DRAFT

DEPARTMENT OF DEFENSE
HUMAN FACTORS ENGINEERING
TECHNICAL ADVISORY GROUP

MINUTES OF THE FORTY-SIXTH MEETING
MAY 2001
COLORADO SPRINGS, COLORADO

HOST:

AIR FORCE SPACE COMMAND
PETERSON AFB, COLORADO

CHAIR:

MAJOR SCOTT SMITH
TECHNICAL DIRECTOR
311 HSW/XPH
(HUMAN SYSTEMS INTEGRATION OFFICE)
BROOKS AIR FORCE BASE, TEXAS

DRAFT

DEPARTMENT OF DEFENSE
HUMAN FACTORS ENGINEERING TECHNICAL ADVISORY GROUP

DoD HFE TAG-46 Minutes Editor:
Sheryl G. Cosing
10822 Crippen Vale Court
Reston, Virginia 20194
(703) 925-9791
sherylcosing@earthlink.net
DoD HFE TAG's Website: http://hfetag.dtic.mil

DoD HFE TAG CONTRACT BY:
Army Research Laboratory Aberdeen Proving Ground Site Contracts Branch
ATTN: AMSRL-OP-PR-AP
Building 434
Aberdeen Proving Ground, Maryland 21005-5001

Comments/Amendments to these Minutes should be sent to:
Major Scott Smith
HSC/XRC (Human Systems Integration Office)
2510 Kennedy Circle, Suite 220
Brooks AFB, TX 78235-5120
(210) 536-3657 DSN 240; FAX (210) 536-6620
scott.smith@brooks.af.mil

Executive Summary

The forty-sixth meeting of the Department of Defense Human Factors Engineering Technical Advisory Group (TAG) was held at the Antler's Adams Mark Hotel in Colorado Springs, Colorado, 14-17 May 2001. The Meeting was hosted by Air Force Space Command Peterson Air Force Base, Colorado. There were 120 attendees.

Major Scott Smith,TAG Chair, would like to express his gratitude and appreciation to all the plenary presenters, subTAG chairs, and to the TAG Program Coordinator for their contributions to the success of this meeting.

Theme

The theme of TAG-46 was "Space: Meeting the Challenges for Exploitation by the Warfighter." Space as a medium presents many human related challenges, if we look on the Space Mission Areas:

- Space Force Enhancement
- Space Control
- Space Support
- Space Force Applications
- Mission Support

Each of these mission areas hold distinct challenges such as Command and Control issues; Intelligence, Surveillance, and Reconnaissance dissemination and exploitation; remote operations; and extreme environments. To fully exploit space we need to ensure that the human is fully integrated into our space systems for both operations and maintenance aspects of the space mission. As we look into the future, our space mission will only be increasing. We need to posture ourselves today, to support the warfighters of tomorrow.

Meeting Highlights

Call to Order – Major Scott Smith called the forty-sixth meeting of the TAG to order and welcomed presenters, guest, and attendees.

Highlights –

Social – Members of the TAG attended a trip to the historic mining town of Cripple Creek, Colorado.

Announcements

Mr. Jerry Chaikin informed the TAG membership of the passing of Mr. Jean M. Ring. The following is a tribute he wrote to Jean M. Ring.

Jean M. Ring passed away in the early morning hours of 30 October 2000. He was born June 12, 1921, was an Air Corps veteran of WWII, where he had been a glider pilot and instructor. Jean earned a master's degree from Northwestern, worked in the Aerospace Medical Lab at

Wright-Patterson Air Force Base as a research psychologist, and retired from federal service in 1983.

He was one of the four original members of the Tri-Service Human Factors Standardization Steering Committee (HFSSC), the predecessor of the Human Factors Standardization SubTAG. Jean served as the Air Force Member of the JFSSC through its third meeting. At DoD HFE TAG #3, he was a party to the TAG's inviting the HFSSC to become a SubTAG.

Jean was the Air Force alternate spokesman at the Tri-service/NASA/Industry unification meeting in December 1967 that consolidated eight service standards and specifications to create MIL-H-46855 and MIK-STD-1472, the two most prominent human factors standardization documents in the DoD ensemble. For most of the 1970s, Jean was the official Air Force spokesman on the Tri-Service Technical Groups for MIL-H-46855 and MIL-STD-1472, responsible for all technical changes to these documents as they developed.

Almost all the requirements and guidelines in MIL-STD-1472 have survived all these years because of Jean's no-nonsense approach to considering recommended new provisions and to his own carefully crafted proposed new provisions. Jean was a principled negotiator who required any new provision to be contractually necessary, enforceable, practical, applicable with little or no exception, expressed if possible as legitimate numerical limits, and be strongly supported. Typically, the other service representatives adopted Jean's philosophies. He taught us a lot.

Considering the human factors standardization interests of the HFS SubTAG, I don't think we'd have accomplished what we did had it not been for Jean Ring's principles, many talents, and hard work. Since the 1970s, those of us who used the DoD Human Factors Standardization documents – as contract requirements, design guidelines, or as seminal documents for fashioning other standards and guidelines, in and out of government, in the US and worldwide – owe a debt of gratitude to Jean Ring for his valuable contributions so may years ago that still help us today.

Administrative Business

Website –The TAG Website now has a new Home page with member publications and links to each subTAG's homepage. SubTAG Chairs are encourage to review their information and to post subTAG specific information.

SubTAG Reports -

Controls & Displays – The subTAG updated its charter with a name change to Controls and Displays deleting the reference to Voice Interactive Systems.

Human Factors in Telemedicine and Biomedical Technologies - This subTAG would like to focus on Biomedical aspects rather than Telemedicine.

Human Factors Test and Evaluation – The subTAG updated its charter.

Sustained/Continuous Operations – The subTAG focused on the performance of teams when tired.

System Safety/Health Hazards/Survivability – Mr. Steve Merriman, EIA, SAFE & AsMA Rep., will co-chair the subTAG for a two-year rotation along with the current chair, Mr. Ben Gibson.

Technical Society/Industry – Mr. Bill Lytle, AsMA Rep., will take over as chair for a two-year rotation.

Tri-Service Workload Coordinating – Mike Vidulich will chair the subTAG effective TAG-48.

User-Computer Interaction – LT Jim Patrey will chair the subTAG effective TAG-48.

Caucus Reports –

Air Force The Air Force Service Representative, Dr. Grant McMillan, Air Force Research Laboratory, Wright-Patterson AFB, OH), stated that the caucus agreed for each member to bring a new member to the next meeting. The caucus also agreed to move the meeting to the evening early in the week rather than during the last day, so as to enjoy greater participation from its Air Force members.

Army Ms. Dawn Woods, Army Representative, Natick, MA reported that the subTAG would like to hold a meeting in the area of West Point to encourage student participation.

Navy - The caucus nominated LCDR Sean Biggerstaff as the incoming TAG chair. The next Navy hosted meeting will be held in San Diego, hosted by SPAWARSYSCEN. For the next TAG meeting, the caucus hopes to encourage participation of line officers, will try to entice students from Naval Postgraduate school to attend, and the Aviation Experimental Psychologists (AEPs) will hold a meeting

Executive Committee/Operating Board Reports –

Badge Colors – The operating board voted to get rid of the current system of badge colors as most individuals didn't understand or know the system. All TAG member badges wil be white.

Hot Issues – Much of the Executive Committee meeting dealt with the current Hot Issues and the format of the existing documents. Major Scott Smith stated that approximately 50% of the hot issues deal with procedures, tool, techniques, etc while few address increasing the ability of the warfighter. The Hot Issues document is still going through its next revision cycle. The time schedule presented to the Operating Board is as follows:

- Major Smith is to draft a short list of the most important hot Issues 1 June 01
- Develop Presentation Formats and supplementary Information for the briefing. 15 June '01
- Brief Dr. Foster at DDR&E Mid-June '01
- Publish Hot Issues III on TAG Web site July '01

Upcoming TAG meetings - TAG-47 will be held in San Diego, CA on 22-25 October, 2001. Due to the incidents on September 11th, 2001, TAG–47 was postponed until April 2002.

Operating Board

Proponent

Robert E. Foster, Phd
Director, BioSystems
ODUSD(S&T)/ODDR&E/OUSD(AT&L)
3080 Defense Pentagon, Rm 3E801
Washington, DC 20301-3080
(703) 588-7437 DSN 425; FAX (703) 588-7560
robert.foster@osd.mil

Program Coordinator

Ms. Sheryl Cosing
10822 Crippen Vale Ct.
Reston, VA 20194
(703) 925-9791; FAX (703) 925-9694
sherylcosing@earthlink.net

Executive Committee

Current Chair (Air Force)

Major Scott Smith
HSC/XRC (Human Systems Integration Office)
2510 Kennedy Circle, Suite 220
Brooks AFB, TX 78235-5120
(210) 536-3657 DSN 240; FAX (210) 536-6620
scott.smith@brooks.af.mil

Army Representative

Ms. Dawn Woods
AMSSB-RSS-E(N) Attn: Dawn Woods
100 Kansas St.
Natick, MA 01760-5020
(508) 233-5069 DSN 256; FAX (508) 233-5527
dawn.woods@natick.army.mil

Chair Select (Army)

Dr. James C. Geddie
ARL Field Element - HQ USAOTC
Attn: AMSRL-HR-MV
Ft. Hood, TX 76544-5073
(254) 288-9572/9917 FAX (254) 288-1691
geddiejames@otc.army.mil

Navy Representative

LCDR Dylan Schmorrow
Naval Research Laboratory, Code 5580
4555 Overlook Ave SW
Washington, DC 20375-5320
(202) 404-8624 DSN 754; FAX (202) 404-7887
schmord@onr.navy.mil

Immediate Past Chair (Navy)

