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From: Aviation Maintenance Human Factors Program Manager, ATO-P R&D Human Factors

To: Aviation Maintenance TCRG

Subj: AVIATION MAINTENANCE HUMAN FACTORS THIRD QUARTER '05 REPORT

Ref: (a) Aviation maintenance human factors execution plans
(<http://www.hf.faa.gov/maintfunded.htm>)

1) Each project is listed below.

Special note: the creation of the Human Factors in Aviation Maintenance website was launched last quarter. The new website contains a wealth of aviation maintenance human factors publications, NTSB accident reports, ASRS incident reports, and numerous other related information.

The website is located at <http://www.hf.faa.gov/hfmaint/Default.aspx?tabid=275>.

a) An Evaluation of Broadband Applications to Aircraft Maintenance Safety

The researcher has analyzed over 100 maintenance-related Aviation Safety and Reporting Systems (ASRS) reports. Modeled the keystrokes required to use each of the electronic documentation tools at a major air carrier maintenance facility. Keystroke sequences will be used to derive usability measures for each of the systems. Maintenance personnel have reviewed our models for accuracy and completeness, and we have begun to make recommendations based on our findings.

All available information indicates the project is on track.

b) Vision Testing Requirements for Certain Persons Maintaining and Inspecting Aircraft and Aircraft Components

Project is complete.

c) Language Barriers Result in Maintenance Deficiencies

All data from Mexico (250 participants at four sites) Puerto Rico (26 participants at one site) and Colombia (86 participants at one site) has been entered for analysis. Data collection for Argentina has been arranged from 17 June to 25 June. Data for one large site in Spain will be collected 5-12 July 2005. We have asked three additional sites in the USA for cooperation in collecting a better baseline data set. One has refused due to mentioning of “outsourcing” in our work.

Data analysis from Mexico and Puerto Rico suggests a different Speed Accuracy Trade-Off pattern from the Asian sites. Translation may be beneficial, as it appears to result in reduced errors at about the same performance time. Only a complete analysis of all Latin American data will confirm this finding.

Our final report will provide refined estimates of error frequency, patterns of error types, effectiveness of intervention strategies and recommendations for FAA action to mitigate language related errors. We will provide a report on the activities in Year 3 on time by the end of the project period, to include the current report on all Asian sites. The second region (Latin America) will see collection of over 500 participants and a site in Europe with about 150 participants has been scheduled to provide data from a third region.

Project will be completed in August 2005.

d) Using Technology to Support Inspector Training

Completed final interface coding for following beta version testing for the introduction. Edited and incorporated accompanying audio (voice-overs) for the various modules. Sought and incorporated feedback on the following modules – introduction, training, simulator, design and analysis modules. Created CD version of the first prototype GAITS module. Developed the first prototype of the GAITS module.

Work to be completed: Test the prototype GAITS module with industry partners. Researchers submitted the chapter:

Sadasivan, S., Dharwada, P., Nickles, G. M., and Gramopadhye, A. K., Computer Based Training Systems: Using Technology to Aid Aircraft Inspection Training, International Encyclopedia of Ergonomics and Human Factors, (Invited Chapter), 2nd Edition, CRC Press, 2005.

All available information indicates the project is on track.

e) An Assessment of Barriers to Implementation of Aviation Safety Programs (ASAP) in Maintenance Organizations

Participation in multiple industry working groups has contributed to the overall climate of strong positive interest in building ASAP programs in maintenance. Mr. Yorman's leadership in bringing other maintenance organizations to participate in the overall research project has been exceptionally helpful to the overall Maintenance ASAP program. As a result of such collaborative efforts, Saint Louis University will be hosting a two-day working meeting to discuss the following key issues: error data classification, data-sharing across companies, and Part 145 ASAP programs. The meeting dates are June 27 and 28.

The June meeting in St. Louis is the most significant achievement. Over 35 participants from airlines, repair stations, and the FAA are planning to attend. Unlike a conference, this is a working meeting and the emphasis will be on collecting responses from the audience. A data collection and classification tool developed by UTRS and a prototype of the WASP tool, developed as a part of this research, will be demonstrated.

All available information indicates the project is on track.

f) Auditing and Surveillance Maintenance Error Tool

Developed a data model for the technical audits module prototype. A working prototype for the technical audits module prototype was developed. Researchers visited Northwest Airlines, Minneapolis to validate the selected process measures. The first set of product map screen design iterations with FedEx for the Technical Audit Module (see attached PDF file) was tested. Researchers conducted interview sessions with Technical and Internal Audit managers and IT department at the FedEx facility in Memphis, TN. A web-based process measures validation survey was conducted with other airlines to ascertain the support for the selected process measures.

