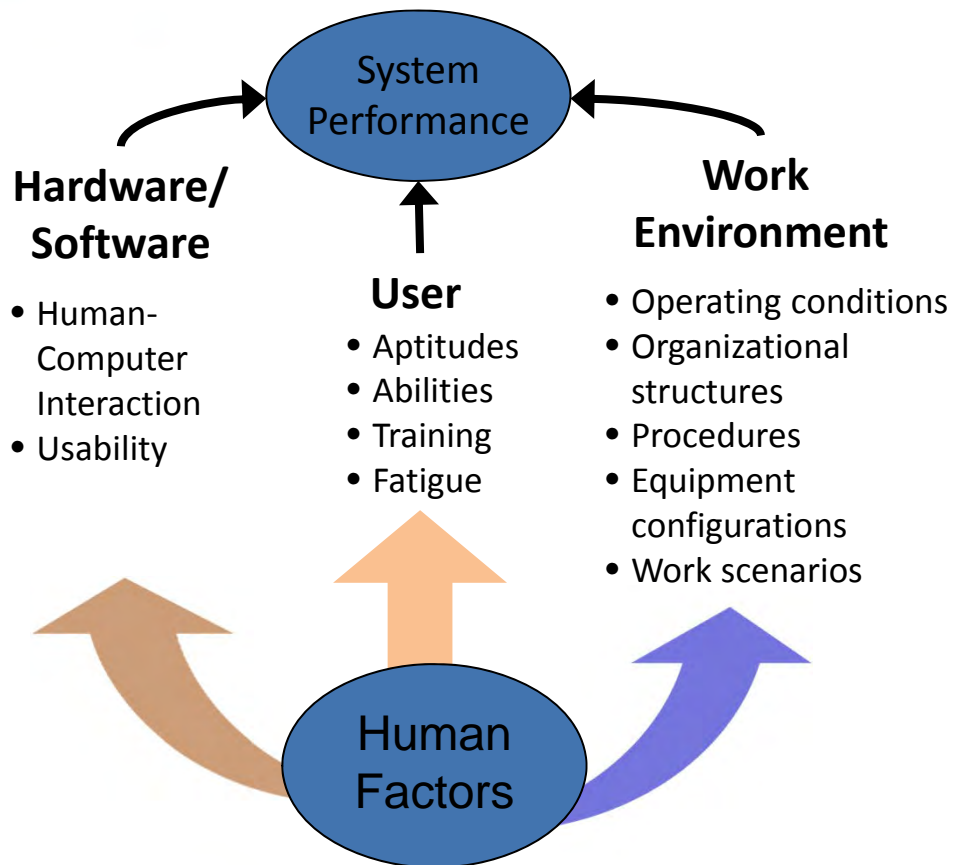
Training, Staffing,  
Personnel Management



“As a lifelong safety advocate, I clearly understand the critical importance of designing systems to assign to people what they do best, and to machines, what is appropriate for them to do. I know from long personal experience how vital a task this is in aviation, particularly as newer aircraft incorporate increasing levels of automation.”

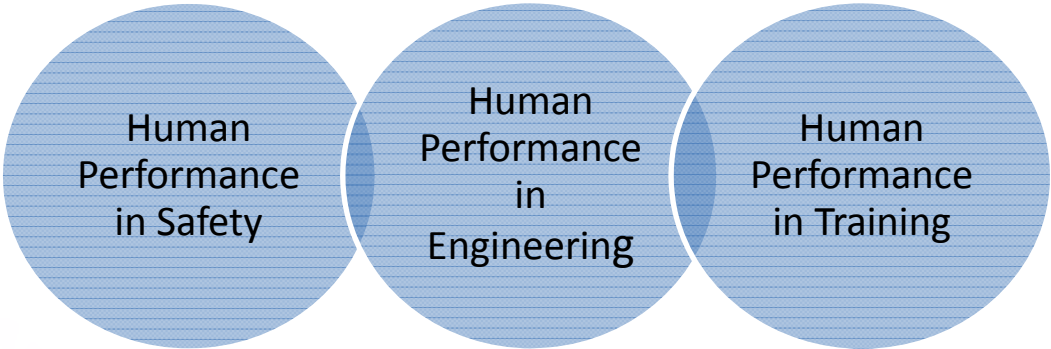
–Captain Chesley “Sully” Sullenberger

# Why Does Human Factors Matter?



- Improve overall performance
- Reduce technical risk in system acquisitions
- Lower lifecycle costs of systems and equipment
- Improve human interfaces with the system.
- Contribute to economical decisions on controller training

# Research On Human Performance





# ATC Research Human Centered Design

- Developing safety alert design guidance, e.g., Minimum Safe Altitude Warning (MSAW)
- Assessing controller information requirements for data blocks that are common across en route and terminal radar displays
- Developing standards for Technical Operations on symbols and markings, and use of abbreviations



# ATC Research Human Centered Design

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# Challenge For Effective Tower System Integration And Standardization