LCDR Russell Shilling
Associate Professor
OR/MOVES, 212 Glasgow Hall, NPS
Monterey, CA 93943
(831) 656-2543 DSN 878; FAX (831) 656-2595
rdshilli@nps.navy.mil

Air Force Representative

Dr. Grant McMillan
AFRL/HECP, Bldg. 33
2255 H St
Wright-Patterson AFB, OH 45433-7022
(937) 255-8750 DSN 785; FAX (937) 255-8752
grant.mcmillan@wpafb.af.mil

NASA Representative

Mr. Clete Booher
MC SP5 NASA – JSC
2101 NASA Rd One
Houston, TX 77058
(281) 483-8951 FAX (281) 483-1847
cletis.r.booher1@jsc.nasa.gov

FAA Representative

Dr. Thomas McCloy
FAA; AAR-100, Rm. 907
800 Independence Ave., S. W.
Washington, DC 20591
(202) 267-7167; FAX (202) 267-5797
tom.mccloy@faa.gov

Ex Officio Members - SubTAG Chairs

Controls and Displays/Voice (Displays/Voice)

LT Chris Hart
48110 Shaw Rd., Unit 5
Bldg 2187, Suite 2280
Patuxent River, MD 20670-1906
(301) 342-9254 DSN 342; FAX (301) 342-9305
hartcl@navair.navy.mil

Design: Tools and Techniques (Design)

Co-Chairs:

Mr. John Lockett
ARL-HRED
Attn: AMSRL-HR-MB
Aberdeen Proving Ground, MD 21005-5425
(410) 278-5875 DSN 298; FAX (410) 278-5032
jlockett@arl.army.mil

Mr. Lester Jee
OPM Crusader
ATTN: SFAE-GCSS-CR-E, Bldg 71
Picatinny Arsenal, NJ 07806-5000
(973) 724-5208 DSN 880; FAX (973) 724-2221
ljee@pica.army.mil

Human Factors Engineering/Human Systems Integration: Management and Applications (HSI)

Mr. Richard Armstrong
ARL-HRED Field Element
PO Box 620716
Enterprise, AL 36362-0716
(334) 255-3303 DSN 558; FAX (334) 255-2711
armstrongr@rucker.army.mil

Human Factors in Extreme Environments (Extreme Environments)

Mr. Clete Booher
MC SP3 NASA – JSC
2101 NASA Rd One
Houston, TX 77058
(281) 483-8951 FAX (281) 483-1847
cletis.r.booher1@jsc.nasa.gov

Human Factors in Telemedicine and Biomedical Technologies (Biomed)

LT William Deniston
Naval Health Research Center
P.O. Box 85122
San Diego, CA 92186-5122
(619) 553-8408 DSN 553; FAX (619) 553-8551
deniston@nhrc.navy.mil

Human Factors Standardization (HFS)

Mr. Alan Poston
Federal Aviation Administration, AND-202
800 Independence Ave. SW, Rm 339
Washington, DC 20591
(202) 493-4519
alan.poston@faa.gov

Human Factors Test & Evaluation (T&E)

Ms. Dawn Woods
AMSSB-RSS-E(N) Attn: Dawn Woods
100 Kansas St.
Natick, MA 01760-5020
(508) 233-5069 DSN 256; FAX (508) 233-5527
dawn.woods@natick.army.mil

Human Modeling and Simulation (Modeling)

Ms. Diane Barnette
US Army Research Lab, HRED
ATTN: AMSRL-HR-S
Aberdeen Proving Ground, MD 21005
(410) 278-9523 DSN 298; FAX (410) 278-3148
dbarnett@arl.army.mil

Sustained/Continuous Operation (SUSOPS/CONOPS)

Co-Chairs:

James C. Miller, Ph.D., CPE
Director, Chronobiology and Sleep Lab
AFRL/HEPM
2504 Gillingham Drive, Ste 25
Brooks AFB, TX 78235
(210) 536-6371 DSN 240
jcmiller@brooks.af.mil

Thomas E. Nesthus, PhD
Human Factors Research Laboratory
FAA CAMI
PO Box 25082
Oklahoma City, OK 73125
(405) 954-6297 FAX (405) 954-4852
tom_nesthus@mmacmail.jccbi.gov

System Safety/Health Hazards/Survivability (SS/HH/Sv)

U.S. Army Medical Department Center & School
ATTN: MCCS-FCC-P (Mr. Gibson)
1400 E. Grayson St, Suite 219, Room 226H
Fort Sam Houston, TX 78234-5052
(210) 221-1622 DSN 471; FAX (210) 221-0121
ben.gibson@cen.amedd.army.mil

Technical Society/Industry (TSI)

Mr. Stephen C. Merriman, MS 269
The Boeing Company c/o Raytheon TI Systems
P.O. Box 660246
Dallas, TX 75266-0246
(972) 344-7578 FAX (972) 664-0092
stephen.c.merriman@boeing.com
scmerriman@home.com

Tri-Service Workload Coordinating (Workload)

Director
U.S. Army Research Laboratory
Attn: AMSRL-HR-SC (Chris Smyth)
Aberdeen Proving Ground, MD 21005-5425
(410) 278-5833 DSN 298; FAX (410) 278-5944
csmyth@arl.army.mil

User-Computer Interaction (UCI)

Mr. Walter P. Benesch
OSD C3I Software Management Division
1225 Jefferson Davis Hwy
Suite 910 #26
Arlington, VA 22202
(703) 604-1571
walter.benesch@osd.pentagon.mil

Affiliated Groups (NO VOTE)

Human Factors in Training Interest Group (Training)

Laurie Quill
University of Dayton Research Institute
Human Factors Group
300 College Park
Dayton, OH 45469-0158
(937) 256-9243
Laurie.Quill@wpafb.af.mil

Table Of Contents

Meeting Agenda

Monday, 14 May

0800 - 1000 Executive Committee meeting
1000 - 1100 New member orientation
1300 - 1700 Plenary Session -

- Lieutenant General Roger DeKok, Vice Commander of the Air Force Space Command, Peterson AFB, CO
- Major General Joseph Bergantz, Program Executive Officer for Aviation, Redstone Arsenal, AL
- Human Systems Research and Development in DoD – Commander Tim Steele, Assistant Director, Human Systems, ODUSD (S&T)/BioSystems
- Engineering Psychology Program at West Point Military Academy – Lieutenant Colonel Lawrence G. Shattuck, Engineering Psychology Laboratory, United States Military Academy West Point
- Training Human Factors Engineers for an Air and Space World – Lieutenant Colonel Daryl Smith, Air Force Academy, CO
- Human Systems Information Analysis Center (HSIAC) Spatial Disorientation – Mr. Thomas Metzler, HSIAC, Wright-Patterson AFB, OH

Tuesday, 15 May

0730 - 0830 Technical Society/Industry
0830 - 1700 Human Factors in Training Interest Group
0830 - 1100 System Safety/Health Hazards/Survivability
0830 - 1100 Human Factors in Telemedicine and Biomedical Technologies
1230 - 1430 Design: Tools and Techniques
1230 - 1430 Tri-Service Workload Coordinating
1500 - 1700 Human Modeling and Simulation
1500 - 1700 Human Factors Test and Evaluation

Wednesday, 16 May

0830 - 1700 Human Factors in Training Interest Group
0830 - 1100 Human Factors Standardization
0830 - 1100 Controls and Displays/Voice-Interactive Systems
1230 - 1430 Human Factors Engineering/Human Systems Integration: Management and Applications
1230 - 1430 User-Computer Interaction
1500 - 1700 Human Factors in Extreme Environments
1500 - 1700 Sustained/Continuous Operations
1800 - 2230 Social – Trip to Cripple Creek, Colorado

Thursday, 17 May

0830 - 1000 Service Caucuses & TS/I Meetings
1000 - 1130 Operating Board
1130 Adjournment

Plenary

The following briefing summary submitted by Mr. Stephen Merriman

- Lieutenant General Roger DeKok, Vice Commander of the Air Force Space Command, Peterson AFB, CO

General DeKok provided the keynote opening for the 46th TAG meeting, the theme of which was *"Space: Meeting the Challenges for Exploitation by the Warfighter."* To set the stage, General DeKok provided some powerful statistics. There are now in excess of 700 satellites in orbit; this represents in excess of $100 billion in annual business, with more than 20,000 companies involved. In the US alone, this represents an annual impact of $60 billion per year. The US has invested more than $500 billion since 1996. In the next 10 years, between 500 and 1,000 additional satellites will be launched.

Space represents the ultimate "high ground." It allows global coverage without over-flight restrictions. Satellites are lasting between 15 and 20 years and they provide coverage 24 hrs. a day, seven days a week. While the space shuttle orbits at about 300 miles, satellites orbit from 22,000 miles to 12,500 miles.

The mission of Air Force Space Command is to provide:
- National Security
- Force Enhancement (helping the warfighter)
- Space Control (offensive and defensive)
- Force Application (nuclear strike- currently via ICBM)

The Air Force Space Command mission is continuing to evolve. In the near term, there will be GPS updates, EELV, re-usable launch vehicles, improved resolution surveillance, kinetic and laser space weapons. In recognition of one contribution of the DOD HFE TAG, General DeKok recognized that the TAG had recently convinced Space Command to implement operator rotation every 15 minutes to maintain vigilance (thanks to Dr. Jay Miller's efforts).

