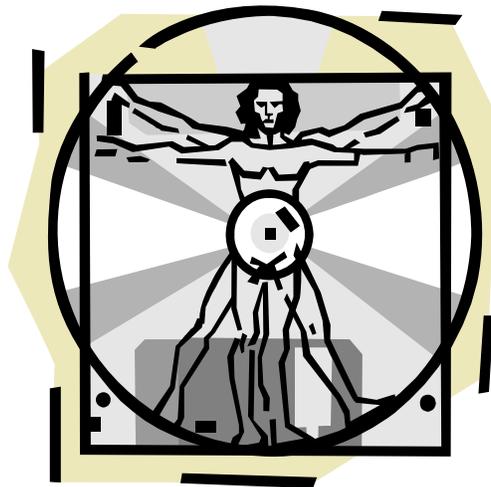




Federal Aviation
Administration

The Flight Standards Service Plan for Maintenance Human Factors (FY 2006 - 2007)



September 30, 2006

Executive Summary

A good plan tells you where you are, where you are going, and identifies the potential obstacles along the way. This plan does that!

This document provides an overview of Maintenance Human Factors activity within the Flight Standards Service (AFS). Tasks are classified as regulatory support and guidance; workforce support; or research and development. The plan presents activities categorized as past, present and future and offers a format for subsequent annual reporting. The plan ends with a summary of seven challenges facing the Maintenance Human Factors activity within Flight Standards.

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1.0 Maintenance Human Factors in the Flight Standards Service

This introductory section defines the goals and overall positioning of Maintenance Human Factors activities within the Federal Aviation Administration. Emphasis shall be on the Flight Standards Service (AFS) within the Office of Aviation Safety. Since FAA responsibility for aircraft maintenance resides with the Aircraft Maintenance Division (AFS-300) of AFS, it can be argued that this plan is really the aircraft Maintenance Human Factors plan for the FAA.

1.1 Plan Goals

- To provide a single source for general descriptions of Maintenance Human Factors activity throughout the Flight Standards Service.
- To promote enhanced understanding and appreciation of Maintenance Human Factors activity by offering concise lists and descriptions of key past, current, and future activity, as well as anticipated challenges and evolving requirements.
- To illustrate the human factors capabilities of AFS, AFS-300 and related divisions, and contract support personnel by offering concrete examples of services, products, and plans.
- To promote increased understanding of Maintenance Human Factors activities by Flight Standards airworthiness inspectors, resulting in increased field input to current and planned activities.
- To offer a human factors plan format that may serve as the potential structure for other plans for human factors within the FAA.

1.2 Aircraft Maintenance Division Overview

The Aircraft Maintenance Division is highlighted in this section because it has all maintenance responsibility for AFS, which in turn has all aircraft maintenance responsibility for the Office of Aviation Safety (AVS), which ultimately has all aircraft maintenance responsibility for the FAA.

The Flight Standards Service promotes safe air transportation by setting the standards for certification and oversight of airmen, air operators, air agencies, and designees. AFS-300 promotes safety of flight of civil aircraft and air commerce by performing the following actions:

- Advises the agencies' officers and executives, and other principal officials, and serves as a point of contact for the public and the aviation community on technical matters appropriate to the national level
- Assigns special technical projects, recommends priorities, and provides broad policy and program guidance to ensure the adequacy of maintenance program activities performed by the Regulatory Support Division
- Determines the need for, justifies, and formulates new or amended regulations and supplementary regulatory material
- Participates in regulatory review programs
- Recommends grants or denials of exemptions
- Develops maintenance operations specifications (OpSpecs)
- Determines the need for and sponsors research and development projects
- Develops and recommends national policies, standards, systems, procedures, and program plans
- Develops, coordinates, and issues national directives to provide technical guidance on policies and procedures
- Develops standards, policies, and procedures for examining and appointing private persons to act as representatives of the Administrator, under the provisions of Title 49 of the United States Code (49 USC), sections 44702 and 45303, with respect to the maintenance and continued airworthiness of civil aeronautical products
- Establishes policies and procedures and recommends final action on granting or denying deviations under Title 14 of the Code of Federal Regulations (14 CFR) part 119 for Directors of Maintenance and Chief Inspectors
- Establishes policies and procedures and recommends final action on granting or denying exemptions under 49 USC, section 44711, to foreign airmen who are directly in charge of inspection maintenance, overhaul, or repair of aircraft, aircraft ongoing propellers, appliances, or components.
- Guides and assists other divisions, the regions, and other elements of the agency in the conduct of related programs, and provides guidance on applying agency policies, standards, and procedures pertaining to safety issues
- Recommends final action on any petition for reconsideration or original issuance, amendment, or denial of OpSpecs pertaining to maintenance or continued airworthiness of aircraft
- Recommends final action on requests for reconsideration or original issuance, amendment, or denial of a maintenance airman or air agency certificate
- Recommends, initiates, and coordinates regulatory and policy action to resolve safety problems resulting from accidents, incidents, or other sources

- Represents the service in developing international agreements, arrangements, policies and practices involving maintenance of civil aircraft and certification of foreign airmen and air agencies

Therefore, AFS-300 has responsibility for the human factors aspects of the list of actions above. The technical and managerial lead for AFS-300 Maintenance Human Factors is delegated to the Air Carrier Maintenance Branch (AFS-330). While this branch focuses on air carrier maintenance policy, guidance, and regulations, an individual within this branch also is assigned the added responsibility of handling maintenance human factors issues. The AFS-330 lead is heavily supported by AVS through the Chief Scientist and Technical Advisor for Human Factors in Aircraft Maintenance Systems (CSTA-MxHF).