Presented a paper, "*Strategy for Evaluation of Aircraft Maintenance Operations Using Process Measures*" in the International Symposium on Aviation Psychology, 2005 (see attached PDF file).

Presented a paper, "*Selection Strategy for Identification of Process Measures for Surveillance in Aviation*" in the Industrial Engineering Research Conference, 2005 (see attached PDF file).

Published a journal paper titled "WebSAT: Development of Process Measures for Aircraft Safety" submitted to IJAAS (International Journal of Applied Aviation Studies), 2005 (see attached PDF file).

Work to be completed:

- Work towards more aesthetic and professional Technical Audit Module (October, 2005).
- Generate personas and scenarios for Internal Audit and Surveillance Modules (July 20th, 2005).
- Design Internal Audit Module (September, 2005).
- Design Surveillance Module (September, 2005).
- Develop the risk model for WebSAT (August, 2005).
- Develop methods to analyze qualitative data collected by WebSAT (August, 2005).
- Submit a paper titled “Use of Product Design Methodology to Develop the Technical Audit Prototype for WebSAT” to Proceedings of Safety Across High-Consequence Industries Conference to be held at St.Louis, Missouri (August 15th, 2005).
- Embed data analysis module in Technical Audit prototype (December, 2005).
- Validate WebSAT risk model using research methodologies (January, 2006).
- Validate WebSAT User-Interface design approach using research methodologies (January, 2006).
- Disseminate User-Interface design methodology identified from WebSAT research (February, 2006).
- Disseminate quantitative and qualitative data analysis techniques identified from WebSAT research (February, 2006).

All available information indicates the project is on track.

g) Effects of Fatigue, Vigilance, Environment on Inspectors Performing Fluorescent Penetrant and/or Magnetic Particle Inspections

Data collection continues, with 50 out of the 80 participants in the screening experiment completed to date. It will probably be mid July before data collection is completed.

Status of deliverables is as follows:

- Report on comprehensive literature reviews on Vigilance, Inspection, Fatigue and hours of work was completed by Jan 31 2004.
- Report on findings for distribution of working times, fatigue strategies, inspection environments. Have collected data from approximately 30 inspectors, and will collect additional data from our contacts in Year 2. Status Yellow
- Report on design of experiment and result of pre-tests. Status Green, FPI simulation tested on two groups of pilot subjects, and 50 out of the planned 80 actual participants.

All available information indicates the project is on track; however the report on findings for distribution of working times, fatigue strategies, inspection environments will be delayed.

h) Human Factors Maintenance Considerations of Unmanned Aircraft

Objective: the Federal Aviation Administration needs to identify human factors issues in the maintenance of unmanned aircraft so that it can begin to develop policies, procedures, and approval processes to enable operation of unmanned aerial vehicles. The objective of this task is to identify human factors issues related to UAVs that will need to be addressed by the FAA for incorporation into SFAR documents.

Activities in this quarter:

One researcher attended the “Human Factors of UAVs” workshop in Mesa AZ, May 25 & 26 2005. This provided an opportunity to make contact with UAV developers and operators. Available literature on UAV human factors issues has been gathered. Initial contact with UAV operators and manufacturers has been made, and arrangements are being made to visit UAV operational sites in several locations. A visit to one UAV manufacturer has been made. Structured interviews with UAV operators have commenced. At the time of this report, several interviews had been completed.

Development of a maintenance model: a model of UAV system elements and ground support tasks is being developed. System elements include vehicle components such as airframe, engine and autopilot, and ground-based equipment such as control equipment, computer systems and transmission equipment. Ground support tasks include assembly, pre-flight preventative maintenance, system adjustment, corrective maintenance, and modifications. Each task will be associated with maintenance procedures and documentation. This model will be used as a basis for the identification of unique UAV maintenance tasks.

Activities for next quarter: in the next quarter interviews with UAV operators will continue, on site visits to UAV maintenance facilities will be conducted and UAV flight operations will be observed. A draft interim report will be prepared in accord with the Statement of Work.

All available information indicates the project is on track

i) Human-Centered Graphics and Web-Based Support for Human Factors Operations Manual

The objective of this project is to provide graphics, content review, and programming support in order to deliver a web-based (and printable) human factors document that will aid managers of aviation maintenance programs. The

working title of this document is “Human Factors Operations Manual”. The role of Human Centered Research (HCR) is to provide expertise in the graphic and interaction design of the web-based document, as well as graphic and layout expertise for the printable version(s) of the document. After the graphic and interaction design has been developed and approved by the project sponsor, HCR will implement the web-based document, as well as the printable and downloadable version(s), on the FAA website. HCR will also provide limited content review and suggestions and recommendations related to the content of the document. The actual content for the Human Factors Operations Manual will be supplied to HCR by Bill Johnson, FAA Chief Scientific and Technical Advisor for Human Factors in Aircraft Maintenance.

