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From: General Aviation Human Factors Program Manager, ATO-P R&D Human Factors
To: General Aviation TCRG

Subj: GENERAL AVIATION HUMAN FACTORS THIRD QUARTER '05 REPORT

Ref: General aviation human factors execution plans (http://www.hf.faa.gov/gafunded.htm)

1) Each project is listed below.

   a) Human Error and General Aviation Accidents: A Comprehensive, Fine-Grained Analysis using HFACS

      Although the collaborative agreement between the University of Illinois (Dr. Douglas Wiegmann) and the Civil Aerospace Medical Institute (Drs. Scott Shappell, Bert Boquet, and Carla Hackworth) associated with this requirement has been completed, both parties have agreed to extend the agreement *at no cost to the Federal Government* to include several important initiatives on the FAA's agenda. Specifically, CAMI and the University of Illinois will complete a number of HFACS analyses and provide reports to sponsors on the following issues (many of which are part of the FAA Flight Plan, AVS business plan and dashboard):

      - *Complete data processing and prepare a report describing the analysis of commercial aviation accidents (1990-2002) using the Human Factors Analysis and Classification System (HFACS).* This project can be found on page 10 of the AVS Business Plan as part of Flight Plan Performance Target: Airline Fatal Accident Rate; Strategic Initiative: Human Factors; Strategic Activity: Commercial Accidents Analysis.

        As anticipated, the commercial aviation database (1990-present) has been delivered and the human factors quality assurance has been completed. The final report is currently in draft form will be delivered to AVS sponsors in July after completing the internal review process.

        Briefly, our analyses included a total of 1,020 commercial (14 CFR Parts 121 and 135) accidents occurring between CY1990-2002 associated with aircrew and/or supervisory errors. Of these, 181 involved 14 CFR Part 121 aircraft and 839 involved 14 CFR Part 135 aircraft.

On the surface, the percentage of commercial aviation accidents associated with aircrew unsafe acts (i.e., skill-based errors, decision errors, perceptual errors, and violations) has remained relatively unchanged since 1990 (see Figure 1). Note that due to low numbers, we had to collapse the 14 CFR Part 121 data into 3-yr blocks except for the last block (1999-2002) that includes 4 years. Furthermore, as with our previous findings using general aviation data, more accidents were associated with skill-based errors than any other human error form followed by decision errors, violations, and perceptual errors. *Note: Because there is typically more than one cause factor per accident the total percentage will not equal 100%.*

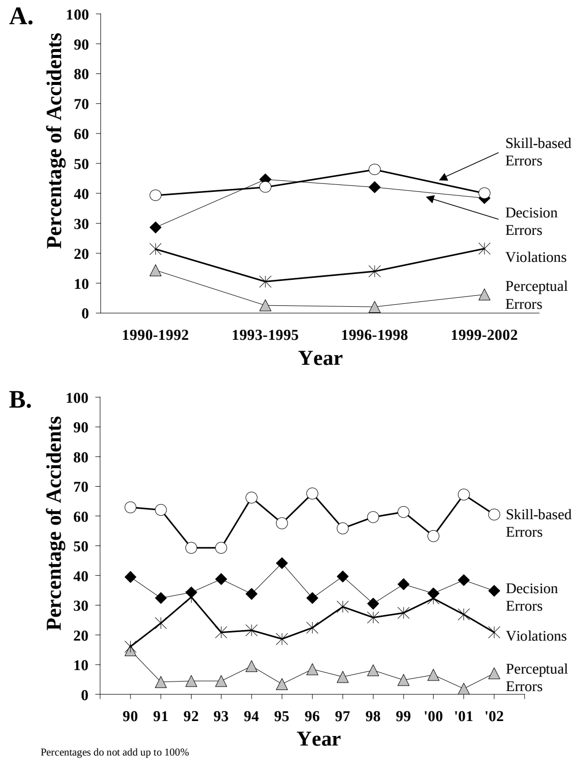

Figure 1. Percentage of unsafe acts committed by aircrew during 14 CFR Part 121 (Panel A) and 14 CFR Part 135 (Panel B) operations by year.

Due to the low number of human error related accidents involving 14 CFR Part 121 operators few additional conclusions could be drawn regarding these accidents. However several important observations were made from the 14 CFR Part 135 data. For instance, violations associated with 14 CFR Part 135 accidents were 5 times more likely to occur during impoverished visual conditions (i.e., at IMC and/or at night/twilight) than in clear (VMC and daytime) visual conditions. Likewise, violations associated with 14 CFR Part 135 accidents were 3 times more likely to result in fatalities. In fact, when comparing fatalities (fatal vs. non-fatal) with visual conditions (clear vs. impoverished), nearly 70% of the fatal 14 CFR Part 135 accidents occurred during visually impoverished conditions.