The combination of one person from AFS-330 and the CSTA-MxHF currently accomplish the majority of Maintenance Human Factors activities for AFS-300. These personnel are supported by a technical/contracts manager from the Air Traffic Organization Operations Planning Research and Development (ATOP-R&D). In most cases, technical support for activities is provided, under contract, through universities, government labs, and other private contractors.

1.3 Human Factors Defined

There are a variety of useful definitions of human factors throughout various organizations within the FAA. There is no unanimous agreement of the definition among FAA human factors professionals. This situation presents a challenge to clearly explaining human factors to FAA management, to FAA employees not directly involved in the human factors area, and to the public. The current document that offers an “official definition” is FAA Order 9550.8A, *Human Factors Policy*, which was developed by the Air Traffic Organization Operations Planning – Human Factors Research and Engineering Group (ATOP). This definition is acceptable to AFS, and is defined in FAA Order 9550.8 as follows:

“Human factors entails a multidisciplinary effort to generate and compile information about human capabilities and limitations and apply that information to equipment, systems, facilities, procedures, jobs, environments, training, staffing, and personnel management for safe, comfortable, and effective human performance”.

The Human Factors and Ergonomics Society consists of just fewer than 5,000 members, most of whom have employment or high interest in the human factors field. Its definition is different but not in conflict with the FAA definition:

“Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies

theory, principles, data, and other methods to design in order to optimize human well-being and overall system performance”.

Another definition comes from the European Aviation Safety Agency (EASA). EASA defines human factors as follows:

“‘Human factors’ means principles which apply to aeronautical design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration of human performance. ‘Human performance’ means human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations”.

For AFS, all three definitions mean that Maintenance Human Factors program activities must pay attention to people, the environment in which they work, the actions they perform, and the resources necessary to perform those actions. That characterization constitutes another definition based on people, environment, actions, and resources, or PEAR. Table 1 shows examples of some of the elements included in PEAR.

<p style="text-align: center;">PEOPLE – Who</p> <ul style="list-style-type: none"> Physical Factors <ul style="list-style-type: none"> Physical size Sex Age Physical characteristics Strength Sensory limitation Physiological Factors <ul style="list-style-type: none"> Nutritional factors Health Lifestyle Fatigue Drugs Incapacitations Psychological Factors <ul style="list-style-type: none"> Workload Experience Knowledge Training Attitude Mental or emotional state Psychosocial Factors <ul style="list-style-type: none"> Interpersonal conflicts Personal loss Financial hardships 	<p style="text-align: center;">ENVIRONMENT – Where</p> <ul style="list-style-type: none"> Physical <ul style="list-style-type: none"> Weather Location inside/outside Workspace Shift Lighting Noise Safety Organizational <ul style="list-style-type: none"> Personnel Supervision Union management relations Pressures Crew structure Size of company Profitability Morale Culture
<p style="text-align: center;">ACTIONS – What</p> <ul style="list-style-type: none"> Steps Performance Number of people involved Communication <ul style="list-style-type: none"> Oral Visual Written Information Control Requirements 	<p style="text-align: center;">RESOURCES – What and Who</p> <ul style="list-style-type: none"> Procedures/Work Cards Manuals/Bulletins/FARs Test Equipment Hand/Power Tools Machine Tools Computers/Software Paperwork/Signoffs Ground Handling Equipment <ul style="list-style-type: none"> Forklifts/tow motors Ladders/steps/work platforms Cranes hoist/jacks Fixtures Materials Task Lighting Manpower Training

Table 1: PEAR - People, Environment, Actions, Resources

While models like PEAR help define human factors, it is also helpful to consider the technical and scientific disciplines that contribute to the study and application of human factors. In practice, the definition of human factors is often based on the discipline of the party offering the definition. Figure 1 offers examples of disciplines that may be involved in human factors applications and research. The examples are by no means exhaustive.