The following briefing summary submitted by Mr. Stephen Merriman

- Major General Joseph Bergantz, Program Executive Officer for Aviation, Redstone Arsenal, AL

Major Bergantz discussed MANPRINT efforts on the RAH-66 Comanche program. [General Bergantz was previously the Comanche Program Manager.] He explained some of the success criteria that had been established for MANPRINT on the Comanche:
- Designing for the soldier
- Optimizing operational effectiveness
- Maximizing crew effectiveness
- Minimizing crew workload
- Improving Situational Awareness (SA)
- Implementing identical cockpits, front and rear
- Improved maintenance capability
- Air Warrior Compatibility

MANPRINT had impact on the following areas of Comanche design:

- Crew station designs
- Crew station design processes
- Crew station/Crew systems tradeoffs
- Anthropometric accommodation analyses
- Control/display simulation evaluations
- System Safety working group activities
- Maintainability accessibility evaluations

Throughout the Comanche development cycle, there was a lot of soldier participation in the design process.
- Soldiers were assigned to work at contractor facilities
- Soldiers performed early operational assessments
- Soldiers provided continuous expertise directly into the design
- Soldiers served as SMEs
- Soldiers coordinated contractor/Government actions.

Insofar as the Comanche crew station is concerned, the Naval Air Systems Command (NAVAIR) is currently conducting a final anthropometric accommodation check. Tools used during Comanche crew station geometry development were: Crew Chief, TAWL, HARDMAN, TOSS, HARDMAN III and MPTQ. Currently, the Comanche is being upgraded to incorporate "Pilot's Associate capabilities and improved maintainability characteristics. Training and Human Factors Engineering were so well coordinated that it was possible to deliver the training with the first aircraft.

In summary, General Bergantz was extremely well versed in human factors engineering, tradeoffs between HFE and other disciplines, as well as the role HFE should play in MANPRINT.

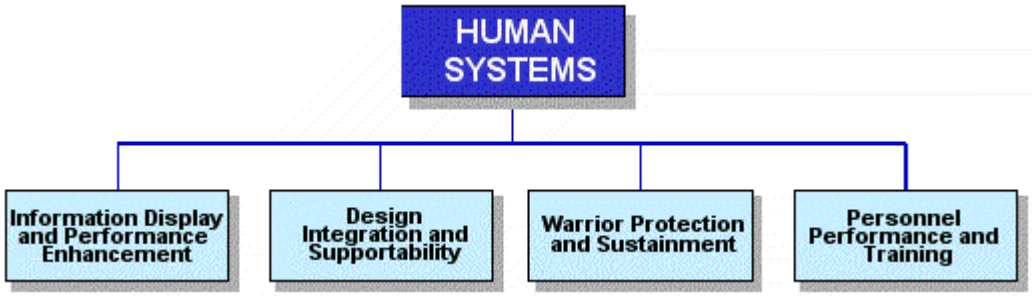
The following briefing summary submitted by Mr. Stephen Merriman

- Human Systems Research and Development in DoD – Commander Tim Steele, Assistant Director, Human Systems, ODUSD (S&T)/BioSystems

CDR Steele provided an overview of the Human Systems R&D funding picture. Over the past 10 years, the USAF has lost some ground and the Army/Navy have gained funding. Some useful web sites for the Human Systems area are: Http://www.dtic.mil/biosys, http://www.dtic.mil/dusdst, https://ca.dtic.mil/dstp, and https://ca.dtic.mil/tara/. Two of the areas being funded under Joint Vision 2020 are related to bio systems: Cognitive Readiness (information overload, augmented reality, training) and Smart Sensor Webs (real time imagery, etc.). Cognitive Readiness is currently emphasizing the importance of people "thinking" in war fighting; that is, focus is being directed toward ensuring that war fighters are mentally prepared and that they can perform at optimal levels. CDR Steele can be reached at: timothy.steele@osd.mil.

New acquisition regulations, such as DOD 5000.2-R, are talking about technology readiness levels (7 levels). There are changes being made to the S&T planning process, such as moving from DTOs to technology roadmaps.

The Human Systems technology area is composed of four areas: Information Display and Performance enhancement, Design Integration and Supportability, Warrior Protection & Sustainment, and Personnel Performance and Training. Human Systems R&D annual funding is approximately $300 million.



A Human Systems/Information Systems workshop will be held at MIT Lincoln Labs on July 24-27. This workshop will explore the Human Systems and Information Systems technology areas, with the objective of improving relationships.

The following briefing summary submitted by Mr. Stephen Merriman

- Engineering Psychology Program at West Point Military Academy – Lieutenant Colonel Lawrence G. Shattuck, Engineering Psychology Laboratory, United States Military Academy West Point

Twenty to twenty five cadets each year major in engineering psychology, which means there are about 50 engineering psychology major cadets at the academy at any time. LtCol Shattuck reviewed the excellent curriculum in place for these junior-senior cadets. The academy has an interesting system called “pre-looks” whereby cadets may submit their papers/projects early. The professor may comment on the early submittals and the students may fix them before final submittal. LtCol Shattuck can be reached at: ll6857@exmail.usma.army.mil.

- Training Human Factors Engineers for an Air and Space World – Lieutenant Colonel Daryl Smith, Air Force Academy, CO

The United States Air Force Academy was founded in the 1950s, with the first class graduating in 1959. Currently there are over 4,000 cadets enrolled. The Academy curriculum is designed around a broad range of general education classes called the core. Cadets take 33 courses in four divisions; Engineering, Basic Sciences, Humanities, and Social Sciences. The courses help prepare the cadet for their 12 course Major. The Behavioral Sciences Major has three tracks; Human Factors & Systems Design, Counseling and Human Development, and an Open Track. The Human Factors Track is the most popular with an average of 50 cadets enrolled per class. The core curriculum provides the Engineering and Mathematical background necessary for training a HF Engineer. Other department courses (e.g. Research Methods and Design, Cognitive Psychology) further prepare the cadet for the discipline. Cadets take four specific HF courses; Aviation Psychology, Introduction to Human Factors, Engineering Psychology, and a capstone course called HF in System Design. The courses are designed to build upon one another and prepare the cadet for the future challenges of an Air and Space world. Cadets have opportunities for working with outside agencies in HF research through three programs. The Summer Research Program allows a cadet to work for 3-6 weeks on location in applying their HF knowledge. There are group design projects in the capstone course, where we welcome “real world problems”. Finally cadets can engage in a year long individual research project while being mentored by a faculty member. If you are interested in participating in any of these research programs please contact me at (719) 333-3860, DSN 333-3860 or via email at daryl.smith@usafa.af.mil.

- Human Systems Information Analysis Center (HSIAC) Spatial Disorientation – Mr. Thomas Metzler, HSIAC, Wright-Patterson AFB, OH

This presentation describes the creation of a knowledge "Pillar" that is accessible through the HSIAC web page at http://iac.dtic.mil/hsic. This is the first opportunity for HSIAC to create a pillar that will have in one place all of the relevant information that pertains to a given subject area within the eight domains of HSIAC. The eight domains of HSIAC are; Human Factors Engineering, Safety, Survivability, Manpower, Personnel, Training, Habitability and Medical. These domains within themselves are very wide and encompass several areas of study. Some areas such as spatial disorientation involves several of these domains so this effort was initialed to create pillars of knowledge that cut across several domains and brings together the pertinent information on a given subject. Also of interest was the need to create pillars that focus on issues that transcend the interest of the researcher, the acquisition/development community as well as the end user, the war fighter. This effort is only possible because of the efforts of the Air Force Research Laboratory under the direction of Major Todd Heinle, AFRL/HEM, DSN 656-7011, Todd.Heinle@he.wpafb.af.mil who has contracted with Veridian Engineering. Tom Hughes of Veridian Engineering is the Program Manager, thughes@dytn.veridian.com. Veridian is collecting all of the information and organizing it for presentation on the HSIAC web page. As additional pillars are created they will be able to be presented in a similar manner on the HSIAC site thereby creating the opportunity for the Human Systems community at large to have one place to go to get in-depth information on a special topic. This does not mean that this same information maybe available elsewhere, as illustrated by the fact that currently the HSIAC has over a 180 links to other web sites where additional information is presented.

The need for this effort stems from the realization that there has been no other centralized source of Spatial Disorientation Information. That information has not been presented in a form that is easily used or accessed. And material has often been outdated or irrelevant. The utility of the pillar is to provide a Central Source of the Spatial Disorientation Information, share knowledge across related disciplines and develop new information and presentations to reduce Spatial Disorientation related mishaps. You can all participate in this effort by providing your information to us for presentation on this web site. The more that our community contributes and uses this capability the stronger the effort will become and the increase potential of having a positive impact on the war fighter.

Additional features will be added to the web site and it is our intention to work with MATRIS to develop a searchable database for the information being provided. In addition to contributing to this pillar on spatial disorientation, you may wish to start a pillar on a different subject area that you are pursuing. If so please contact the presenter of this briefing: Tom Metzler, Director of HSIAC, DSN 785-6623, tom.metzler@wpafb.af.mil.

SubTAG Reports

Controls and Display

The Controls and Displays SubTAG met on May 16, 2001 and was attended by 27 people. Attendees included people from the Army, Air Force, Navy, FAA, NASA, and industry. Following introductions, there were three presentations:

- Tactical Tomahawk Interface Design and Testing - Captain Rob Willis, U.S. Army

Military personnel are continually faced with new and more advanced forms of automated technology. Of interest is the design of command and control (C^2) systems that allow personnel to remotely monitor not only an emerging battlespace, but also the numerous semi-autonomous vehicles and weapons currently being developed. The U.S. Navy is currently developing its next-generation cruise missile, the Tactical Tomahawk, which improves upon current versions by its ability to be retargeted in flight against emergent time-critical targets. These targets include mobile surface-to-air missile systems, surface-to-surface ballistic missile launchers (Scud), and other high-value relocatable targets. Based partly on experience during Operation Allied Force (1999), the military services have established a goal of ten minutes to service these types of targets once identified. Tactical Tomahawk expands the list of weapons available for this purpose, and adds to the Navy's arsenal of Land Attack Warfare systems for integration into the revolutionary design of the DD 21 destroyer. Further, the Navy's Director of Surface Warfare recently focused weapon system development on the operator, stating, "...our ability to successfully and effectively employ Land Attack Warfare systems will directly reflect our commitment to Human Centered Design...[and]...Human Systems Integration" (Mullen, 2000).