The project objectives will be accomplished through the performance of four tasks:

- Task 1 – Cooperate with the FAA to establish the overall format, graphic themes, etc. of the document
- Task 2 – Conceptualize, present, and create graphics and artwork to support project
- Task 3 – Convert FAA document content to web-based format
- Task 4 – Cooperate with the FAA to ensure successful transfer of the completed product to the FAA website

Progress during this Reporting Period:

The start of work on the project was authorized approximately the last week of April, 2005. During the intervening period, HCR has performed the following activities:

Task 1: HCR has reviewed and commented on two versions of document content. Mike Maddox attended a meeting of the content committee in Dallas, TX, on May 18, 2005. The content is currently being reviewed by the committee. We estimate the content to be roughly 90% complete. The committee members are in the process of locating photos and captions that are being provided to HCR as part of the document content.

HCR has developed a number of alternate graphic and interaction approaches to the web version of the HF Ops Manual. The content committee reviewed various early concepts at the Dallas meeting and provided direction for further refinement of these approaches.

Task 2: HCR has subsequently more fully developed two of these approaches and presented them to our FAA POC and the FAA content. These concepts include

depictions of home page, navigation, chapter page, section page, and print and download symbols, This is in line with the SOW requirement to present these concepts one month after the contract award.

Task 3: No conversion has taken place yet. We are waiting until the content is finalized by the content committee. Also, we must decide on a final graphic/navigation convention prior to actually converting the content to web- and print-appropriate form.

Task 4: HCR interaction designers and web programmers have established contact with the CSSI web master and have defined the requirements and constraints of the FAA web environment. We are also cognizant of the Section 508 requirements for the web-based version of the HF Ops Manual. These requirements are being integrated with the navigation, content, and layout of the web-based Ops Manual.

Planned Activities for June:

As the content is finalized and HCR receives photos, captions, etc., from the content committee, we will begin to prototype the home page and at least one complete chapter. The final decision regarding a graphic/navigation approach for the web-based and print-based versions of the Ops Manual will be made within the next week, or so. From that point, our graphics level of effort should increase, peak, and then decline. Our interaction design and programming effort should then ramp up as we begin, in earnest, to develop code that will run on the FAA website. The first web application prototype is due at the end of July. HCR is coordinating this effort with CSSI to ensure the Ops Manual code is successfully integrated into the FAA website.

j) An International Survey of Maintenance Human Factors Programs in Maintenance Organizations

Drs. Hackworth and Schroeder held a telcon with Dr. Bill Johnson on the development of a survey examining airline maintenance practices. Scott Goldman agreed to serve on the team and developed a draft web-based survey based upon our collective suggestions. As part of the initial planning for the development of the survey instrument, we reviewed the Aviation Maintenance Human Factors (EASA/JAR145 Approved Organizations) guidance material as well as the U.S. maintenance organization survey that was used in 2002. The draft on-line survey was provided to Drs. Johnson, Cromie, and Demosthenous for comment. Feedback received prior to Dr. Johnson's departure for the Joint Aviation Authorities (JAA) working group meeting in London June 21st-22nd was incorporated into the proposed instrument. An electronic copy and web-version was sent to Dr. Johnson prior to his departure so that he could showcase the site

during the meeting. Dr. Hackworth submitted a brief description of the project following OMB requirements announcing the survey in the Federal Register. To date, we have not received notification that the announcement was published. Work has also commenced on the development of a preliminary list of potential respondents from several international sites. We have also initiated contact with Dr. Sam Cromie from the psychology department at Trinity University in Dublin. He is a potential international collaborator. Dr. Schroeder has arranged to visit Dr. Cromie to discuss potential collaboration following a planned visit to London involving collaboration with scientists from the United Kingdom. Efforts are underway to complete the paperwork required to submit the questionnaire for OMB approval and to complete the IRB approval process. During the next two weeks we will be responding to input provided to Dr. Johnson during the meeting. It appears that we will need to resolve some differences in opinions concerning the nature of the survey. Dr. Johnson has asked that Dr. Cromie provide a draft proposal concerning his support for the survey effort. A meeting has been proposed for July to review the status of the effort and gain additional sponsor input.

The task is on schedule and via e-mail and telecons efforts will be directed toward further development of the survey instrument and planning for the conduct of the survey. Once the instrument is finalized we will prepare the necessary paperwork and submit the request for approval to OMB. During the next quarter we will also be exploring the establishment of a collaborative working relationship with Dr. Cromie and his colleagues.

William K. Krebs, Ph.D.