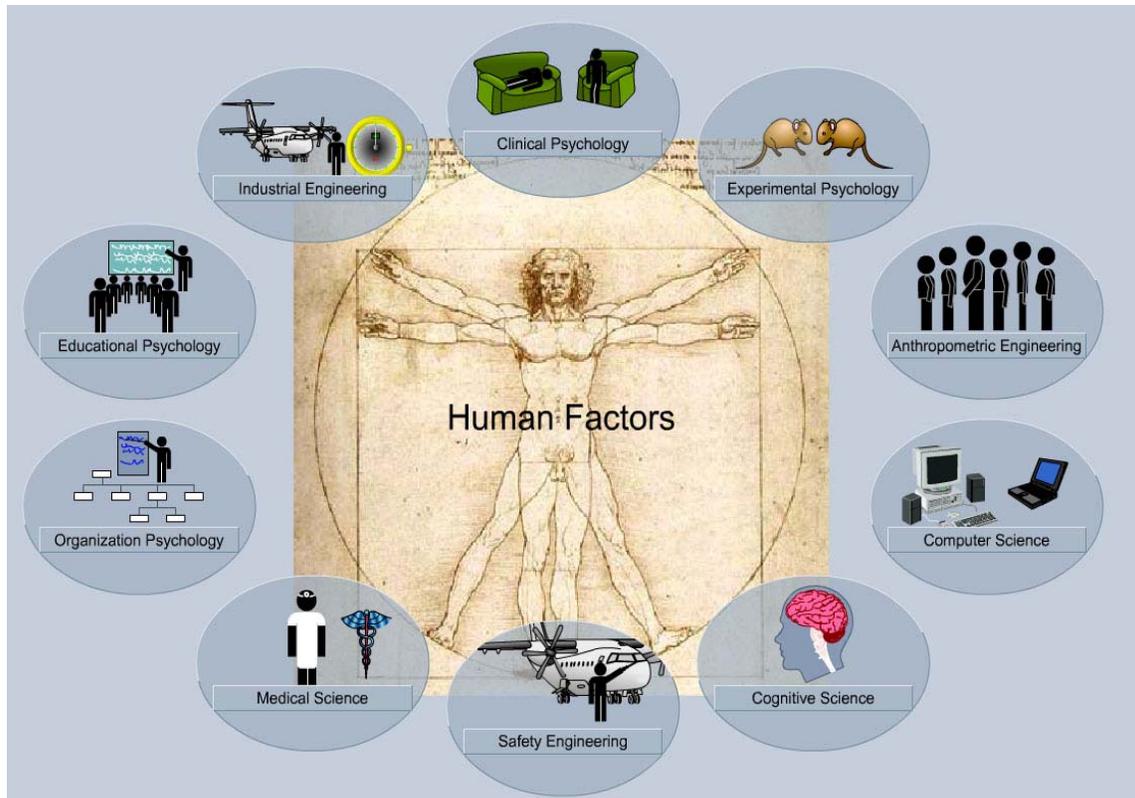


Figure 1: Example Disciplines of Human Factors

For example, safety engineering is very important to workplace design issues like the height of platforms, the width of passageways, signage for safe work, and other concerns. Anthropometric engineering focuses on the design of equipment to match the physiological characteristics of humans. Organizational psychology is an important foundation of modern aviation human factors since it addresses many of the social and teamwork issues associated with crew resource management (CRM).

The list of contributing disciplines is extensive, as it should be. In most cases, the specific discipline must be matched with the aviation subject matter expertise. For example, a display and test probe for non-destructive inspection must be designed with an understanding of not only human factors issues but also the technical issues related to how, how often, where, and by whom the equipment will be used.

These definitions and the disciplines of human factors should help form a basis for the Maintenance Human Factors activities described in the next section.

1.4 General Categories of Activity

To describe past, present, and planned activities, Maintenance Human Factors projects have been grouped into three general categories. These projects are classified into the following categories: regulatory support and guidance (Regs.); workforce support (Support); and research and development (R&D), each of which is described below.

1.4.1 Regulatory Support and Guidance (Regs.)

Creation of new regulations or modification of existing rules must take human factors into account. In some cases this is a small task; in other instances it has a major impact on the rule. For example, regulations for training programs or information displays may require extensive input regarding human factors.

Guidance material for the public, like advisory circulars, often requires Maintenance Human Factors input. Similarly, FAA guidance materials, like inspector handbooks, often require technical information or review of content related to human factors.

1.4.2 Workforce Support (Support)

Guidance material, such as that described above, is only one small example of workforce support. More substantive examples are creations of training programs, audio-visual media, online and hardcopy job aids, and specialized instruction manuals. In many cases, Maintenance Human Factors personnel deliver training to large and small audiences of FAA employees or designees. An example of a workforce support activity is the creation and ongoing development of *The Operator's Manual for Human Factors in Aviation Maintenance*, which is available at www.hf.faa.gov/opsmanual.

1.4.3 Research and Development (R&D)

Research and development is one of the three major activities for Maintenance Human Factors personnel. Portions of the FAA's R&D are conducted in-house while contractor support is used for selected activities. In those cases, the FAA works closely with the contractor. One such example is the 2006 - 2007 activity of designing and writing the revision of the *Human Factors Guide for Aviation Maintenance and Inspection*. In that case, the chapters are written by a team of contractors and FAA personnel.

Another example of contractor involvement is a project to support industry implementation of voluntary event reporting systems in accordance with the FAA Aviation Safety Action Program (ASAP). This activity is conducted by a university with very close involvement of the two FAA Maintenance Human Factors representatives from Flight Standards. It is actually an ASAP support contract to AFS-200, in cooperation with Maintenance Human Factors.

1.5 Identifying Maintenance Human Factors Requirements

Requirements for Maintenance Human Factors projects or activities are derived in many ways. The most formal process is the Technical Community Requirements Group (TCRG) process which complements the AVS Quality Management System (QMS). This process is documented in the *AVS R&D Requirements Process* document and is not repeated in this plan. Most importantly, the TCRG process is the formal manner in which AVS conducts long-term planning based on field requirements. The process has the means to address immediate requirements that arise, but were not included in the long-term planning. Such “pop-ups” are often driven by emerging safety issues (e.g., increased contract maintenance), evolving technologies and procedures (such as very light jets [VLJ] and Unmanned Aerial Systems [UAS]), changing airline or FAA economic conditions (like bankruptcy or inspector workforce shortages), audit findings from the Department of Transportation Office of the Inspector General, National Transportation Safety Board (NTSB) recommendations, ideas from FAA aviation safety inspectors, and more.

2.0 Descriptions of Past, Present, and Future Maintenance Human Factors Activities

Every division and sub-entity has a business plan that is used to develop new programs and demonstrate the value of current resource allocations. Within each of those plans are activities with some aspect of Maintenance Human Factors participation. That is the nature of the human factors discipline; it is embedded into good organizations.