*Mitigate use of multiple pieces of equipment having different interfaces*



Boston Tower

# ATC Research Controller Training

- Assessing techniques to improve visual scanning methods during training
- Assessing controller on the job training success
  - ✦ Screening for effective facility placement
  - ✦ Reduce facility training failure rate
- Developing guidance on training techniques for Loss of Separation



Head mounted eye tracking equipment

# ATC Research

## Human Performance and Safety

- Developing techniques to analyze controller voluntary incident reports as part of Air Traffic Safety Analysis Program (ATSAP)
  - + Automated handoff
  - + Use of RNAV/RNP procedures
- Assessing changes in controller performance from time on task
- Developing guidance for top safety risk mitigations

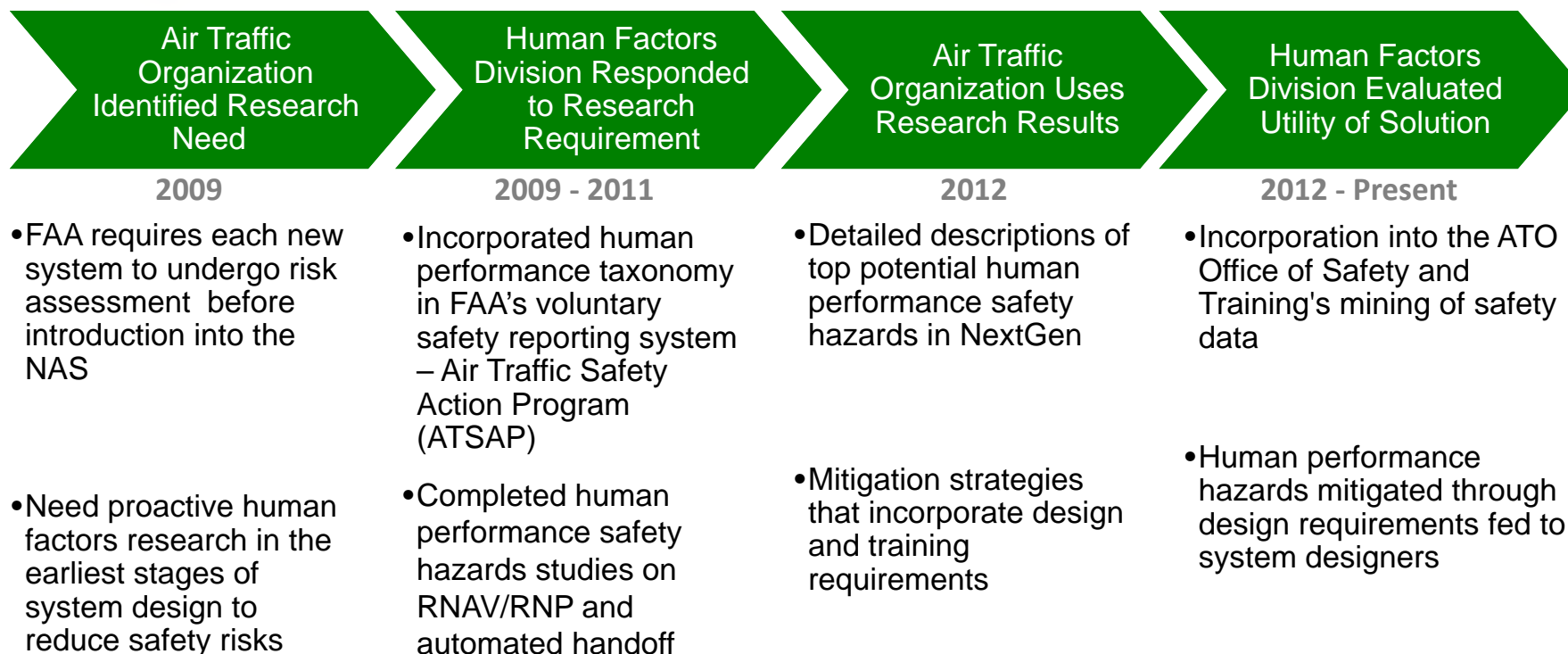


STARS equipment

# Top Safety Risks

- Top 5 nearly always involve “Human Error”
  - ✦ “The old view” sees human error as a cause of failure
  - ✦ “The new view” sees human error not as a cause but as a symptom of failure
  - ✦ Safety is not inherent in systems. The systems themselves are contradictions between multiple goals (safety and efficiency) that controllers must pursue simultaneously.

