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

To: Aviation Maintenance TCRG

Subj: AVIATION MAINTENANCE HUMAN FACTORS THIRD QUARTER '04 REPORT

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

1) Each project is listed below.

a) An Evaluation of Broadband Applications to Aircraft Maintenance Safety

Researchers combined the three surveys into one larger survey. This survey asks line maintenance technicians about: (1) their attitudes toward existing computer/broadband applications used in line maintenance; (2) the use of “quick reference” materials; and (3) technicians’ preferences for what design features they would like to see in next-generation computer/broadband tools.

Surveys have been completed at one airline maintenance facility. These completed surveys comprise about 1/4 of the data we aim to collect. Data collection is underway at a second, larger airline maintenance facility, which should provide the remaining 3/4 of the data.

Expected FY04 Deliverables include: (a) Completed surveys, (b) A task analysis for the line maintenance process at an airline maintenance facility, and (c) an article describing our results.

*All available information indicates the project is on track; however the BF Goodrich survey will not be completed.*

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

NASA Ames: Data collection in pilot observers has begun. Based on these data the psychophysical technique was refined and we have generated a second model that is more predictive of the detectability of small cracks. The difference between the two models has to do with how the mean luminance of the image is calculated. Recruiting for experienced maintenance inspectors has begun. Data collection in the experiment proper is expected to begin in 2 weeks.

Tasks to be completed in Q4 FY04 include: complete data collection and submit final report.

Ohio State University and CAMI: researchers coordinated with several maintenance facilities to perform vision screening on aircraft inspectors. The vision screening data will be used to determine the potential impact that a revision of the recommended vision standards would have on the current NDI/NDT population. Site visit for data collection sessions were scheduled at Timco Aviation Services, Inc., Greensboro, NC (June 8-9) and at Delta Air Lines, Atlanta, GA (June 16-17). Dr. Nakagawara and Ms. Kathryn Wood supported the data collection sessions. A total of 59 inspectors were screened at Timco and 91 inspectors at Delta Air Lines.

Tasks to be completed in Q4 FY04 include: ongoing research activities include managing and evaluating vision and demographic data to determine the time interval for administration of vision screenings, developing draft guidance material for the administration of vision standards, and evaluating the potential impact that possible revisions in the recommended vision standards could have on the current aircraft maintenance workforce.

*All available information indicates the project is on track.*

c) Language Barriers Result in Maintenance Deficiencies

The researchers collected intervention effectiveness data on 254 participants in mainland China, Hong Kong, and Taiwan during two separate trips to Asia in March/April and May, respectively. This data will be used to quantify the effectiveness of representative intervention strategies to reduce language-related errors. In addition, 249 completed questionnaires were obtained, which will be used to better quantify the incidence of each type of language error identified in the taxonomy from Phase I. During the visits to 11 sites located in the above three areas, the researchers conducted 12 focus groups, which provided valuable information on how these MROs currently mitigate potential maintenance deficiencies caused by language barriers at work place. The MROs kindly provided the researchers samples of their typical workcards and other job aids (e.g., bilingual aircraft maintenance glossary) for reference.

Currently, the researchers are preparing a report on Asian data collection and findings on the questions originally posed. We are planning data collection visits to Europe and Central / South America in Fall 2004.

The December 2004 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 all Asian sites.

*Indications are that there are minor risks to the activity being completed as planned. Due to the researcher's inability to access maintenance facilities (current climate in aviation post 9/11), the researcher has not been able to collect the proposed data that was stated in the grant proposal. The researcher will receive a no cost extension to complete the grant by December 2004.*

d) General Aviation Alaska Maintenance Accidents

CAMI: One of the larger HFACS efforts focused on a comparison of the human factors associated with GA accidents in Alaska and those occurring in the rest of the U.S. (see FY03, Q4 report). Ms. Cristy Detwiler presented her findings at the Annual Meeting of the Aerospace Medical Association in May. Dr. Boquet and Ms. Detwiler also presented the Alaskan data at the Alaska Airmen's Association Annual Trade Show and Conference. They have also been asked to present their work at next year's Alaska Air Carrier's Association meeting.

CSSI: HFACS maintenance internet database application (<http://www.hf.faa.gov/hfacs>) to allow users to query NTSB maintenance reports by HFACS or NTSB or NASDAC fields. To obtain access to the searchable database, please contact at Dr. Krebs at [william.krebs@faa.gov](mailto:william.krebs@faa.gov). Researcher is working on the front end portal application to allow searches, pilot entry and administrative functions. He contacted NASDAC to get additional database fields that were not included in the original download from CAMI. Sent screenshots of the application to stakeholders to ensure application meets initial requirement.

*Project is back on track. All available information indicates the project will be completed in FY04.*

e) Using Technology to Support Inspector Training

Researcher sought feedback from industrial partners on the prototype interfaces. Incorporated feedback into the prototype interfaces. Identified the suitable interface for the training system. Developed interface prototypes for the following modules: Introduction, Training, Simulator, and Design and Analysis. Find the power point presentation containing few screens of the interface in the following website (<http://www.hf.faa.gov/docs/508/docs/GAITSmodule.pdf>).

Expected FY04 tasks include: incorporate multimedia data [text information, images of structures/defects, videos, and voice over support] into the training system.

*All available information indicates the project is on track.*

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

During this period, most of the time was dedicated to entering the 5,006 (as of June 30, 2004) returned surveys from the Maintenance ASAP Questionnaire (MAQ) that was mailed to a randomly selected national sample of 83,000 Aircraft Mechanic Certificate holders. Assuming that at least about 50% of the recipients are actively involved in aviation maintenance, about 40,000 individuals were likely to be realistic candidates for the survey. The typical response rate for mail-in surveys is 30% and the typical response rate for aircraft mechanics is about 10%. Therefore, it was estimated that between 4,000 and 12,000 surveys would be returned.