The list of activities and descriptions provided herein are simply a convenient means to collect and describe Maintenance Human Factors activities and plans in one document. By design, the lists are not meant to catalog every past, current, and planned activity. Instead, this Maintenance Human Factors plan offers enough information to allow one to adequately understand the status of current major projects and plans for the future. This plan is not the “yardstick” by which Maintenance Human Factors activities should be measured. Instead, it provides an overview and general description of Flight Standards Maintenance Human Factors activities.

Maintenance Human Factors activities, in this plan, are divided into three sections: selected 2005 accomplishments, selected 2006 activities, and selected planned activities. Each activity within the sections has been further categorized as regulatory support and guidance, support, or R&D, as described in section 1.4. A table version of the plan is included as appendix A. Appendix A, while less detailed, contains additional tasks not fully described herein.

2.1 Selected 2005 Accomplishments

During 2005, the highest priority was to re-establish Maintenance Human Factors activities after reduced activity from 2001 through 2004. Initially, these activities focused on information dissemination to the FAA inspector workforce and industry.

- Publication – *The Operator’s Manual for Human Factors in Aviation Maintenance (The Manual)*, available at <http://www.hf.faa.gov/opsmanual>, describes the five most important safety-related areas upon which a maintenance human factors program must concentrate. *The Manual* was produced by the FAA with a team of industry advisors. It capitalizes on clear communication and presents much of the information in a checklist format. The web site contains the complete downloadable version. Based on the number of site “hits”, the document was downloaded over 2500 times in the first six months after release. In 2006, it received the Administrator’s Award for Plain Language. This web-based document is now available in three languages (English, Spanish, and Chinese). See figure 2. **(Support)**

Operator's Manual
Human Factors
in Aviation Maintenance
Last update: 4/17/2006

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Search

Introduction
1.0 Event Investigation
2.0 Documentation
3.0 Human Factors Training
4.0 Shift/Task Turnover
5.0 Fatigue Management
6.0 Sustaining & Justifying an HF Program
Acknowledgements

Introduction

This manual is in response to the industry's requests for a simple and manageable list of actions to implement a Maintenance Human Factors (MHF) program. A panel of experts selected the following six topics for such a program to be successful:

1. Event Investigation
2. Documentation
3. Human Factors Training
4. Shift/Task Turnover
5. Fatigue Management
6. Sustaining & Justifying an HF Program

Figure 2. *The Operator’s Manual for Human Factors in Aviation Maintenance*
www.hf.faa.gov/opsmanual

- Human Factors Guidance Documents – Cooperated in the production of an advisory circular and inspector handbook guidance to develop maintenance human factors training materials for all employees of repair stations operating under 14 CFR part 145. **(Regs.)**
- Revision of 14 CFR Part 145 – 14 CFR part 145 underwent final revision and was published in 2005. There was extensive activity at FAA headquarters and in the field offices to ensure that inspectors had useful knowledge of the 14 CFR part 145 issues associated with maintenance human factors and related training programs. **(Regs.)**
- Language Study – Completed a study to analyze risks associated with language-related error in international maintenance repair stations where English was not the native language. The study showed that international maintenance contractors are taking steps to minimize risk associated with the use of English-language technical manuals. The report addressed the issues and offered methods to further mitigate risk associated with technical documentation. **(R&D)**

2.2 Selected 2006 Activities

Current and completed activities are a mix of support to rulemaking along with research and development matched to the requirements of the Human Factors TCRG. The highest priority is maintenance human factors education and information for FAA aviation safety inspectors and in U.S. and international maintenance organizations.

- International Survey – Created and disseminated a survey on human factors in maintenance organizations. The survey addressed issues of regulatory compliance, fatigue management, an assessment of the impact of the Maintenance Human Factors program, and more. Over 400 volunteer participants from more than 50 countries completed the survey. **(R&D)**
- International Symposium – Reconvened the annual FAA and industry symposium on human factors in maintenance and inspection. Conducted in cooperation with the US Air Transport Association, Boeing, and Airbus, the 2006 conference expanded to include ramp operations. The two-day symposium included international speakers representing operators, service providers, manufacturers, academia, and government. See figure 3. **(Support)**

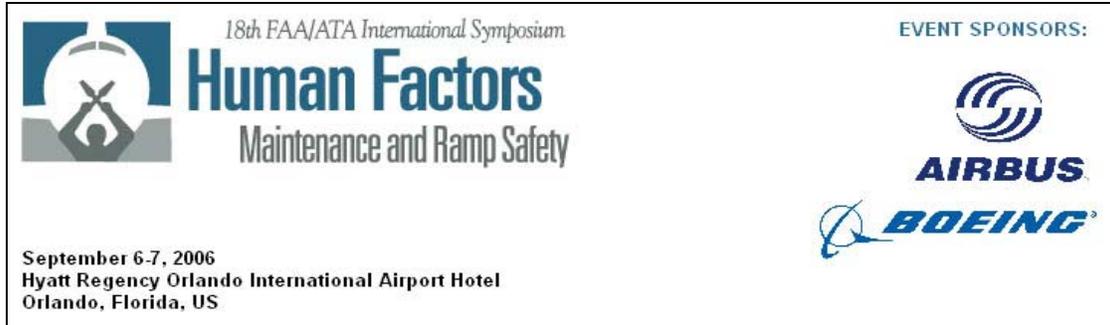


Figure 3. International Symposium

- Inspector Training – Completed revision of the maintenance human factors training course, *Human Factors in Aircraft Maintenance*, for FAA aviation safety inspectors, which included a change from two to three days of training. The course provides FAA inspectors with the knowledge requirements compatible with EASA, Transport Canada, and other regulatory agencies. Further, the redesigned course provides material to help FAA aviation safety inspectors assist in human factors course and related program development with their respective operators and air agencies. **(Support)**
- Industry Training – Extensive cooperation with U.S. industry and the FAA Safety Team (FAAST) to deliver maintenance human factors training ranging from one hour to one day. Conducted 12 industry training classes during 2006. **(Support)**
- Unmanned Aerial Systems (UAS) – Completed an initial assessment of the personnel qualification challenges associated with UASs. Once registered in the U.S., UAS flight and maintenance operations must be conducted by certificated personnel. Current maintenance regulations and technical training requirements (i.e., 14 CFR part 147) do not adequately address new technologies and operations associated with UASs. **(R&D)**