# From Research To Reality: Human Performance Safety Assessment



# Human Factors Engineering

- Human Systems Integration Roadmap shows implementation schedule of new technologies that affect operations
- Human Factors Acquisition Working Group responsible for guidance and technical support for stakeholders and programs





# Human Factors Standards

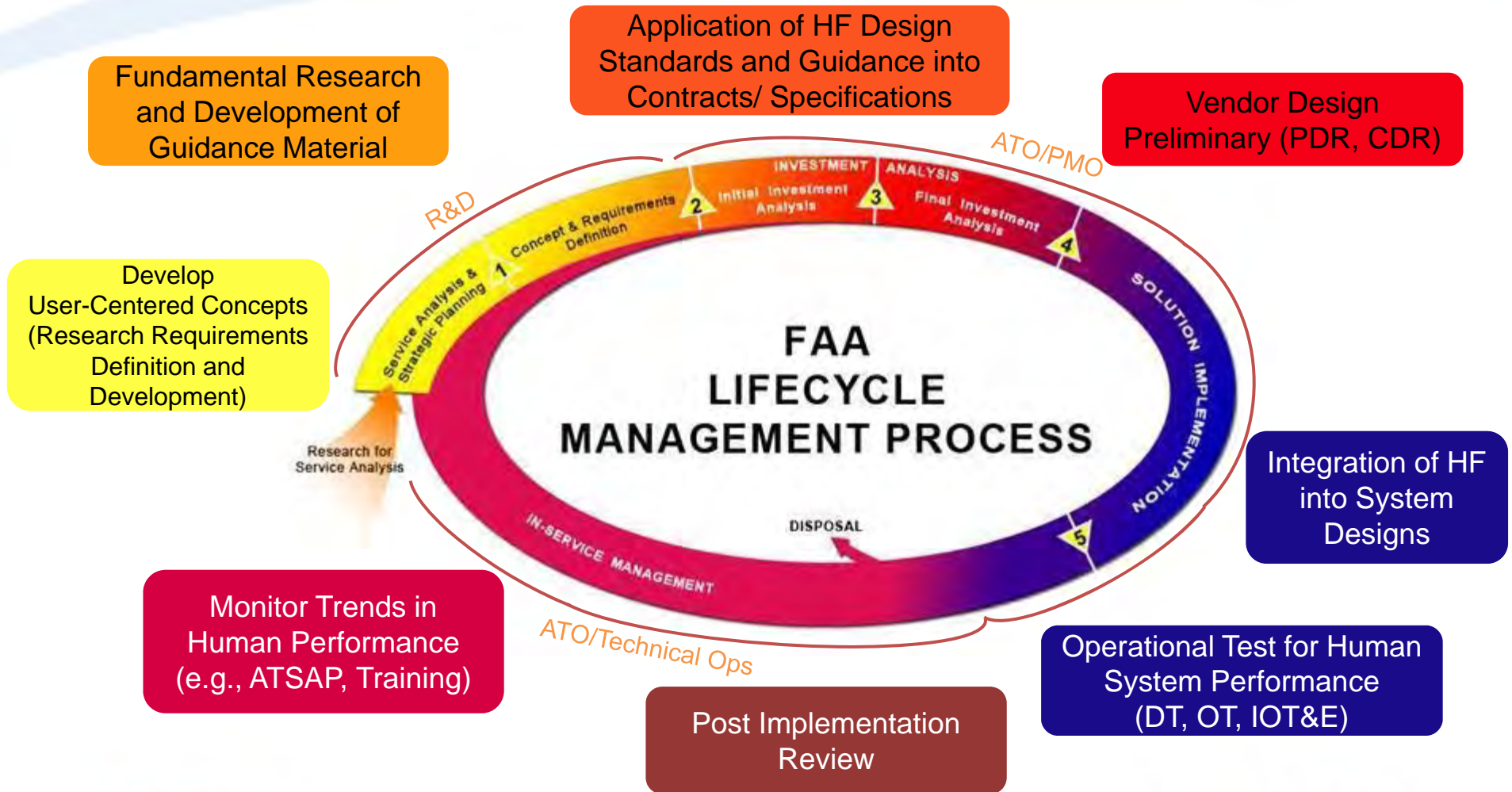


- Recently published HF-STD-004, Requirements for a Human Factors Program
- Updating HF-STD-001, Human Factors Design Standard
- Developing standards for Technical Operations on symbols and markings, and abbreviations

Standards & Guidance available at:  
<https://www.hf.faa.gov/hfportalnew/SAE.aspx>



# Human Factors Application in ATC Acquisition Programs



# Our Approach

- Helping programs to understand human factors costs and benefits
- Leveraging standards and best practices for consistent human factors integration and avoid duplication
- Building communications across FAA lines of business on human factors in research, acquisitions, and operations
- Coordinating activities with EUROCONTROL on safety and human performance through Action Plan 15
  - ✦ Principles for integrating automation in controller workstations



# Summary

- FAA supports an systems-level integration of human factors in research, acquisitions, and operations
  - In-depth perspective on interconnected changes in capabilities for ATC and flight deck avionics
- Research is focused to resolve shortfalls and gaps
  - Research stands up well from external reviews
  - Research shown to be effective in transitioning to implementation
- We drive guidance into acquisitions across the acquisition life cycle by leading the Human Factors Acquisition Working Group





Questions?