In this study, we developed an operator interface prototype for the Tactical Tomahawk Weapon Control System (TTWCS) and empirically tested the effect of mission complexity on the ability of operators to maintain situational awareness in various operational scenarios. The first phase of research involved a domain analysis of three primary domains: the weapon system; time-critical decisionmaking; and principles of interface design. The second phase was a concurrent Cognitive Work/Task Analysis (CW/TA) and Display Development effort. For the CWA, we first profiled the user population and then analyzed the tasks, using scenarios to decompose the system into objects & properties, a task flowchart, and a formal list of functional requirements. Major functional requirement headings include the following: 1.) Monitor and communicate status, 2.) Conduct queries to the system, 3.) Develop and modify plans, and 4.) Facilitate retargeting decisions. Next, tasks and system properties were synthesized into prototypes of individual display features as well as a system operator interface. We iterated on this development process to produce three prototypes of increasing fidelity. The final version of the system interface is dynamic and interactive, and incorporates varying degrees of automation for different tasks. As a separate but relevant project, Appendix G of the thesis proposes a methodology and program for rapidly analyzing terrestrial constraints on missile terminal dive angle. The program is implemented in ArcView GIS (geographical information system), and could be used by targeting cell personnel to instantly assess whether a target is suitable for Tomahawk attack with respect to required attack heading and dive angle.

In the final phase, we trained and tested twenty graduate students on the dynamic and interactive prototype, based on hypotheses pertaining to both monitoring and retargeting tasks. Statistical results support two primary conclusions. First, operators can maintain adequate situational awareness when monitoring eight missiles and twelve targets simultaneously.

Second, results support the use of the missile timebar feature in the interface to compare events. Subjective results indicate the requirement for a robust decision support tool to facilitate rapid retargeting decisions. The tested prototype was subsequently expanded to include such a tool. These and other results form the basis for recommendations to the Naval Surface Warfare Center, Dahlgren Division about how to most effectively allocate personnel resources in the designing of a command and control watchstation for the Tactical Tomahawk cruise missile system.

- Critical C2 Workstation Design Issues for Satellite Operations - Mr. Chad Oster

The Center for Research Support (CERES) at Schriever AFB, CO, is currently studying concepts which may improve C2 workstation designs for Air Force satellite operations. Traditionally, satellite control facilities have used a single-sensor single-indicator (SSSI) philosophy in the design of their satellite telemetry displays. This design philosophy incorporates the use of mnemonics and measurands to represent satellite subsystem data. Unfortunately, overuse of this design principle has lead to telemetry displays that are often dense with information and difficult to interpret. These traditional displays rely heavily on an operator's ability to find appropriate information when it is needed and then correctly interpret that information. This task can be difficult during routine operations and even more overwhelming during emergencies or when time constraints are in place. There is much concern that by using these displays an expense is created in operator performance. CERES is attempting to improve the design of satellite C2 systems by applying principles used in ecological displays as well as other fundamental human factors principles. Culminating from this research and presented for the conference are C2 mockups of a satellite master control frame and a satellite communication subsystem frame. By building stronger more meaningful displays, CERES aims to improve operator performance in the command and control of Air Force satellites.

- Manned Spaceflight Human Factors and Their Broad Implications for Long-Duration Spaceflight Missions from a Systems Engineering Perspective at Multiple Levels of Analysis with Special Attention Given to Issues Surrounding to Design and use of Controls and Displays - Captain Dwight Holland, Ph.D., U.S. Air Force

Person-rated space travel on long missions requires careful attention to consideration of all of the factors that may affect human performance on these missions. Properly accounting for the "human factor" on these missions should be a cornerstone for competent overall systems and mission design. These human factors issues predominantly include, but are not limited to: neurovestibular disturbances, muscle weakness, a variety of cardiac concerns, bone demineralization, radiation effects, spacesuit usability and decompression protocols, IVA/EVA issues, workstation/workspace design in microgravity, controls and displays interfaces, and a host of psychosocial and group dynamics issues. Each of these areas are touched upon briefly, with special attention given to how effective systems and mission architecture design can optimally impact the performance of astronauts as the human capability envelope changes during an extended mission. Non-normative aspects of controls and displays in the microgravity environment are discussed, including the need for refresher training and ground sensitivity as to the state of current astronaut proficiency if difficult maneuvers or tasking is be executed. A Case Study of the MIR/Progress 234 mishap is highlighted as a learning tool to highlight some of the critical points with regard to how human factors issues impact human performance throughout the various levels of the system, and how they may interact with each other to produce complex failure modes in this and other situations. Suggestions are given to help mitigate and account for the human performance changes in the long duration spaceflight realm within a larger systems and mission context. In sum, the multi-dimensional human factors

issues must be thoughtfully considered within a total systems context as a critical component of such systems and missions architecture that is quite often changing as the mission evolves.

Design: Tools and Techniques

- Digital Anthropometric Video-Imaging Device (DAVID): An Effective Screening Tool – J.L. Saxton and F.R. Patterson, Naval Aerospace Medical Research Laboratory, Pensacola, FL

Anthropometry is important in military aviation due to restrictive cockpit environments and the limited range of motion allowed for safe operation of controls. Methods of obtaining anthropometric measurements are varied; they range form manual techniques such as tape measures and calipers to three-dimensional whole-body scanners. In addition to these methods, a computer-based technique called the digital anthropometric video-imaging device (DAVID) has been developed at the Naval Aerospace Medical Research Laboratory, in Pensacola, Florida. The DAVID provides a means to capture and measure a person's digital image using off-the-shelf hardware and measurements scales, transcription errors, and data entry errors are eliminated; 2) the output of the DAVID can be imported into off-the-shelf modeling or data analysis software if desired; and 3) most importantly, files can be retrieved for quality control or for any other reason a retrospective review is needed. Most of the current manual technologies require the subject to return if a measurement is questioned. With the DAVID, the operator only has to retrieve the subject's file to evaluate positioning of the subject and accuracy of the measurements. Comparison studies have been completed to evaluate the accuracy, reproducibility, and value of the DAVID technology. One study indicated no significant difference between the DAVID and the standard caliper (anthropometer) measurement technique. An additional study demonstrated a strong correlation between the DAVID and the current method used valuable technology for linear anthropometric measurements. During the present anthropometric screening process, if one of more of an aviation candidate's individual measurements approach an unacceptable limit, a dynamic fit check is required. For a dynamic fit check, the appropriate aircraft must be made available so an Aeromedical Safety Officer (AMSO) can subjectively evaluate the candidate's ability to reach/operate the controls and have acceptable field-of-view. As an alternative, we are investigating how well virtual fit checks predict the results of multivariate-analysis program called the automated anthropometric evaluation program (AAEP) developed at the Naval Air Systems Command, Patuxent River, Maryland. If virtual fit checks successfully replace or reduce dynamic fit checks, the Navy could see a significant savings in both time and money. Future applications for the DAVID are promising. We hope to add interpupillary distance measurements to the DAVID's capabilities. We are also looking into ways to reduce the number of cameras to complete height, thumbtip reach, sitting height, sitting eye height, sitting acromial height, buttock-knee length, bideltoid breadth, and functional leg length, which are currently used in the Navy's anthropometric screening.

- Automating the Development of Human Performance Models: Data-Driven Knowledge Engineering – Mr. Anthony Cowden and Dr. John Burns, Sonalysts, Inc. and LT James Patrey, PhD USAF

Data-Driven Knowledge Engineering (DDKE) is the process of automatically generating a model, in this case of human performance, and reviewing and tuning that model. We have demonstrated a fuzzy logic-based approach to DDKE for a particular ship-handling evolution using a commercial data mining tool (Hyperlogic's Rule Maker for CubiCalc) and an adjunct program (Rule Maker) that generates fuzzy system rules from data sets.

The basic premise of this effort is that rule induction systems can significantly enhance behavioral scientists understanding of an individual's decision-making process while performing

complex or hard-to-quantify tasks. Ship-handling expertise is a good example of a skill set that is difficult for experts to describe beyond telling us that skilled ship drivers have “seaman’s eye.”

The value of a fuzzy-logic based knowledge discovery approach is its ability to provide results in a semantically meaningful structure (i.e., natural language if-then sentences that it’s adjunct program for generating fuzzy system rules were used on performance data from 19 Surface Warfare Officers (SWOs) who conducted simulated underway replenishments in a VE-based system. User defined input variables were the separation range between the two ships, the ships fore-and-aft alignment, and the direction and speed of relative motion.

In this process, the knowledge engineer specifies the number of output variables to associate with he input variables. Rule Maker then determines the definition of the output variables as part of its rule discovery process and automatically numbers these adjective “adj01,” “adj02,” etc. However, these fuzzy sets do not correspond to the actual conning officer actions, so presently the DDKE process includes modify the output fuzzy sets to accurately represent conning officer options. The two output fuzzy variables in this analysis reflected conning officer course and speed changes.

The paper will review our DDKE efforts including a description of the process that was followed to develop a human performance model, and our efforts to validate this model. The potential for automating the development of human performance models will be discussed as well as the potential of DDKE for supporting the development of cost-effective intelligent tutoring systems.

- Applying Human Figure Modeling Tools to the RAH-66 Comanche Crewstation Design – Mr. Richard Kozycki, Mr. Richard Armstrong, US Army Research Laboratory Human Research and Engineering Directorate

Graphical three-dimensional anthropometric human figure models are widely used to perform ergonomic assessments of vehicle and aircraft crewstation designs. When physical prototypes do not exist or access to them is limited, human figure models can provide an effective yardstick to evaluate the designs against the specified accommodation requirements. In cases when the design requirement has not been met, it is equally important to determine the extent of any modification needed and to provide possible design options.