- Creation of a New Edition of the *Human Factors Guide for Aviation Maintenance and Inspection* — This detailed document was first published in 1996. The new version is web-based. Chapter topics, format, and content are being completely revised. This project will continue into 2007. See figure 4. **(Support)**

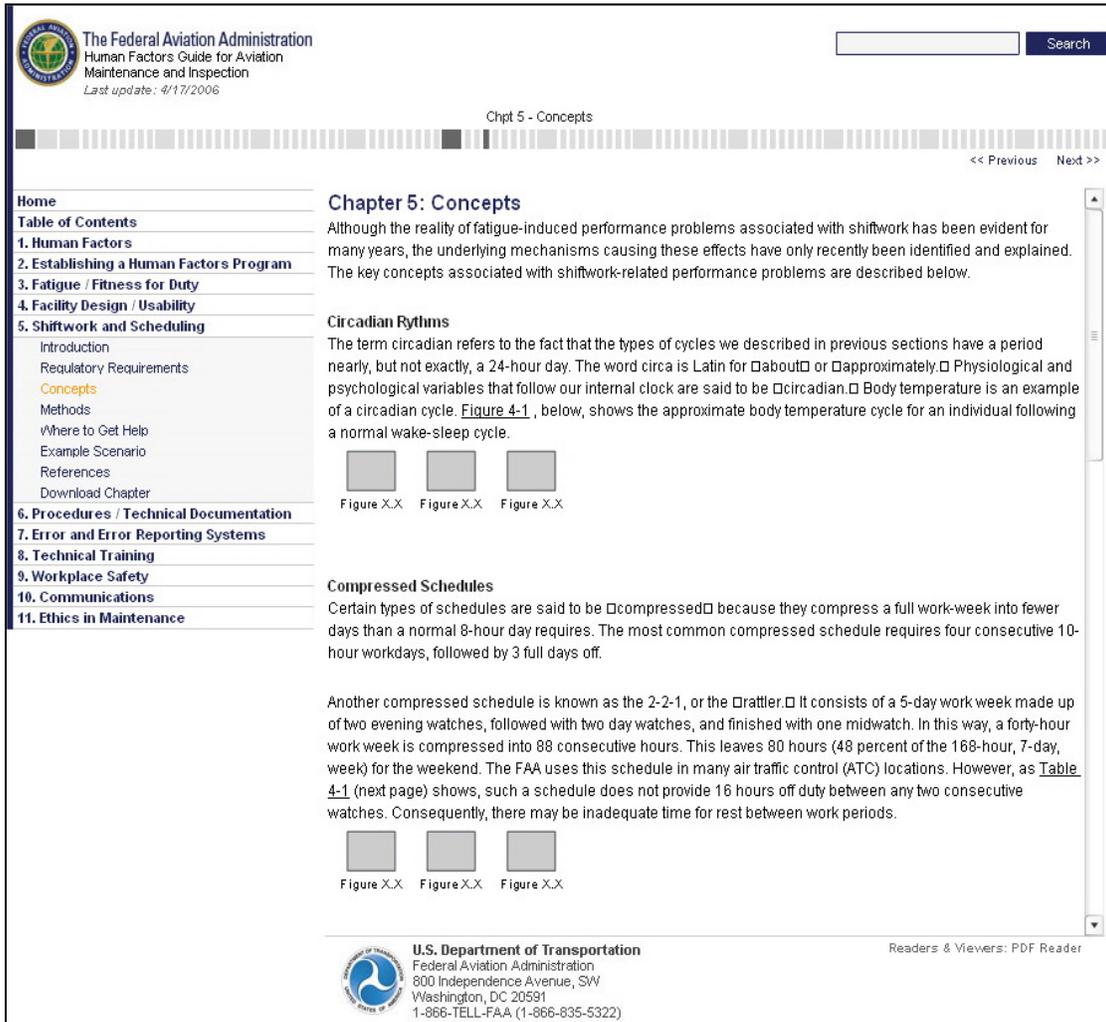


Figure 4: The Revised Human Factors Guide Sample Web Page

- Web-Based Surveillance and Auditing Tool (WebSAT) – Continued with the specification and development of prototype software to promote a web-based auditing tool that offers a standardized data format for maintenance data collection, data reduction, and analysis to identify threats affecting maintenance safety. See figure 5. **(R&D)**

WebSAT
Technical Audits

LOGOUT

Hello Michael Karwoski! [Help](#)

Audit Tasks **Checklists** **Reports** **Administration**

[Start New Audit](#) [View Checklist](#) [Audit Report](#) [Edit Auditors](#)

Resume Audit [Modify Checklist](#) [Vendor Assessment Report](#) [Edit Vendors](#)

[Corrective Actions](#) [New Audit Type Checklist](#) [Audit Planning](#) [Edit Audit Type](#)

[Search Audits](#) [Approve Checklist](#) [Re-Assign Auditors](#)