A closer, “fine-grained,” analysis of the unsafe acts committed by aircrew operating under 14 CFR Part 135 operations was conducted for visual conditions (clear versus impoverished) and injury severity (fatal versus non-fatal) and is presented in Tables 1 and 2. The most frequently cited error forms were similar for accidents occurring during impoverished visual conditions and those involving fatalities, where intentional VFR flight into IMC (violation), poor in-flight planning/decision making (decision error), failure to follow procedures/directives (violation), loss of aircraft control (skill-based error) and failure to control airspeed (skill-based errors) were observed most frequently within the accident data. Similarities were also observed between accidents occurring in clear visual conditions and those resulting in non-fatal injuries as the failure to adhere to procedures and directives (violations), takeoff/landing from unsuitable terrain (decision error), and compensation for winds (skill-based errors) were most common.

Notably, when we examined only the fatal accidents occurring in visually impoverished conditions (Table 3), the most common errors involved intentional or continued VFR flight into IMC (violation), poor inflight planning/decision making (decision error), and failure to maintain airspeed (skill-based error). It would appear that these specific causal factors seem to be an area ripe for intervention if fatalities are to be reduced among 14 CFR Part 135 operations.

Table 1. *Part 135 Unsafe Acts Fine-Grained Analysis by Clear vs. Impoverished*

SKILL – BASED ERRORS			
CLEAR		**IMPOVERISHED**	
	Subject N (%)		**Subject N (%)**
Compensation for Wind Conditions	42 (10.8)	**Aircraft Control**	28 (10.6)
Airspeed	38 (9.7)	**Airspeed**	27 (10.2)
Visual Lookout	32 (8.2)	**Clearance**	21 (7.9)
Directional Control	31 (7.9)	**Proper Altitude**	18 (6.8)

DECISION ERRORS			
CLEAR		**IMPOVERISHED**	
	Subject N (%)		**Subject N (%)**
Unsuitable Terrain Selection	43 (21.5)	**In-Flight Planning/Decision**	37 (24.3)
In-Flight Planning/Decision	38 (19.0)	**Flight into Known Adverse Weather**	11 (7.2)
Planning/Decision	21 (10.5)	**Planning/Decision**	9 (5.9)
Go-Around	17 (8.5)	**Unintentional VFR Flight into IMC**	8 (5.3)

VIOLATIONS			
CLEAR		**IMPOVERISHED**	
	Subject N (%)		**Subject N (%)**
Procedures/Directives	15 (23.8)	**Intentional VFR Flight into IMC**	53 (30.1)
Checklist	9 (14.3)	**Procedures/Directives**	25 (14.2)
Refueling	6 (9.5)	**IFR Procedure**	14 (8.0)
Aircraft Weight and Balance	6 (9.5)	**Flight into Known Adverse Weather**	10 (5.7)

Table 2. *Part 135 Unsafe Acts Fine-Grained Analysis by Non-Fatal vs. Fatal*

SKILL – BASED ERRORS			
NON – FATAL		**FATAL**	
Subject	**N (%)**	**Subject**	**N (%)**
Compensation for Wind Conditions	44 (9.6)	**Airspeed**	35 (17.9)
Directional Control	44 (9.6)	**Aircraft Control**	23 (11.7)
Visual Lookout	35 (7.6)	**Proper Altitude**	16 (8.2)
Clearance	34 (7.4)	**Clearance**	16 (8.2)

DECISION ERRORS			
NON – FATAL		**FATAL**	
Subject	**N (%)**	**Subject**	**N (%)**
Unsuitable Terrain Selection	46 (19.3)	**In-Flight Planning/Decision**	40 (35.1)
In-Flight Planning/Decision	35 (14.7)	**Flight into Known Adverse Weather**	9 (7.9)
Planning/Decision	22 (9.2)	**Planning/Decision**	8 (7.0)
Go-Around	18 (7.6)	**Unintentional VFR Flight into IMC**	5 (4.4)

VIOLATIONS			
NON - FATAL		**FATAL**	
Subject	**N (%)**	**Subject**	**N (%)**
Procedures/Directives	23 (19.5)	**Intentional VFR Flight into IMC**	37 (30.6)
Intentional VFR Flight into IMC	20 (16.9)	**Procedures/Directives**	17 (14.0)
Checklist	12 (10.2)	**IFR Procedure**	11 (9.1)
Ice/Frost Removal From Aircraft	8 (6.8)	**Aircraft Weight and Balance**	9 (7.4)