The accuracy of any analysis that uses human figure modeling toools depends not only on the data and method used to construct the figures but also on the posture of the figures when they are placed in the crewstation Clothing and equipment worn by the operator, which has an impact on the posture, must also be taken into consideration

The US Army Research Laboratory recently performed a detailed ergonomic analysis of the RAH-66 Comanche crewstations using human figure modeling tools. The details of the methodology used in applying these tools are presented here.

- PERVISO: A Tool for Representing Decision-Making in Command and Control – Josephine Q. Wojciechowski, US Army Research Laboratory, ATTN: AMSRL-HR-M, Aberdeen Proving Ground, MD jqw@arl.army.mil

In 1998, the US Army initiated a Science and Technology Objective (STO) entitled, “Cognitive Engineering of the Digital Battlefield.” The goal of this STO is to better understand the cognitive processes associated with battle command. One of the major thrusts of the STO is to use models, simulations, and tools to assist in predicting the efficiency and effectiveness of human performance during battle command.

A model was developed of a concept organization. One critical measure of effectiveness is to measure the quality of the decisions being made by the soldiers represented in the model. Decision quality was determined to be a function of the information quality, the experience, training, and fatigue of the operator, and the environment in which he or she had to work. A framework was developed that represents the information quality as it applies to decision-making in the model. Information is broken down into 24 separate "information elements." These elements are then attached to the tasks that the human is performing. Information is collected in processing tasks, shared in collaboration tasks, and used in decision-making tasks. The outcome of this technique gives a probability that the decision-maker will have the information needed to make a good decision. Added to that are the impacts of experience, training, fatigue, and environmental stressors. The model also provides efficiency measures of utilization, task drops and suspensions, operator task completions and sensor to shooter timelines. These measures together provide investigators with a tool that can indeed be used to examine the process of battle command.

Human Factors Engineering/Human Systems Integration: Management and Applications

The HFE/HSI subTAG met on 16 May 2001. There were nineteen members present representing the US Army, US Navy, US Air Force, FAA, NOA, and the Technical Societies. Presentations were oriented towards the successes each of the services have experienced. The subTAG was provided insights regarding how each of the services apply the overall DoD Human Systems Integration requirements to their specific programs. The presentations included:

US Air Force Human Systems Integration Update	Major Scott Smith, USAF Human Systems Integration Office
MANPRINT in Laundry Advanced System	Dawn Woods MANPRINT
Crusader, US Army Success Story	Lester Jee USA PM-Crusader
Human-Centered Systems Engineering	Debbie Bardine Naval Surface Warfare Center

During the open discussion period, the subTAG members expressed a desire to continue the "program successes" them for the next meeting in the fall.

- Air Force Human Systems Integration Update – Major Scott Smith, USAF Human Systems Integration Office, Brooks AFB, TX

The Air Force Human Systems Integration Office is located at Brooks AFB, TX. Over the past year there have been many changes. The most exciting is the direction from LtGen Plummer that all new acquisition programs include HIS in their Acquisition Strategy Panel Planning process. This includes training and potential inclusion in the Acquisition Strategy Panel. Our office has felt all along that it is important to get involved early in the process. We have also continued to work closely with the requirements development community. We now coordinate on documents rather than just review. This is a significant improvement. Finally, there has been a lot of turn over in staff. The most significant is a new Chief for the office: Major Bob Lindberg. If you have any questions, I'm sure he would be glad to hear from you. He can be reached at (210) 536-4457.

- Human Systems Integration (MANPRINT) in Laundry Advanced Systems (LADS) – Ms. Dawn Woods, MANPRINT, Natick Laboratory 100 Kansas Street, Natick, MA 01760-5020 (508) 233-5069 dawn.woods@natick.army.mil

DoD 5000 requires that a Human Systems Integration (HSI) program be conducted on all acquisition programs. MANPRINT (Manpower and Personnel Integration), as defined by AR 602-2, is the Army's HSI program. This presentation explores how the MANPRINT program is conducted (by this speaker) within the Natick Soldier Center of the Army Materiel Command. An overview of a typical program was presented. Then an example was provided describing the MANPRINT efforts associated with a Natick Soldier Center item: the Laundry Advanced System

(LADS). The LADS was in development for several years (due to changing requirements). MANPRINT efforts for the LADS included input to the Operational Requirements Document, the Performance Specification, the contract solicitation, the source selection process, detailed design of user interfaces, technical and operational testing, and recommendations to the Milestone Decision process. Due to early involvement and strong support at the project management level, all MANPRINT concerns were evaluated early and either eliminated or reduced to acceptable levels of risk. The LADS is currently being fielded and user satisfaction is uniformly high. This is a success story for MANPRINT. Unfortunately not all systems can have all risks eliminated or reduced to acceptable levels. Another program was used as an example to show that even when we (as MANPRINT practitioners) do all the right things, risks remain. In that situation the emphasis is on quantifying the risks so that decision makers can make informed trade-offs.

- CRUSADER: A US Army MANPRINT Success Story – Mr. Lester Jee, Project Manager-Crusader, ATTN: SFAE-GCSS-CR-E, Picatinny Arsenal, NJ 07806-5000, (973) 724-5208, ljee@pica.army.mil

The Crusader is one of the US Army's top acquisition programs, the purpose of which is to develop the world's most advanced field artillery "system". Since the beginning of the program, MANPRINT has been and remains to be a primary focus of TEAM CRUSADER which is reflected throughout the program from requirements to design.

TEAM CRUSADER has utilized manpower resources from both the government and industry to ensure that all the domains (Manpower, Personnel, Training, Human Factors Engineering, System Safety, Health Hazards, and Soldier Survivability) of MANPRINT are adequately addressed. In addition, state-of-the-art design tools and techniques (particularly modeling and simulation tools) are being employed to evaluate design alternatives before any metal is bent.

The Crusader has been and will continue to be a US Army MANPRINT "Success" story that demonstrates enthusiastic application of Human Factors Engineering principles and consideration – the key to which is the early support of the TEAM CRUSADER management and the financial resources to make it happen.

- Human-Centered Systems Engineering – Debbie Bardine, Naval Surface Warfare Center, Dahlgren Division, 17320 Dahlgren Road, G53, Dahlgren, VA 22448, (540) 653-3735

Typically good Systems Engineering processes have adequately represented the hardware and software, but have often struggled with how to represent the human element as part of the system. Human-Systems Integration (HSI), up to this point, has been reactive, that is forcing the human to fit the constraints of the human element. This is mainly due to bringing HSI issues into the design process at the end, after allocations have been made to hardware and software, thus leaving little room for modifications to meet the needs of the operator. The result is poor system design that negatively impacts operational effectiveness in many ways, including life cycle cost, maintenance, quality of life, and other HSI issues.

In order for the human to be adequately represented in the system design, the user must be represented as an integral part of the system from the very beginning in the form of HSI requirements at the ORD level. These requirements decompose into testable HSI metrics at the system level so that operator performance within the system can be understood, quantified and evaluated. The HSI metrics also offer solid support to the design and facilitate more quantifiable, effective usability testing during HSI assessment of the system. The system must

also have representation from each of the HSI domains in order to fully and adequately represent the human within the system. The Navy has a vast amount of expertise in the various domains of HSI, but these HSI domains still often fail to be integrated within a program. NSWCDD has identified the need to provide a center that would facilitate collaboration and partnerships amongst the various HSI domain expertise that are specific to a given organization in an effort to create a comprehensive HSI community within the Navy. This Human-Centered Systems Engineering (HCSE) will provide full service HSI connectivity that allows the customer easy access to HSI expertise available from the various Navy organizations. In addition, the HCSE will facilitate comprehensive HSI collaboration that will shape the HSI capabilities for future Navy programs. For more information, please contact Dr. Daniel Wallace, Division Chief Scientist, at 540-653-8970, Brad Collie at 540-653-7716 or Debbie Bardine at 540-653-3735.

Human Factors in Extreme Environments

- Shortfalls in In-Flight Crew Station Assessment Methods for Developmental Flight Testing – James G. Casler, PhD, PE, Veridian Engineering, 22309 Exploration Drive, Lexington Park, MD 20653

The purpose of this paper is to assess the available in-flight crew station evaluation methods in the context of developmental flight testing. The primary purposes of developmental flight testing have been to make an initial assessment of the "usability" of the system and to articulate observed deficiencies in terms that facilitate redesign of the system. While developmental flight testing has traditionally emphasized disciplines such as aircraft performance, stability and control, and avionics system performance, relatively little attention has been given to the development of in-flight methods to evaluate the crew stations of these vehicles. The United Sates Naval Test Pilot School (USNTPS) trains test pilots, test flight officers, and flight test engineers to evaluate the suitability the proposed aircraft crew station and system interface designs. The USNTPS curriculum has highlighted apparent inadequacies in the methods available for developmental flight testing of crew stations. Among other areas of concern, in-flight measurement techniques are inadequate to effectively quantify individual and crew workload, situation awareness, cognitive task analysis, and decision making. Including the venerable Cooper-Harper Handling Qualities Rating Scale (and derivatives), the tools and test methods currently in use are either primarily research tools or have limitations with respect to in-flight use. A new set of "tools" is necessary to enable the developmental test pilot to adequately assess the mission suitability of aerospace crew stations. Some criteria for in-flight use to quantitatively assess workload, situation awareness, and decision-making include satisfaction of face, content, and construct validity concerns; as well as utility, efficiency, and economy.