[Delete Audits](#)

Resume Audit

[Checklist Data Entry](#) [Audit Details](#)

You are currently working on the following Audits
(Click on the Audit ID to perform checklist data entry)

Audit ID▲	Vendor Name▲	Audit Type▲	Audit Start Date▼	Status Name▲
435	ZICO-TN-USA	Fuel	7/1/2004	Opened
433	vizag-sc-India	Fuel	7/3/2006	Findings
434	AMEX-OH-United States	Fuel	7/3/2006	Opened
421	JPMCO-DE-United States	Fuel	7/12/2006	Corrective action

Figure 5: Web-Based Surveillance and Auditing Tool (WebSAT)

- Re-hosting of HFSKYWAY.faa.gov Web Site – This web site contains a legacy database of all FAA-sponsored Maintenance Human Factors activity since 1988. This project began in 2006 and will continue into 2007 and beyond. **(Support)**
- Creation and Distribution of the “Dirty Dozen” Calendar – In conjunction with the FAA Safety Team (FAAST), AFS created a 2007 pocket calendar for mechanics that depicted one of the “dirty dozen” human errors in maintenance for each month. Forty thousand calendars were distributed by the end of fiscal year 2006. Industry demand for this product has been overwhelming.

2.3 Selected Planned Activities

The mid- and long-term goals are generated by a combination of ideas and requirements from field personnel, industry, other government agencies, and the FAA. The FAA entities most involved include AFS management; an aviation safety inspector assigned to maintenance human factors issues in the Air Carrier Maintenance Branch; and the Office of the Chief Scientific and Technical Advisor for Human Factors in Aircraft Maintenance Systems. The Maintenance Technical Community Requirements Group (TCRG) and the AVS Human Factors TCRG also contribute to the goals. These goals and requirements fall into the following categories: operational requirements, rulemaking support, or research and development.

- Guidance Materials – Continue development of guidance and training materials for FAA aviation safety inspectors and industry personnel in the form of advisory circulars and chapters for the *Airworthiness Inspector's Handbook*, FAA Order 8300.10. **(Regs.)**
- Safety Management Systems – Implementation and assessment of safety management systems in maintenance and engineering departments. This activity will be aligned with evolving FAA guidance and regulation. These initiatives will commence with airline and maintenance, repair, and overhaul organizations (MROs) and will migrate into general aviation. **(Regs.)**
- Fatigue Management – Expand advisory materials (leading to eventual rulemaking) on fatigue management programs in maintenance organizations. **(Regs.)**
- Strategies to Reduce General Aviation Maintenance Errors – In the past, the major focus of Maintenance Human Factors has been on airlines and MROs. In keeping with the FAA Flight Plan and the AVS and AFS business plans, the FAA must strive to ensure general aviation safety and reduce general aviation accidents. This effort will address issues related to human error in general aviation maintenance. **(R&D)**
- Guidelines to Select and Train Human Factors Managers and Trainers for Maintenance Organizations – Proper training in maintenance human factors will help reduce the number of fatalities and injuries caused by maintenance personnel. The FAA will issue improved guidance material to help industry select and qualify the maintenance human factors training workforce. Industry representatives continually ask about reasonable criteria to select and prepare personnel for management and training positions. **(R&D, Support)**

- Creation of Maintenance Human Factors Audit Tools – To fulfill a requirement to audit human factors in maintenance organizations, tools and procedures will need to be developed. The tools will be checklists, job aids, and procedures that can be shared by both industry and FAA inspectors. **(Support)**
- Forecasting the Future of Aviation Maintenance and Aviation Maintenance Technicians – The aircraft mechanic profession has faced layoffs and uncertainty since 2001, resulting in a reduction of aviation maintenance training. At the same time, emerging technologies and increased airliner sales show trends for increased employment. This situation must be more clearly understood by the FAA to enable the FAA to revise curriculum and certification requirements accordingly. **(R&D)**
- Safety, Regulatory, and Human Factors Issues on the Maintenance of New Technology in General Aviation/Rotorcraft, Including VLJ Risk Identification/Reduction - Since a variety of new technologies are likely to impact general aviation maintenance systems, the FAA needs to determine if rules and guidance materials must be changed for general aviation maintenance. The risks associated with new technologies, including VLJ maintenance, must be identified and addressed. A database may be necessary early in the life of VLJs that classify errors and event data to help identify risks and determine approaches to mitigate such risks. **(R&D, Regs.)**
- Advanced Training Technologies – Training technologies have had a large impact on the efficiency and effectiveness of maintenance training. These technologies raise the issue of the appropriateness of mandated training duration and also have an impact on curriculum content. Future work must determine if FAA requirements are an appropriate representation of today's training and job aiding technology to ensure that these rules are not outdated. **(Regs.)**
- Advanced Job Aiding and Technical Documentation and the Impact on Personnel Training and Certification Requirements – As with the advent of new training technology, new job aiding technology will impact performance and knowledge requirements for maintenance personnel. The FAA may need to adjust its rules for training and certification accordingly. **(Regs.)**
- Flight Crew, Maintenance, and Ramp Personnel Technical Communications – Enhancing inter-disciplinary communication continues to be an opportunity to improve safety in maintenance and ramp operations. Recent communication failures have led to in-flight decompressions and other safety events. This challenge shall continue to be an important focus for Maintenance Human Factors study. **(R&D)**

3.0 Challenges for AFS Maintenance Human Factors

This section addresses challenges, both short- and long-term, which will likely define Maintenance Human Factors activities. The solutions to these challenges will be addressed not only with specific Maintenance Human Factors activity, but also by other personnel in the Aircraft Maintenance Division whose primary responsibilities are not specifically focused on Maintenance Human Factors.