A basic analysis of the demographic data indicates the following:

1. Responses were received from all 50 states and the District of Columbia.
2. The distribution of employment categories was as follows: 36.7% from major air carriers, 5.4% from commuter airlines, 20% from repair stations, 3.1% from FAA, 17.9% from corporate or general aviation, and 27.7% from others (includes employers such as universities, military, self-employed, non-aviation etc.).
3. The distribution of job titles was as follows: 59.3% were mechanics, 15.2% were managers, 18.15 were inspectors, 2.3% were FAA inspectors, and 21.1% had other job titles (includes technical representatives, logistics coordinators, fleet managers, quality assurance analyst, etc.).
4. The awareness level regarding Maintenance ASAP programs was as follows: 42.3% were aware and 57.7% were not aware.
5. The involvement of those FAA inspectors, out of those who responded to this survey, in Maintenance ASAP programs was as follows: 31.5% had been involved and 68.5% had not been involved.

*All available information indicates the project is on track.*

g) Auditing and Surveillance Maintenance Error Tool

Researchers conducted interview sessions with key members in the Quality Assurance and Audit departments at the FedEx facility in Memphis, TN. Completed a trip report, documenting the information gathered from the interview sessions at Memphis, TN. Conducted observation session at Mobile, AL. Completed a trip report, documenting the information gathered from the observation session at Mobile, AL. Identified the modules that will be incorporated in WebSAT. Developed the goals and functions to be included in each module. Developed objectives for each module and sub – objectives for modules. Used task analysis to identify needs to support surveillance and inspection performance. Designed a framework of the WebSAT tool which

presents the WebSAT model. Presented two papers at the IERC conference at Houston, TX, in May 2004 (<http://www.hf.faa.gov/docs/508/docs/maintIERC2004WebSAT.pdf> and <http://www.hf.faa.gov/docs/508/docs/maintIERC2004WebSAT2.pdf>).

The following tasks will be completed in Q4 FY04: (a) define the process measures to be considered for WebSAT, in association with key members in the Quality Assurance and Audit departments, at the FedEx facility at Memphis, TN, (b) arrange for a conference call with Quality Assurance to gain clarity on certain processes, (c) develop the survey tool for the first round of survey with FedEx on process measures, (d) conduct a web based process measures validation survey with FedEx to ascertain the accuracy of the selected process measures (July 30th, 2004), (d) schedule a trip to a participating airline company to validate the selected impact variables (August 14th, 2004), (e) incorporate the feedback from FedEx and conduct a similar web based process measures validation survey with other airlines to validate WebSAT's global application of the selected process measures (August 9th, 2004), (f) complete a survey analysis report documenting the results of the web based impact variables validation survey with other airlines. The report findings will be included in the HFES presentation (September 1st, 2004), (g) schedule a trip to Memphis, TN (September 13th, 2004), (h) present paper/poster in the proceedings of Human Factors and Ergonomics Society Conference (September 20th - 24th, 2004), (i) schedule a trip to the FedEx Greensboro maintenance base (September 30th, 2004), (i) started preliminary work on designing the iteration prototype for each module using the conceptual design methodology (October 31st, 2004).

*All available information indicates the project is on track.*

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

Colin Drury visited CAMI on 19 May to discuss potential cooperation in vigilance and fatigue studies. The researcher's computer program for simulating FPI inspection is now complete and was given to FAA / HQ in June 2004, with copies for Dr. Krebs and R. Jones. The program has a full complement of engine blades, a comprehensive data collection facility and a good navigational interface. An interactive training program has been written as a PowerPoint presentation, and also supplied to FAA/HQ. Both the training program and the simulation have been pilot tested on 6 engineering students to find any problems with the programs, and to establish data needs by measuring the rate of inspection chosen by the participants. All worked well and the mean rate was 43 blades per hour.

Two team members visited a partner airline on July to provide an operational test and validation of the simulation program and the training program. Six NDI technicians experienced in FPI were given training and the opportunity to test the simulation. Although the inspectors were pleased with the realism of the

simulation, we received a number of suggestions for changes in both training and simulation. Overall the inspectors stated that they would believe fatigue control recommendations based on use of this simulation. The mean rate of inspecting blades was 41 per hour, not significantly different from the student pilot subjects ( $t(5) = 0.14$ ,  $p = 0.90$ ).

On the basis of this feedback, several changes have been made to the simulation and training programs, e.g. changing the border from white to dark gray to avoid glare in darkened rooms, and changing the software to prevent overwriting of existing data files.

The experiment for data collection is ready for operation. An advertisement is ready for the local newspaper so that data collection can begin before the end of July.

The status of FY04 deliverables:

- i. Report on comprehensive literature reviews on Vigilance, Inspection, Fatigue and hours of work. Status Green: completed by Jan 31 2004.
- ii. 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
- iii. Report on design of experiment and result of pre-tests. Status Green, design and programming completed and tested on two groups of pilot subjects. Data collection scheduled for July and August.

*All available information indicates the project is on track.*

i) Human Factors Maintenance Considerations of Unmanned Aircraft

ASU market survey announcement was posted on May 28<sup>th</sup> 2004. Twenty-eight institutions responded to the announcement. ATO-P Human Factors R&D formed a review panel to down select some of the institutions to submit a cost proposal. The panel will then review the second round to select the final institution(s) for this requirement. ATO-P Human Factors R&D anticipated start date is December 2004.

*The first report will be due to AVR on December 31<sup>st</sup>, 2005.*

William K. Krebs