Human Factors in Telemedicine and Biomedical Technologies

1. SubTAG name: Human Factors in Telemedicine and Biomedical Technologies

2 Number of members present: 23

3. Organizations represented: ARL, NSWCCD, HSIAC, NASA Ames, NHRC, NAMRL, USAF DFBL, ONR

4. Agenda covered: Given that the SubTAG chair, LT Deniston, was not available and that LT Carr was serving in capacity of chair on short notice, the agenda was limited to 4 presentations. Hot Issues, membership, leadership, directions, and other issues were tabled until the next meeting of the TAG, in which LT Carr will serve as chair.

5. Abstract of each presentation:

a. Who Presented: HM1 Michael Stiney, NAMRL
b. What was presented: Tactical Medical Coordination System (TacMedCS)—a candidate system for efficient tracking of casualties from the point of injury through transport and definitive care. System components will include an individual computer chip containing patient information (Tier-1), A hand-held unit (Tier-2) will have the capability of interrogating and updating Tier-1 components. It will also store identification, diagnostic, treatment, and location information on board for later download. Finally, it will be capable of transmitting data to a medical regulating control center, or appropriate operational coordination site, and a tactical-medical information display system (Tier-3). The research effort will include initial component assembly, parity tests, and initial operating procedure development (Year 1), functional tests under existing training and development scenarios with operating procedure refinement (Year 2), and operational tests in a deployed situation (Year 3).
c. Bottom line and useful information from the presentation: The current system of medical regulating and evacuation coordination are prone to errors and are poorly suited to the expected battlefield. Degradation of the medical regulating system during battle has and will result in casualties "lost to the system." Additionally, the existing system is inherently inefficient, which wastes valuable time and resources which could otherwise be employed to save life and limb. Paradigmatic shifts in warfighting thus compel us to consider new concepts in medical regulating, particularly at echelons 1 and 2. A flexible, user-friendly information management system for real-time correlation of tactical operations, patients, and echelons 1 through 4 evacuation and treatment resources would significantly improve medical regulating on the battlefield of the future.

a. Who Presented: LT Tamara Trank, NHRC
b. What was presented: The Medical Decision Support System (MDSS)—is an interactive medical web application. It contains advanced data analysis methods that enable the user to expedite preventive health measures. Daily and weekly rates of occurrence are calculated using Population At Risk values associated with the casualty sources (Medical Treatment Facilities, and Military Units). The Population At Risk for each source along with its position is manually entered. The dates associated with the Population At Risk and the position can be set for one day increments.
c. Bottom line and useful information from the presentation: MDSS is an executive information decision support system whose database provides the medical planning staff

and the operational commander with analytical assistance and decision support required in the delivery of operational healthcare.

a. Who Presented: LT Tamara Trank, NHRC
b. What was presented: Navy Voice Interactive Device: Applying Voice Technology to Shipboard Medical Department Administrative Functions—a lightweight, wearable, voice-interactive computer capable of capturing, storing, processing, and forwarding data to a server will be a useful tool to aid in the environmental surveillance and preventive medicine aboard ships.
c. Bottom line and useful information from the presentation: NVID will be an expert system that will focus on environmental surveillance, which can be accomplished quickly and efficiently without compromising the quality of the information. Such an interactive system, with further modifications, could be integrated with other emergent medical information elements, such as the Navy Theater Medical Information Program and other computer-based training and medical encounter systems. These tools will expand Navy medicine's ability to detect disease and injury trends early, allowing quicker intervention to prevent illness and force degradation.

a. Who Presented: Dr. Michael Freckleton, ASOM/TEES/Brooks AFB
b. What was presented: Development of a Portable Forward Diagnosis, Continuous Monitoring, and Medical Information System for Casualties Ashore and Afloat. Commercially available field medical technologies (medical data acquisition devices; e.g., ruggedized portable ultrasound devices) are identified and are then used in the field for evaluation of effectiveness. Given that chosen field medical technologies are usable and useful in the field, we further develop an integrated software backbone, "middleware," to afford device interoperability (i.e., data exchange). As warranted over the course of the award period, we integrate additional data acquisition elements into an Electronic Patient Record and build decision support, medical reference, and telemedicine capabilities.
c. Bottom line and useful information from the presentation: The delivery of state-of-the-art medical care to deployed forces, in theater operations and operations other than war, continues to be a top priority for U.S. Navy and Marine Corps. A key to supporting this priority is the integration and deployment of portable technologies to assist primary health care providers in the diagnosis and treatment of injuries and illnesses at the most far forward level of care possible.

6. Highlights of issues or concerns discussed during the meeting, the results of the discussion and recommendations for action, if any: As noted in Item #4 (above), all such issues were tabled until the next meeting of the TAG.

7. The results of any elections held: As noted in Item #4 (above), all such issues were tabled until the next meeting of the TAG.

8. SubTAG open actions, if any, and the target date for completion: As noted in Item #4 (above), all such issues were tabled until the next meeting of the TAG. The next meeting of the TAG is the date for completion of all SubTAG business.

9. Name and phone number of chairperson: LT Walter Carr, 619/DSN 553-8408/0479/8416, carr@nhrc.navy.mil

Human Factors Standardization

The Human Factors Standardization (HFS) SubTAG met on May 16, 2001 with 18 attendees. Following an introduction of the attendees, the SubTAG proceeded through its agenda.

Status Reports:

a. MIL-STD-1472F, Human Engineering: Mr. Alan Poston announced that copies of the pocket-size Human Engineering Design Data Digest have been sent to the service standardization representatives for distribution.

Dr. Jim Geddie reported that U.S. Army Research Laboratory – Human Research & Engineering Directorate (ARL-HRED) received a call from Mr. Walt Hollis (Deputy Under Secretary of the Army for Operations Research). Mr. Hollis had read the TAG Minutes from the May 2000 meeting (at least the Standardization SubTAG report) and wanted to know HRED's view on the conversion of MIL-STD-1472 to an Interface Standard. Dr. Geddie was not sure how HRED responded to Mr. Hollis, but would look into it. Based on that response, the SubTAG can decide on the most appropriate course of action. The interest expressed by Mr. Hollis is very encouraging. The SubTAG stands ready to assist Mr. Hollis and HRED in whatever way it can.

Mr. Alan Poston raised a question to the group regarding population ranges. More specifically, para 5.6.2.1 of MIL-STD-1472 states in part "Under ordinary situations, the total percentage of men excluded by the design for all physical factors (size, weight, reach, strength, and endurance) shall not be greater than 5 percent, and the total percentage of women excluded by the design for all physical factors (size, weight, reach, strength, and endurance) shall not be greater than 5 percent." What does this really mean? How would a contractor reasonably interpret this? Does this paragraph say what we want it to say?

There was an enthusiastic discussion on the topic. It was noted that part of the problem stems from Mission Need Statements and Requirements Documents which specify accommodation of 90% of the population (5^{th} percentile female through 95^{th} percentile male). It was also noted that percentiles relate to a single dimension while percentage exclusion can come from several varying parameters. The point was made that there are numerous data bases and models that describe different populations and there may need to be a better definition of which data bases should be used. The bottom line is that the group could not reach consensus on what the specific paragraph meant, so there is some ambiguity that should be removed. It was noted that this is only a single statement out of a larger section and that correcting one statement may leave other, equally ambiguous statements in the document. Mr. Poston agreed to send all of paragraph 5.6 (Physical Accommodation) to the SubTAG for review and comment. Based upon the responses, a course of action will be decided.

Mr. Dick Armstrong suggested that MIL-STD-1472 as a whole should be reviewed. He noted that the "F" version is less valuable than previous versions due to its designation as a Design Criteria standard. It was decided to defer any action on this topic until we knew the outcome of Mr. Hollis' inquiries.

b. MIL-H-46855, Human Engineering Requirements for Systems, Equipment, and Facilities: Mr. Lou Adams, Chair of the G-45 (Human Factors) Committee of the Government Electronics and Information Technology Association (GEIA), indicated that the G-45 has begun

work on preparation of an industries “Best Practices” document based on the old MIL-H-46855. In essence, the document would convert MIL-H-46855B into a GEIA Bulletin. The end result would be an industry document (non-government) that would be available for use on government contracts. An initial draft of this document has been sent to the SubTAG Chair, who in turn will send it to the SubTAG membership for their review and comment.

c. MIL-STD-1787, Aircraft Display Symbology: Dr. Jen Narkevicius reported that the “C” revision, prepared by the Flight Symbology Working Group, was promulagted on January 5, 2001. Jen noted that the “D” version, which would include rotary wing symbology, has begun initial coordination with the Army.

d. MIL-STD-882D, Standard Practice for System Safety: Dr. Mark Brauer reported that the System Safety/Health Hazard SubTAG sent a formal letter on May 7, 2001 to the Air Force proponent requesting a change to the document to include a third dimension to the risk matrix which would address human exposure.

e. HFES/ISO/TC 159: Mr. Richard Armstrong had nothing new on the HFES standardization restructuring to report. He indicated that HFES is still reviewing its position regarding liaisons.

f. Joint Service Specification Guide – 2010: Mr. Dave Britton reported that recent revisions have been made to JSSG-2000 (Air Systems) and JSSG-2001 (Air Vehicle). Based on these changes, Dave indicated that JSSG-2010 would require revisions.

g. NASA Man-Systems Integration Standards (NASA-STD-3000): Mr. Clete Booher indicated that they are still working on a strategy for keeping the MSIS on the web. The plan is to have a MSIS web site, utilizing a MS Word version of the document, on-line by the end of the calendar year. Clete indicated that a final draft of Volume VII, MSIS for Space Earth Analog Facilities, is still being reviewed. This volume is intended to be applicable to all ground-based test facilities which have been created to simulate on-orbit habitable environments. The first specific application of this volume was to be the Bio-Plex facility at the Johnson Space Center, but this program has now been “moth-balled.” Clete added that the development of a Human Systems Requirements Database, which is applicable to multi-year exploration class missions, is well underway. Data entry began with incorporation of MSIS text and graphics. Many sources will be tapped for input, including military and industry association standards and specifications, and attendees of the TAG.

h. Data Item Descriptions: Mr. Alan Poston reported that there currently are five human factors-related DIDs within the FAA. These are the Human Engineering Program Plan, Human Engineering Design Approach Document – Operator, Human Engineering Design Approach Document – Maintainer, Critical Task Analysis Report, and Human Engineering Simulation Concept. The Naval Air Systems Command (NAVAIR) also has generated five DIDs that could be used for their acquisition purposes. The five NAVAIR DIDs are the Simulation Concept, Human Engineering Task Report, Human Engineering Design Approach Document – Operator, Human Engineering Design Approach Document – Maintainer, and Human Engineering Systems Analysis Report. Mr. Poston also reported that the G-45 Committee (Human Factors) of the GEIA decided not to pursue DIDs for the Human Engineering Test Plan and Human Engineering Test Report. Mr. Poston will send electronic versions of the five FAA and five NAVAIR DIDs to the SubTAG membership.