3.1 Challenge 1 – Addressing Known Risks

Priority for new regulations and understanding evolving requirements must be increased on selected maintenance human factors issues. This includes, at a minimum, event investigation and reporting, matched to new Safety Management Systems (SMS) trends, and maintenance human factors training programs for all segments of the industry. Another AFS challenge is to better understand the issues associated with regulations related to duty time for mechanics.

This challenge is ongoing. The FAA technical community, industry, and the FAA entities that define requirements and specify research activities, must continue to address these issues. The R&D outputs must be delivered in a straightforward manner that can be immediately applied to work practices and eventually to applicable regulations.

3.2 Challenge 2 – Training of the Maintenance Workforce

There is an impending shortage of qualified aviation maintenance technicians. In addition, the training requirements for new technicians are not matched to the job requirements. Experts agree on these challenges. This is a maintenance human factors issue because personnel qualifications are tied to personnel performance.

The Federal Aviation Regulations have not kept pace with industry needs and maintenance training requirements. Projects defined in section two of this plan mention such technologies as very light jets, non-conventional engines, unmanned aerial systems, and electronic engine and flight controls, which present sophisticated challenges that extend even to general aviation aircraft.

New technicians, often first exposed to the workforce in general aviation positions, are unprepared for the challenge of advanced technology existing in modern general aviation equipment. Corporate aviation training organizations have repeatedly emphasized that newly certificated mechanics do not have sufficient understanding of the fundamentals required for the maintenance of new technology products.

Aviation Maintenance Technician schools are training to the Federal Aviation Regulations, which may not be enough for today's, or tomorrow's, industry. The

challenge is that 14 CFR part 147 should be revised/updated — and this challenge must be raised in priority. AFS is proceeding with rulemaking for approved training programs in 14 CFR parts 121, 135, and 145 organizations. At the same time, AFS should revisit the training requirements for 14 CFR part 147.

3.3 Challenge 3 – Consistent Maintenance Human Factors Message

The maintenance human factors language, message, and direction contained in current guidance materials could be improved to ensure consistency. This challenge became apparent during the issuance of the new 14 CFR part 145, *Advisory Circular for Repair Station Training Program (AC 145-10)*, and the most recent change to the *Airworthiness Inspector's Handbook*, FAA Order 8300.10. The challenge was addressed by the issuance of a Handbook Bulletin for Airworthiness, HBAW 06-04, *Guidance for Evaluation and Acceptance of Maintenance Human Factors Training Program*.

The challenge extends from the written guidance to FAA speeches regarding maintenance human factors. For example, selected FFAST personnel deliver numerous speeches regarding human factors. Currently, non-AFS-300 personnel who deliver human factors services have not generally communicated with AFS-300 or with the CSTA-MxHF. These FAA personnel seem to operate independently with regard to the style and content of their human factors message. That does not suggest that the presentations are not good; however, often the style and content of the human factors message varies depending on the individual delivering the presentation. There should be an effort to formalize and standardize the maintenance human factors message from the FFAST members and others who represent the FAA on the maintenance human factors topic.

An additional solution to this challenge is the addition of a new chapter to FAA Order 8300.10, *Airworthiness Inspector's Handbook*. The new chapter should be dedicated to the topic of human factors. It should serve as a human factors reference point for all appropriate chapters of the handbook. Such a chapter would eliminate the requirement to add human factors language to every chapter of the handbook. This chapter should provide references and links to FAA information that can be used for training as well as dissemination of general information. This solution is manageable and should be accomplished during fiscal year 2007.

3.4 Challenge 4 – Ensure that Maintenance Human Factors Research Activities Match Field Requirements

AFS should ensure the reliability and validity of the process of identifying maintenance human factors research requirements, establishing priorities, providing funding, and ensuring the usefulness of the results. The process should remain accountable.

The current process, using the Technical Community Requirements Group, presents an ideal method through which all FAA constituents can have an impact on the R&D requirements. However, in practice, it is difficult to involve many field inspectors in this process. The result is that the AVS Human Factors staff does most of the human factors R&D specification.

AFS must remain diligent to ensure that maintenance human factors R&D continues to receive the attention matched to its significant safety impact and legacy. AFS management has directed that the maintenance human factors R&D products be immediately applicable to industry use. The TCRG must continue to recognize the value of the applied R&D products to satisfy maintenance human factors requirements.

The AFS Maintenance Human Factors staff should remain active in the technical community. They must continue to be a frequent presence in industry maintenance environments, including airline, MRO, and general aviation hangars and conferences. They must communicate closely with the FAA inspector workforce and industry personnel. In addition, they must clearly communicate the importance of the industry and regulatory maintenance human factors requirements to the Human Factors TCRG.

3.5 Challenge 5 – International Communication and Leadership

Cooperation with the European Aviation Safety Agency, Transport Canada, and other international entities is important to ensure harmonization and for the FAA to regain its stature as the technical leader of maintenance human factors activity. From 2000 to 2005, the FAA and EASA moved forward with new rules and guidance material for maintenance human factors. In 2004, AVS created a technical executive-level position dedicated to maintenance human factors. At the same time, AFS assigned Maintenance Human Factors coordination responsibility to an aviation safety inspector with extensive airline human factors experience. The goal of establishing the two positions was to ensure that the Maintenance Human Factors program would be highly visible and would have the benefit of the combination of the application of scientific principles and airline working experience.