Table 3. *Part 135 Unsafe Acts Fine-Grained Analysis for Fatal Accidents in Impoverished Conditions*

SKILL – BASED ERRORS	
FATAL and IMPOVERISHED	
Subject	**N (%)**
Airspeed	19 (16.0)
Proper Altitude	16 (13.4)
Aircraft Control	15 (12.6)

DECISION ERRORS	
FATAL and IMPOVERISHED	
Subject	**N (%)**
In-Flight Planning/Decision	26 (32.5)
Flight into Known Adverse Weather	7 (8.8)
Unintentional VFR Flight into IMC	5 (6.3)

VIOLATIONS	
FATAL and IMPOVERISHED	
Subject	**N (%)**
Intentional VFR Flight into IMC	33 (31.7)
Procedures/Directives	13 (12.5)
IFR Procedure	11 (10.6)

These data are only meant to provide the sponsor a flavor for the sort of findings we are seeing in the commercial database. A complete report and briefing to AVS sponsors will be delivered in the 4th quarter of 2005 as well as an Office of Aerospace Medicine technical report.

- *Conduct a detailed human factors comparison of general aviation accidents occurring in Alaska with those occurring in the rest of the U.S.* This project can be found on page 11 of the AVS Business Plan as part of Flight Plan Performance Target: GA Fatal Accidents; Strategic Initiative: Human Factors; Strategic Activity: Human Factors Comparisons and Analysis.

  All general aviation accidents from 1990-2003 have been classified by our pilot subject matter experts (SMEs) and were delivered by OMNI Corporation late in the 3rd quarter of 2005. To date, the human factors quality assurance (HFQA) process has been completed for all accidents occurring between 1990-2002. A draft report based upon the 1990-2000 data has been completed and is undergoing internal review and modification. The 2001-2002 data will be added to the final report due to AVS sponsors early in the 4th quarter of 2005. CAMI scientists are also continuing with the HFACS analysis of all GA accidents from 2003-present.

- *Conduct a human factors analysis of accidents involving emergency medical services (EMS) aircraft.* This project can be found on page 11 of the AVS Business Plan as part of Flight Plan Performance Target: GA Fatal Accidents; Strategic Initiative: Human Factors; Strategic Activity: Human Factors Comparisons and Analysis.

  The National Aviation Safety Data Analysis Center (NASDAC) and NTSB were utilized to identify human error related Helicopter Emergency Medical Service (HEMS) accidents. This analysis included those medical flights operating under 14 CFR Part 91 (ferrying or repositioning flights) and 14 CFR Part 135 (patient transport), resulting in 121 accidents and associated human causal factors, as reported by the NTSB from 1990 to 2003. As a caveat, this analysis was limited to only those accidents occurring in what we have termed the “rescue triangle” (see Figure 1). The rescue triangle includes only those accidents that occurred during the flight to pick up the patient (see below as enroute FAR Part 91), transport of the patient to the hospital (see below as transport FAR Part 135), and repositioning to base from the treatment facility (see below as reposition FAR Part 91). In parsing the data in this manner, we eliminated HEMS accidents that were designated as training accidents and those involving fixed wing and/or maintenance repositioning flights. In the end, our initial analyses included 74 of the possible 121 accidents as reported by the NTSB.

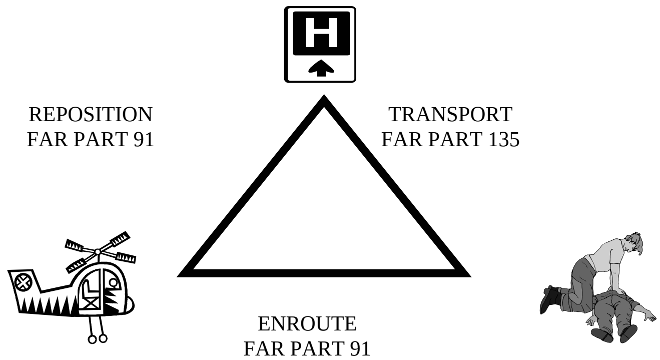

Figure 1. Emergency Medical Service Rescue Triangle.