At the last meeting, several questions were raised concerning DIDs. These involved the procedure, if any, for adopting non-government DIDs, and to determine if the Department of Defense Index of Specifications and Standards (DODISS) can make reference to another source for DIDs that have been canceled. Mr. Poston reported that DoD 4120.24M, DSP Policies and Procedures, (March 2000) is the guiding source reference. DoD 4120.24M states that only DIDs that are DoD approved and listed in the Acquisition Streamlining and Standardization Information System (ASSIST) are valid for use in DoD contracts. DoD 4120.24M notes that DODISS is a hard copy subset of ASSIST. This procedure raised a new question. Acquisition reform has placed great emphasis on the use of non-government standards, yet any data items that may be associated with these non-government standards cannot be used (as they are not DoD approved). This seems to be a large disconnect between using non-government standards and the use of DIDs. Mr. Poston agreed to pursue this further.

Other Business:

AD-1410, Design for Maintainability: A question was raised regarding the status of AD-1410. There is a great importance on human factors in maintainability and AD-1410, though a Naval Air Systems Command (NAVAIR) document, is an excellent source. To prevent this valuable information from becoming lost, it was suggested that AD-1410 be converted to a military handbook. Mr. Poston took the action to start the process. It was suggested that MIL-HDBK-472, Maintainability Prediction, be reviewed for any pertinent information.

Human Factors Test and Evaluation

There were twenty-six attendees at this session including representatives from the Army, Air Force, Navy, FAA, NOAA, academia, technical societies and industry.

There were four excellent presentations:

The first presentation was on the effects of visual cueing: an examination of search performance results in realistic terrain settings. Cadet Reid Finn and Cadet Mark Riegel (from the U.S. Military Academy at Westpoint) did an excellent job presenting this well designed experiment. The paper is authored by Cadet David C. Cibik, Cadet Reid Finn, Cadet H Lee Geissler, and Cadet Mark Riegel.

> Cueing is an important factor that helps people notice phenomenon around them. Visual cueing is a useful cue because humans rely on seeing the environment around them. Military personnel rely on their sense of sight to survive in any situation, whether it is training or battle. One concern was whether or not visual cueing helps soldiers find enemy targets faster in a military setting. Participants were used to test the effects of visual cueing of enemy targets. A dependent variable of detection time was tested, with the cued or un-cued targets being the independent variable. The participants found targets faster when they were cued versus when they were un-cued. Additionally, several targets were never found at all when a visual cue was absent.

The second presentation concerned the effects of white or green phosphors in night observation devices (NODs) on dark readaptation. LTC Shattuck (U.S. Military Academy at Westpoint) presented this topic because the authors (Cadet Gregory Lee and Cadet Jennifer Hughes) were unable to attend. This research could have direct impact on the design of NODs.

> Previous studies found that night vision goggles (NVGs) with white phosphor (P45W) were superior to green phosphor (P43) NVGs with respect to depth perception and visual acuity. The present study examined the ability of participants to recover their dark adaptation after exposure to the two types of phosphor. The results indicate that participants readapted to the dark significantly faster with the white phosphor. In addition, there was an interaction between the size of the visual stimuli and the type of phosphor. The U.S. Army should conduct further studies comparing NVG performance with white vs. green phosphor, which may lead to a recommendation that future NVGs be procured with white phosphor displays.

The third presentation, a human-oriented method for industrial process design, addressed the need for usable “mock-ups” in a CAD environment. Dr. Ken LaSala gave a wonderful example demonstrating the use of inexpensive off-the-shelf software to facilitate good human factors design.

> One of the “hot issues” in human factors test and evaluation is the evaluation of designs in a computer environment. The use of physical mockups is being diminished by computer-aided-design (CAD). One of the inhibitors to using computerized human factors 3-D models is the expense, which can range in the tens of thousands of dollars. This presentation describes low-end and high-end approaches to the 3-D human factors–oriented design of industrial processes. The presentation includes a discussion

of the advantages and disadvantages of each approach and concludes that the low-end approach can accomplish much when time and funds are constrained significantly.

The fourth presentation discussed statistical analysis of subjective data for operational test. LTC Darrell Criswell's presentation initiated much discussion relating to the use, and utility of subjective data.

> Operational test and evaluation is heavily dependent on subjective data collection and analysis, since many OT&E test issues are inherently subjective, focusing on value to the warfighter and usability. Normal experimental methodologies are impractical due to experimental limitations and sample sizes are very small and sampling techniques are limited by operational limitations. The operational tester is often faced with a non-random sample, potentially biased population, and an extremely small sample size due to limited test articles and small budgets. Questionnaires are commonly used to collect subjective data. We have found the most appropriate statistical presentation of questionnaire data is a descriptive statistical analysis using median ratings of descriptors and a histograms of descriptor ratings. Pass/Fail criteria for test measures evaluated by subjective data are not normally used as they cannot be operationally justified, i.e.; it is not valid to say that an 80% of test subjects must rate a question as "largely acceptable". Also, the actual response to a descriptor set is only a part of the subjective data collected. Much of the valuable data from questionnaires is not taken from the descriptor selected by the test subject but rather problem areas identified and user comments and thus numerical analysis of questionnaire data tends to limit the information used in evaluation of subjective data. Some people in the DoD are advocating the use of "bootstrapping" (resampling statistical methodology) to questionnaire data. We randomly examined 72 referreed journal articles utilizing questionnaire data and none employed the "bootstrap". Bootstrapping has the potential for giving stronger than appropriate statistical confidence in the data and a strong justification for its use is not evident.

SubTAG business followed these presentations:

1. The new T&E charter was voted on and approved by the T&E subTAG (changes were editorial in nature, new charter is provided below). The new charter was subsequently approved at the Operating Board meeting.
2. Discussion of the Hot Issues was limited, as the Hot issues had already been distributed and commented on before the meeting.
3. Lastly, the new T&E chair, Ms. Lisa Achille was introduced. Ms. Achille will be assuming the responsibilities of Chair T&E for TAG 47 (Oct 2001).

CHARTER
TEST AND EVALUATION SUBGROUP
OF THE
DoD HUMAN FACTORS ENGINEERING
TECHNICAL ADVISORY GROUP

Objectives:

The objectives of the T&E SubGroup are to provide technical HFE assistance in the execution of T&E and to promote coordinated efforts within the DoD and among other government agencies of HFE T&E techniques. This Subgroup is intended to provide a forum or technical information exchange and to serve as a working level coordination group.

Procedures:

The objectives will be accomplished by means of technical information exchanges, discussions, and workshops which will include, but not necessarily be limited to, the following general topic areas:

a. System Performance including:

(1) Identification, development, validation and standardization of HFE techniques or procedures used during T&E.

(2) Identification, development and validation of effective metrics for assessment of system performance during all phases of T&E.

. (3) Improvement of HFE specifications, standards, and data item descriptions used during design and T&E.

(4) Identification of HFE T&E requirements.

b. Information; specifically:

(1) Improving inter-service utilization of information collected during T&E.

(2) Assisting T&E activities in the training of their HFE personnel.

(3) Development of HFE T&E data base and technology demonstrations. Specifically, "Lessons Learned".

c. Management:

(1) Examining how HFE related management decisions are made.

(2) Improving management's awareness and use of the contribution of HFE T&E.

(3) Provide advice on Tri-Service implications of DoD Directives, Regulations and other management documents as they impact on HFE T&E.

(4) Training human factors T&E personnel.

Composition:

For the routine operation of the SubGroup, only military organizations in each service whose activities are directly or primarily involved in test and/or evaluation of equipment and software will be invited to participate in all meetings. In addition, other government organizations which may have specific HFE T&E interests will be invited to meetings. On occasion, contractors or universities who have developed techniques, methodologies or instrumentation relevant to HFE T&E may be invited to make presentations at SubGroup meetings. Technical society participation is invited.

Concept of Operation:

The HFE T&E SubGroup will meet not less than twice a year. Participants are encouraged to communicate informally among themselves, with a copy of their informal correspondence being sent to the SubGroup Chair for information purposes. At SubGroup meetings participants may be requested to, or volunteer to, prepare presentations on topics of interest to the SubGroup. In addition is an item of interest to the group arises between meetings, the Chair may request a participant, or group of participants, to make a presentation. Ad hoc committees will be established as necessary.

The criterion to be employed regarding topics to be addressed at the HFE T&E meeting is: "Will this information allow me to improve my HFE T&E?"