At the same time, AVS and AFS senior management repeatedly showed renewed commitment to maintenance human factors. Today, the FAA is in an excellent position to restore the maintenance human factors international leadership that it had during the 1990's. Recent successes like the September 2006 International Symposium and the International Maintenance Human Factors Survey are clear indications that the FAA is reemerging with international leadership activity.

3.6 Challenge 6 – Human Factors in General Aviation

The FAA must increase attention to human factors in general aviation maintenance. The majority of FAA attention to maintenance human factors has focused on the airlines. Research projects completed by the Civil Aerospace Medical Institute have looked at accident causes in general aviation. However, there has not been a high level of formal attention to general aviation topics. While FAAST has delivered educational seminars to many general aviation audiences, there is no documented list of the challenges and solutions that the FAA has offered to the general aviation community.

There are many reasons to expand maintenance human factors services to general aviation and that must be done. It is only a matter of raising it as an AFS business priority and commencing with the work. The challenge, therefore, is to extend FAA Maintenance Human Factors activity to the general aviation community.

AFS Maintenance Human Factors staff should increase their participation in general aviation activities, when available. In addition, AFS should continue to empower members of the FAA Safety Team as they deliver the message to general aviation audiences. The new three-day human factors course for FAA inspectors will also provide solutions for this challenge.

3.7 Challenge 7 – Intra-FAA Human Factors Communication and an AVS Human Factors Plan

Maintenance Human Factors activity must coordinate with human factors activity throughout the rest of the FAA. The AVS Human Factors Coordinating Committee is the primary vehicle for that coordination. The committee meets quarterly and involves the primary services, divisions, and branches where there are significant human factors activities. This includes, but is not limited to the following: the Flight Standards Service, the Aircraft Certification Service, and Civil Aerospace Medical Institute. It remains as an important challenge to communicate FAA-wide human factors initiatives.

Another opportunity, previously mentioned, is increased coordination with the FAA Safety Team. There are human factors personnel on the safety team but the FAA has not fully capitalized on their wisdom and capability.

This Maintenance Human Factors plan is one of the initial efforts to document all of the recent past, current, and planned activities. Such a plan is critical for communication within AFS. However, it is also a valuable way in which to communicate maintenance human factors to other FAA organizations and to the public.

4.0 References

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Appendix A -- Specific Maintenance Human Factors Activities

Selected 2005 Accomplishments

Activity	Activity Type			Provider
	Regs.	Support	R&D	
Publication - <i>The Operator's Manual for Human Factors in Aviation Maintenance</i>		✓		FAA/AFS-300
Human Factors Guidance Documents	✓			FAA/AFS-300
14 CFR Part 145	✓			FAA/AFS-300
Language Study			✓	University of Buffalo

Selected 2006 Accomplishments

Activity	Activity Type			Provider
	Regs.	Support	R&D	
Maintenance Considerations of Unmanned Aircraft Requirement			✓	NASA
International Survey of Maintenance Human Factors			✓	FAA/CAMI
International Symposium	✓	✓		FAA/AFS-300
New Inspector Training		✓		Flight Safety International, AFS-300
Industry Training		✓		AFS-300
Web-Based Surveillance and Auditing Tool			✓	Clemson University
Human Factors Guide for Maintenance & Inspection		✓	✓	Human-centric Technology and Team
Re-hosting of HFSKYWAY.faa.gov		✓		CSSI, ATOP-R&D, AFS-300

Selected Planned Requirements

Activity	Activity Type			Provider
	Regs.	Support	R&D	
Fatigue Management Systems	✓	✓		AFS-300, Contractor TBD
Forecasting the Future of Aviation Maintenance and Aviation Maintenance Technicians	✓		✓	Contractor TBD
Safety, Regulatory, and Human Factors Issues on the Maintenance of New Technology in GA/Rotorcraft, Including VLJ Risk Identification/Reduction	✓	✓	✓	AFS-300, Contractor TBD
Continuing Creation of Regulations and Guidance Material	✓	✓		AFS-300
Safety Management System Support	✓	✓		AFS-300, Contractor TBD
Strategies to Reduce General Aviation Maintenance Errors		✓	✓	Contractor TBD
Guidelines to Select and Train Human Factors Managers and Trainers for Maintenance Organizations		✓	✓	Contractor TBD

Appendix B -- List of Acronyms

AC	Advisory Circular
AFS	FAA Flight Standards Service
AMT	Aviation Maintenance Technician
ASAP	Aviation Safety Action Program
ASI	Aviation Safety Inspector
AVR	Former acronym for AVS
AVS	FAA Office of Aviation Safety
ATO-P	Air Traffic Organization Operations Planning
CAMI	Civil Aerospace Medical Institute
14 CFR	Title 14 of the Code of Federal Regulations
CSTA	Chief Scientist and Technical Advisor
EASA	European Aviation Safety Agency
FAAST	FAA Safety Team
GA	General Aviation
HF	Human Factors
<i>The Manual</i>	<i>The FAA Operator's Manual for Human Factors in Aircraft Maintenance</i>
MRO	Maintenance Repair and Overhaul
MxHF	Maintenance Human Factors
NTSB	National Transportation Safety Board
OpSpecs	Operations Specifications
PEAR	People, Environment, Actions, and Resources
QMS	Quality Management System
R&D	Research and Development
SMS	Safety Management System
TCRG	Technical Community Requirements Group
UAS	Unmanned Aerial Systems
49 USC	Title 49 of the United States Code
VLJ	Very Light Jet