An analysis of the data within the rescue triangle revealed that the unsafe acts were similar to other aviation platforms. That is, they were predominantly characterized by skill-based errors (59.5%), followed by decision errors (33.8%), perceptual errors (18.9%), and violations (14.9%). For skill-based errors, the most common errors were the failure to maintain clearance (physical clearance; 28.6%) followed by aircraft control, visual lookout, and altitude/clearance (i.e., lateral/vertical clearance; 8.2%). The top three decision errors were in-flight planning/decision making (17.9%), unintentional VFR flight into IMC (17.9%), and improper remedial action (10.7%). Perceptual errors consisted of the failure to maintain aircraft control (25%), as well as the failure to maintain altitude/clearance (12.5%) and distance/altitude (12.5%). Finally, the top three violations were procedures and directives not followed (30.8%), intentional/continued VFR flight into IMC (15.4 %) and flight into known adverse weather (15.4%).

When the relationship of unsafe acts to fatalities was examined, the data revealed that those accidents associated with violations claimed a higher percentage of lives compared to the other categories of unsafe acts. Of those accidents involving a skill-based error, 31.8% resulted in a fatality, compared with 20% for decision errors, and 42.9% for perceptual errors. However, when a violation was involved, 63.6% of these accidents had at least one fatality. This is consistent not only with other flight deck operations, but with maintenance violations as well.

Rather than simply compare accident rates associated with time-of-day, fatalities associated with time-of-day were also analyzed. While the actual percentage of accidents associated with time of day was essentially split evenly between day and night (47.9% and 52.1% respectively), the breakdown of fatalities was not. Almost 23% of daytime accidents were associated with fatalities compared with 44.7% fatalities when the accident occurred at night.

The vast majority of HEMS accidents occurred in VMC weather (74.3%) vs. 25.7% in IMC. However, similar to the time-of-day analyses, there were more fatalities associated with IMC. When examining the relationship between fatalities and weather conditions, IMC operations took a greater toll with 73.7% resulting in fatalities, compared with only 20% of VMC related accidents resulting in fatalities. To better illustrate this point, the odds of dying in an accident in IMC were 11 times greater (using odds ratios) than dying in a VMC accident.

Because there were 25-controlled flights into terrain (CFIT) accidents in our database, a closer look at these accidents was performed. For this analysis, CFIT was broken down into two categories, controlled flight into terrain (CFIT/T) and controlled flight into obstacle (CFIT/OBS). In order to gauge the effects of degraded conditions on the occurrence of CFITs, both night/twilight conditions and poor weather were combined to create an impoverished variable. This analysis revealed an increased frequency of CFIT/T in impoverished conditions. A similar analysis was carried out to determine the relationship of the different types of CFITs to fatalities. There was an increased likelihood of a fatality in a CFIT/T accident compared to CFIT/OBS (88.9% vs. 31.3%).

In conclusion, the data examined to date indicate that the percentage of accidents occurring in these degraded conditions across the unsafe acts are noteworthy and appear to be some of the primary factors associated with aircrew and patient fatalities. Based upon this, it would appear that IFR currency and similarly equipped aircraft would likely reduce accidents and fatalities associated with HEMS operations.

The original requirement has been completed and a final report has been submitted for approval. The requirement has been extended to include the analyses above. Note that three of the four principal investigators (Dr. Scott Shappell, Dr. Douglas Wiegmann, and Dr. Bert Boquet) for this project have taken new positions within academia. However, their departure from the FAA and University of Illinois is not anticipated until the July-September time-frame. Consequently, all indications are that the additional items are on track.

b) <u>Credit for Instrument Rating in a Flight Training Device or Personal Computer: Phase III: Transfer of Training Effectiveness of a Flight Training Device (FTD).</u>

The project is complete. The deliverable is being reviewed by ATO-P R&D with a tentative release date next quarter.

c) <u>Visibility in the Aviation Environment</u>

Two accomplishments are notable, 1) completion of a demo interactive program for teaching pilots how to judge aircraft appearance, distance, direction of flight and relative altitude to the AFS-800 sponsor on June 1st. The sponsor was satisfied with the project progress; 2) to meet an AFS-800 FY05 Flight Plan initiative "pop-up" research requirement, the researcher will write a section for the Pre-Flight Weather Briefing Guide due mid August 2005. The researcher satisfactorily met the first milestone by providing a detailed narrative outline by June 15th. The second draft is due July 21st and the final draft is due August 19th. The researcher's input will primarily concentrate on visibility topics.

Other accomplishments include:

- We are currently testing our model of detection based on sparse coding by physiological plausible mechanisms. The present model incorporates several stages including ganglion cell filtering, cortical neuron rectification, and variable threshold of response based on a form of contrast adaptation. This model is being compared to a more simple power spectrum model as well as the model proposed by Ahumada.

- We have developed a demo module for our interactive training software to teach pilots how to recognize distance, relative direction, and altitude of targets.
- We continue to evaluate vision detection models of visibility. We are trying to include the parameters of attention and prior knowledge of target features which play a large role in actual target detection.
- We are completing our detection experiments designed to evaluate the utility of synchronous and asynchronous strobe lights as aids to detection. Preliminary results have been reported at the annual ARVO meeting in Florida. The results indicate that there is very little advantage of asynchromous strobes over synchronous strobes for detection. However the presence of strobe lights (either synchronous or asynchromous) greatly increases detection of targets on masking backgrounds. We are exploring further previous reports of exaggerated motion detection under certain strict stimulus conditions.
- We are continuing to develop experiments that will objectively measure performance under simulated flat light conditions.
- We have submitted a first draft of a vision chapter for an FAA handbook aimed at reducing weather related GA accidents. Refinement of the vision chapter is ongoing.

All available information indicates the project is on track.

d) Migration of HFACS database to a web-based interface

The Analyst screens have been completed with the final logic now allowing Pilots to determine maintenance related items. In the conflict resolution screens the Pilots or Maintenance persons now have the option to save their intermediate results while resolving conflicts.

The HFACS Administrator screens are now complete as well. These screens allow an Administrator to see all cases with conflicts and view the details of and analysts assigned to each case. These admin screens also allow for an administrator to change or accept cases that have deviations, as well as reset an entire case and send it back to be reanalyzed if necessary.

The former crystal reports based reporting system has now been replaced with a more stable, less memory intensive, rtf report.

Work is being started on a data dump process which will automatically create a snapshot of the HFACS database twice a month in Access format and make it available from an ftp site for downloading.

Work is also ongoing to automate the refresh process of the NTSB data contained in the HFACS database.

All available information indicates the project is on track.

e) Flight Deck Technologies and Procedures, Discriminability Assessment of Proposed Traffic Symbol Set

A preliminary assessment was completed to assess the ability of a standard image discrimination model to predict the confusions among the 8 pairs of symbols from the

Wolpe experiment that were most confused. The model predicted that symbols 3 and 13 should never have been confused because the lines surrounding the symbols do not overlap. One actually looks like a smaller version of the other, showing the need for a size-invariant model to adequately predict the results of that experiment. Restricting ourselves to the other 7 pairs at the distances for which there were errors (15 data points), so that the d' for the experimental data could be estimated, the mean ratio of the observed d' to the predicted d' was 0.95 with a standard deviation of 0.50. Since the model has been calibrated on experiments where there were only 2 stimuli to be discriminated, we expected this ratio to be less than one, and the standard deviation is small enough that we consider the results to be promising.

A Matlab program using the Psychophysics Toolbox has been nearly completed. It will allow us to collect more data using the methodology of the Wolpe experiment.

This work was mainly done by Jennifer Guille, who left us on June 24 to work for Qualcomm. She has passed the torch to our new Post-doc Maite Trujillo, a PhD engineer in image processing.

This effort is cost shared with NASA Ames. All available information indicates the project is on track.

f) FITS - Proficiency Standards for Technically Advanced Aircraft

Project is completed. The researcher successfully delivered (1) a detailed list of knowledge and skill elements for advanced avionics, and (2) a draft of a generic technical reference, similar to FAA-H-8083 publications, to support each knowledge and skill element.

g) FITS - Enhanced Decision Making (EDM)

The researcher submitted an execution plan to AFS-800 and ATO-P for approval. The researcher is awaiting feedback from the AFS-800 sponsor POC. Visited FAA HQ and provided Dr. Krebs and AFS-800 POCs an update of the project.

To meet an AFS-800 FY05 Flight Plan initiative “pop-up” research requirement, the researcher will write a section for the Pre-Flight Weather Briefing Guide due mid August 2005. The researcher satisfactorily met the first milestone by providing a detailed narrative outline by June 15th. The second draft is due July 21st and the final draft is due August 19th. The researcher’s input includes strategies and techniques to aid novice pilots in weather related decisions made during preflight. Following Dr. Krebs request, am integrating our input with that of Dr. Wiegmann's which identifies common problems associated with VFR into IMC.

The researcher attended the CGAR annual meeting in Fairbanks, AK. Had some very animated discussions with the various Centers of Excellence leads on the FITS project. The researcher will continue to interact with several COE members on common themes of interest.

We are continuing to summarize techniques for effective training within and outside of aviation and have initiated translating this training into the WEB-based training product.

We have identified the University of Nevada as the site to perform independent product validation (i.e., does EDM training actually improve pilot decision making performance?)

In 4th quarter FY05 we will initiate WEB-based software design.

This effort is cost shared with NASA Ames. All available information indicates the project is on track.

h) Unmanned Aircraft Operator Qualification and Training Requirements

In April, a paper was presented on UAV accident data at the International Symposium of Aviation Psychology meeting in Oklahoma City, OK. In addition, the book chapter entitled, "Human Factors Implications of Unmanned Aircraft Accidents: Flight Control Problems", for the future *Human Factors of Remotely Piloted Vehicles* volume of the *Advances in Human Performance and Cognitive Engineering Research* has been approved for publication.

In May, Dr. Williams attended the second annual UAV Human Factors Workshop, held in Mesa, AZ. During the meeting, contacts were made regarding conducting a workshop to discuss the development of medical certification and pilot qualification requirements for UA operators. In addition, a presentation was made about activities within the FAA relating to UA human factors.

Regular telecons were held with the NASA Access 5 group. Contacts were made with members of SAE-G10 UAV working group, RTCA Special Committee 203, and with ASTM F38 working group. All of these standards development groups have current efforts regarding the integration of UA into the National Airspace.

Planning continues for a meeting to be held at CAMI regarding UA operator medical and certification requirements. In preparation for that meeting, a position paper is being written that will outline an approach to the certification of unmanned aircraft and UA pilots. This paper will be used as a starting point for discussion in the meeting.

Of note, a prototype UA simulation capability was generated using the AGARS simulation capabilities. Future modifications of this simulation capability will be necessary to conduct research, however, important requirements were identified using the prototype.

The final report will be due to AVR on December 31st, 2005

i) General Aviation Private Pilot Survey / Initial Certified Flight Instructor – Airplane Survey/ Designated Pilot Examiner Program Assessment

OMB approved the GA ASEL Pilot survey. The DPE survey was finalized and is ready for distribution. However, CAMI is waiting for AFS-800 to provide the signed cover letter. HQ directed that survey results be aggregated at the regional level. OMNI compiled a list of all FSDOs by region and manager email addresses with the usernames and passwords for the KSN site. Dr. Hackworth, Crystal Cruz, and Janine King participated in a beta test of the KSN site at the OKC FSDO. At this point, CAMI is waiting for the official notice of the GA survey to circulate through AFS, regional offices and FSDOs. AFS will then provide the green light for FSDOs to begin sending the names and addresses of recently certified GA pilots to CAMI. Once this occurs, CAMI will begin distributing the GA ASEL survey.

All indications indicate that this project is on track to complete the milestones as planned.

j) <u>A New Approach to Aviation Accident/Incident Prevention/Mitigation</u>

Efforts continued at the University of Illinois (Dr. Douglas Wiegmann) and the Civil Aerospace Medical Institute (Dr. Scott Shappell) to validate the Human Factors Intervention Matrix (HFIX) using NTSB recommendations from the last 5 years and recommendations for the CAST and JSAT/JSIT processes. A search of existing FAA safety programs has also been initiated to augment this data.

During the 3rd quarter of 2005, the University of Illinois delivered a draft report to CAMI that provides validation data for the HFIX using NTSB recommendations from the last 5 years. A concurrent analysis of recommendations from the NTSB and the JSAT/JSIT processes has just recently been completed at CAMI during which high time pilots from the general aviation, commercial, and military communities have classified the data into each of five HFIX intervention approaches. A final report of these findings will be delivered during the 4th quarter of 2005 to AVS sponsors. Ultimately, these data will provide the baseline information for intervention development and recommendations in FY06 and FY07.

This research is identified within the AVS Business Plan on page 17 under Core Business Measure: GA Fatal Accidents, Core Activity: Research and Development – GA, Activity Targets: Complete development and validation of the Human Factors Interventions Matrix (HFIX) for use by AVS and submit report to sponsor in September 2005.

All available information indicates that this project is on track.

k) <u>Aviation Safety Inspector Training for Technically Advanced Aircraft</u>

Aviation Safety Inspector (ASI) Training for Technically Advanced Aircraft. Dr. Hackworth attended telcons with Mr. Euel Henry, Mr. Mike Casey, Dr. Dan Herschler, Dr. Greta Ballard and members of industry on training standards for ASIs regarding TAA. ERAU will initially develop courses for FAA general aviation operations inspectors geared toward learning about TAA, such as how to perform check rides in TAA, how to conduct CFI initials, 709s, etc…The curriculum will include a generic prerequisite home-study TAA course and a subsequent on-site course. The on-site course will be aimed at providing information on a specific system (e.g., Garmin 1000). In the future, several providers will provide an on-site, system-specific course (e.g., Avidyne at UND). The on-site course will be in two segments, the first being a left seat qualification and the second will involve a right seat qualification, including learning how to give evaluation rides and how to develop Plans of Action for TAA.

Dr. Hackworth delivered Dr. Casner's completed list of proficiency standards for operating TAA with AFS-800 comments included to Dr. Dan Herschler. These proficiency standards are to be included in the ASI course material. Dr. Casner is to provide additional information regarding course development. Dr. Hackworth provided a list of points of contact (e.g., TAA DPEs) to Dr. Casner and to help with course development.

Dr. Hackworth has requested to meet with Dr. Mike Hakim (AFS-530) to discuss evaluation methods for the ASI training courses. The next TAA telcon is scheduled for July 12th.

This is a new start project. On Febraury 2nd, 2005 the GA/VF TCRG identified this requirement as a FY05/FY06 "pop-up" requirement.

l) ASRS Weather Callback

The beta-version questionnaire was finished and ASRS began administering these questionnaires to pilots previously identified by them as having reported weather-related incidents. ASRS reported that about half of the 100 questionnaires have been sent out so far.

This is a new start project. On Febraury 2nd, 2005 the GA/VF TCRG identified this requirement as a FY05/FY06 "pop-up" requirement.

m) How to Pilots Use Weather Ground (internet, FSS dial-up, or other internet services) and/or Aircraft (e.g., data link) Products?

A structured-interview instrument was developed to get at the types of weather products and providers pilots actually use. This instrument was vetted by a dozen pilots, and is now ready to be used for data collection. Recorded tapes of Flight Service Station weather briefings were also received from Seattle, WA and Bridgeport, CT FSSs. Arrangements are being made for a subject matter expert to develop a coding scheme to score these tapes.

A technical report was published on a previous project, Knecht, W.R., Harris, H. & Shappell, S. (April, 2005). *The influence of visibility, cloud ceiling, financial incentive, and personality factors on general aviation pilots' willingness to take off into marginal weather, Part I: The data and preliminary conclusions* (Report no. DOT/FAA/AM-05-7).

This is a new start project. On Febraury 2nd, 2005 the GA/VF TCRG identified this requirement as a FY05/FY06 "pop-up" requirement.

n) Ultra-Fine Grained Analysis of General Aviation Accidents 1990-present

AFS-800 has requested that a comprehensive and systematic "ultra" fine-grained analysis of the operational and individual pilot factors associated with each of the major HFACS unsafe acts previously identified as causal to GA accidents be performed. As a joint effort between researchers at University (to be determined) and CAMI, operational factors and pilot characteristics associated with GA accidents will be systematically and comprehensively analyzed to explore the relationships between these factors and the occurrence of specific unsafe acts of aircrew. These demographic analyses will be integrated with the results of previous HFACS analyses of underlying aircrew errors, so that a complete picture of the causes of GA accidents can be realized. In turn, this information will provide the necessary information for evaluating current intervention strategies, as well as developing future interventions, using the Human Factors Intervention Matrix (HFIX).

A grant proposal will be solicited from a university to be determined in the 4th quarter of 2005. The goal is to award the grant beginning in the first quarter of 2006. CAMI (Dr. Carla Hackworth) will be the COTR on the collaborative agreement between CAMI researchers (Dr. Hackworth) and university scientists (TBD).

This is a new start project. On Febraury 2nd, 2005 the GA/VF TCRG identified this requirement as a FY05/FY06 "pop-up" requirement.

o) <u>Low Visibility and Visual Detection: Design and Development of a Visibility Analysis Tool</u>

The overall objectives for this fiscal year are to: 1) Enhance and validate the Air Traffic Control Tower (ATC) visibility analysis tool (FAA Vis) that was developed for the FAA by ARL in FY04 and, 2) Provide the FAA with a See-and-Avoid analysis tool that provides quantitative information on the available time that a UAV operator would have to respond to a potential conflict with other manned and unmanned aircraft. The technical approach that ARL SEDD will utilize to accomplish the first objective is to team with the U.S. Army's Night Vision and Electronics Sensor Directorate (NVESD) to update the working desktop version of FAA Vis to include: charting routines, new graphical user interface (GUI) elements, the ability to reliably handle a wide range of observation luminance levels, more accurate slant-path calculations, and the ability to account for the effects of atmospheric attenuation by incorporating MODTRAN into FAA Vis. The technical approach that ARL SEDD will utilize to accomplish the second objective is to (again) team with NVESD to develop an interface between NVESD's Solid-State Camera (SSCAM) and Night Vision Thermal Imaging Systems (NVTherm) performance models, and the FAA's See-and-Avoid Detection and Recognition Visibility Analysis tool. The NVESD models will be used to generate all camera- and display-related performance parameters, while the FAA See-and Avoid tool will account for all atmospheric- and target-related performance effects. The FAA See-and-Avoid tool will combine all of the performance parameters to generate overall results. The majority of the algorithms and routines used in the See-and-Avoid tool will be identical to those used in the enhanced version of the ATC analysis tool FAA Vis. Overall validation of the subject analysis tools will require establishment of the proper detection and recognition discrimination criteria. Toward this end, ARL will team with NVESD and participate in a NASA-led *aircraft*-human perception experiment/study.

Tasks/Status:

1. Validate the Probability of Discrimination vs. Range predictions of the visibility analysis tool(s) through participation in a NASA-led *aircraft*-human perception experiment/study.

   Status: In early February, NVESD received a request from Andrew Watson (NASA – Ames) for a target set (complete w/ experimentally-determined N50's) for use in their *aircraft*-human perception experiment/study. NVESD has delivered the target set to NASA-Ames, and Dr. Watson et al have proceeded to analyze the imagery using one of their standard observer model metrics. Significant progress has been made in computing similarities among the images; the next step will be to try to correlate matrix similarities to the confusion matrices associated with the NVESD perception experiments. Concerns were discussed at a recent site meeting @ NASA-Ames about the appropriate approach to utilize in order to effectively apply the *image-based* observer model metric(s) to intra-image, *object-based* discrimination. Further work may be required in this area, but the present plan is to proceed toward correlation of standard observer model metrics with the NVESD target task difficult criteria (N50's). Additional collaborations with NASA on this effort will be forthcoming. (Expected completion date: Sept '05)

2. Update ARL's working desktop version of FAA Vis by adding charting routines and new GUI elements.

   Status: Work on this task is essentially complete. (Expected completion date: July '05)

3. Enhance FAA Vis to reliably handle a wide range of observation luminance level inputs and implement more accurate slant-path calculations.

   Status: Work on the first element of this task is almost complete. Recent experience gained in another performance model development effort with NVESD is being utilized in the approach to more reliably handle a wide range of observation luminance input levels in FAA Vis. (Expected completion date: July '05)

4. Modify FAA Vis to account for the effects of atmospheric attenuation by first, incorporating Moderate Resolution Transmittance (MODTRAN) code into FAA Vis, and second, by incorporating MODTRAN-generated attenuation data into FAA Vis calculations.

   Status: Work on this task is almost complete. NVESD has developed the Atmospheric Attenuation GUI and incorporated the new Ontar Corp. NVESD-model-to-MODTRAN interface that will allow for the arbitrary observer-to-target slant-path calculations that will be required for the See and Avoid analysis tool. The MODTRAN interface is now functional within FAA Vis. The final step for this task is to incorporate MODTRAN-generated attenuation data into FAA Vis calculations. (Expected completion date: July '05)

5. Develop an interface/mechanism to import relevant camera- and display-related performance parameters from NVESD's SSCAM and NVTherm performance models into the FAA's See-and-Avoid Detection and Recognition Visibility Analysis tool.

   Status: Work has started on this task. ARL has had several discussions with NVESD toward the development of an efficient and flexible approach to implement this task; a working approach has now been developed. Implementation is in progress. (Expected completion date: July '05)

6. Incorporate the camera- and display-related performance parameters into the See-and-Avoid tool performance calculations.

   Status: Work has started on this task in that the NVESD-model-to-MODTRAN interface that allows for the arbitrary observer-to-target slant-path calculations needed for the See and Avoid analysis tool has now been developed. (Expected completion date: Aug '05)

7. Develop GUI elements and calculation routines into the See-and-Avoid tool for additional scenario inputs and outputs.

   Status: Work has no yet started on this task. (Expected completion date: Sept '05)

8. Integrate all improvements into the Web version of FAA Vis, as available. This task will require time and resources from both ARL and from an FAA-designated information technology (IT) organization (e.g. CSSI, Inc.).
   Status: Work has no yet started on this task. (Expected completion date: Sept '05)

This effort is cost shared with Army Research Lab and US Army CECOM NVESD.

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