SubGroup Chairship:

In order to encourage tri-service participation, SubGroup Chairship will periodically rotate among the three services, normally to the service which least recently chaired. There will also be two active co-chairs: a chair-select who is elected two meetings prior to his or her succession to the Chairship; and a past Chair. the Chair-select will assist the Chair in developing the agenda for meetings and in making whatever arrangements are necessary for the meeting. The past Chair will serve as an advisor, and will assist the Chair and Chair-select with whatever matters they collectively deem appropriate. Considerable informal communication is expected among these Chairs. The SubGroup Chair will keep the TAG Chair apprised of SubGroup coordination and activities.

Human Modeling and Simulation

- Information-Driven Decision Modeling - Sue Archer, Micro Analysis & Design

In 1998, the US Army initiated a Science and Technology Objective (STO) entitled "Cognitive Engineering of the Digital Battlefield." The goal of this STO is to better understand the cognitive processes associated with battle command. One of the major thrusts of the STO is to use models, simulations and tools to assist in predicting human performance during battle command.

This presentation will describe a particular modeling effort that was performed through this STO. In this effort, a unique approach to modeling human decision-making was implemented, in which the quality of the decision is predicted as a result of “who knew what” and “when they knew it.” These models can be used to predict the efficiency and effectiveness of the command and control (C2) organization that results from different task allocation strategies and different equipment options. In addition, the models can be used to expand on the investigations to determine what are the best measures for evaluating new organization-doctrinal concepts. The models will be described, and a case study to examine their predictability will be discussed.

- Increasing Realism in Computer-Generated Forces: A Computational Model of Recognition-Primed Decision-Making - Patricia McDermott, Klein Associates, Walter Warwick, Micro Analysis & Design, Robert Hutton, Klein Associates, Stacey McIlwaine, Micro Analysis & Design

Those working with computer-generated forces have advocated for more realistic decision making in computer models. This project has explored leveraging a conceptual model of naturalistic decision making, namely the Recognition-Primed Decision Making (RPD) model, to make computational models more robust and realistic. The RPD approach has several benefits over traditional decision making approaches: decisions are made using experience instead of rules, resources are spent sizing up situations instead of comparing options, and it is a satisfying model. The goal is not only to create a model that more closely mirrors human decision-making behavior but one that also mimics the process. In transitioning RPD from a conceptual model to a computational model we have gained insight into the RPD framework in general. The talk will discuss these lessons learned, the current state of the model, challenges associated with applying the model in a driving test bed domain, and issues that are yet to be resolved.

Sustained/Continuous Operations

1. SubTAG name: **Sustained Operations**
2. Number of members present: 19 (9 "members")
3. Organizations represented:
    - Air Force Research Laboratory (AFRL); Army Research Lab (ARL)-Ft. Hood; PMI, Inc.; Hq FAA; Sandia National Lab; FAA Civil Aeromedical Institute (CAMI); Army Evaluation Center (USAEC); DTIC Human Systems IAC (HSIAC); Walter Reed Army Institute of Research (WRAIR); Naval Submarine Medical Research Laboratory (NSMRL); AF NAIC/TATV; Naval Health Research Center (NHRC); Lockheed-Martin Mission Systems
4. Agenda covered:

- Five presentations
- No new business was proposed

5. Presentations (abstracts attached):
    - *Summary of Human Capabilities and Limitations during Urban Combat Operations.* Kristen Jadelis, M.S., Consultant (Booz Allen & Hamilton); Human Systems Information and Analysis Center (HSIAC), Defense Technical Information Center (DTIC).
    - *New Applications and Issues in Wrist-Actigraph Monitoring.* Daniel P. Redmond, M.D., Colonel, MC, U.S. Army; Chief, Department of Biomedical Assessment, Division of Neuropsychiatry, Walter Reed Army Institute of Research.
    - *Shiftwork-Related Changes in Subjective Fatigue and Mood for a Sample of Air Traffic Control Specialists.* Tom Nesthus et al., FAA Civil Aeromedical Institute, Oklahoma City OK.
    - *A Laboratory Comparison of Clockwise and Counter-Clockwise Rapidly Rotating Shift Schedules: Effects on Performance, Sleep, and Subjective Ratings.* Crystal Cruz et al., Federal Aviation Administration, Civil Aeromedical Institute, Oklahoma City OK.
    - *Detecting Unwanted Effects of Operational Drugs: Modafinil and the Vestibular System.* James C. Miller, Ph.D., CPE; Warfighter Fatigue Countermeasures R&D Group, Air Force Research Laboratory, Brooks AFB TX.
6. Highlights of discussions, recommendations:

- Encouraged recruitment of new, younger members

7. Election results: N/A
8. Open actions (target dates):

- Hot Issues revision (15 January and 15 February 2001)—This was completed on time
- Proposed SusOps workshop at Nov 2001 meeting (Nov 2001)—on hold

9. Co-Chairs and phones:
    - Dr. James C. (Jay) Miller, (210) 536-6371 (DSN 240)
    - Dr. Thomas E. Nesthus, (405) 954-6297

- Summary of Human Capabilities and Limitations during Urban Combat Operations - Kristen Jadelis, M.S., Consultant (Booz Allen & Hamilton); Human Systems Information and Analysis Center (HSIAC), Defense Technical Information Center (DTIC)

The objective of this task is to reveal what an urban warrior can be expected to accomplish given the extreme demands of urban combat. The following attempts to identify the stressors that an urban warrior is confronted with and how each affects his/her performance of key mission tasks. A keyword search strategy was developed to find literature containing

studies related to urban combat stress factors and performance limits. Through a review of military combat reports, MOUT (Military Operations on Urban Terrain) web sites, medical literature and personal accounts of retired military officers, performance criteria and associated challenges were identified.

The primary difficulties that military troops encounter during combat are stress and fatigue. There are many different causes of each and their definitions should be clarified for future use. Combat stress is used as a generic term, which includes all possible reactions to the combat environment. Combat fatigue is defined as a reaction to combat stress in which the stresses of combat and other personal stressors combine to overwhelm an individual's psychological defenses and render him/her unable to perform duties. There are a number of elements, from the environment or within the human body, that influences combat stress and/or fatigue which can ultimately inhibit a warrior's capabilities to fight.

Environmental stressors include extreme temperatures, humidity, altitude, noise in the immediate surroundings that is either continuous or overbearing, unfamiliar terrain or darkness/light. In extreme heat, dehydration is the highest risk factor to performance failure. Even highly trained athletes with appropriate hydration are not able to maintain thermal balance at temperatures greater than 95ºF (35ºC) in relative humidity of 60% or more. Dehydration inhibits critical brain functioning which is needed to carry out military operations and simply stay mobile. Humidity can stimulate dehydration even at cooler temperatures. One study has recommended that no outdoor activity take place when temperatures reach 82ºF with 70% or more humidity.

Brain functioning may also be affected in extremely cold temperatures, but at gradual degrees, as body temperature drops. The first sign of decline is when the body's temperature falls below 96ºF and manual dexterity and fine motor control are impaired. When core body temperature falls to 95ºF humans experience violent shivering and disorientation, followed by amnesia and garbled speech at 93.2ºF. Serious life threatening symptoms ensue when the body's temperature is less than 90ºF, such as loss of consciousness and muscular rigidity.

When loud (>85dB) and continuous noise is present, concentration can be hindered which can negatively affect decision-making processes or aiming a weapon at a target. There is risk of hearing loss when noise is at high levels. This risk increases if someone is exposed to a blast [transient?] above 85dB and the risk becomes more significant at [transients?] greater than 90dB. Peak sound pressure levels for some weapons, such as assault rifles (caliber 7.62) are 154dB at 4m from the muzzle. Large caliber weapons can reach up to 140dB from distances as great as 200m from the source.

There are generally no adverse effects on physical performance due to daylight exposure. The exception lies in environments that receive very little darkness or when troops are forced to sleep during daylight hours. In such instances, they experience difficulty falling asleep. It is also said that the ability to see explosions in the distance is made difficult in daylight. An extreme case of adverse light effects is exposure to laser light. This, however, had no effect on performance measures except to cause the eyes to make adjustments to the light.

As with daylight, darkness has no effect on performance measures. Physical movement and capabilities are not affected by darkness especially with the use of night vision devices. Without such technology, navigation and detection would be extremely difficult, if not

impossible. In recent urban operations, all combatants have used night vision devices for navigation and as aiming devices for weapons. This technology is not perfected and still has room for improvement as most night vision goggles have poor peripheral vision capabilities.

Physical performance stressors include carrying heavy loads for extended periods of time, sleep loss, high intensity and durations of operations and insufficient nutrition, all of which can increase the likelihood of fatigue effects and the inability to successfully perform mission critical operations. Load carrying is essential to any type of warrior, mainly because each has to carry at the minimum a weapon and their related battle gear. Additionally, packs may be required that mount on the back or shoulders to carry additional gear for survival. It has been found that with loads equal to 10-40% of body weight, a person compensates walking speed or climbing rate to carry the heavy load in order to preserve energy costs. The primary weight-bearing joint that will be affected by fatigue is the knee. The knee extensors may fatigue prior to overall metabolic fatigue during load carrying and typically a human knee's weakest angle is 60º of flexion.

Aerobic capacity will govern an individual's endurance while traversing long distances or exercising for extended amounts of time. Continuous repetition of any motion will lead to eventual fatigue of the muscle group being used. Conversely, a muscle group will be quickly fatigued if the activity is at a high intensity over a short period of time due to limited anaerobic capacity. Muscular fatigue will not only affect mobility but the accuracy to shoot a manually operated weapon.

Fatigue effects are most commonly induced by sleep loss. In a combat situation, frequently troops will be awake for 48 to 60 hours at a time. Sleep loss does not directly affect the ability to do physical work but quality or effectiveness of performance may suffer due to a person's irritability, depressed mood or lack of motivation. The full debilitating effects of the lack of sleep occur between the 36^{th} and 48^{th} hour of constant wakefulness [not accurate]. As a result, short-term memory capacity decreases and cognitively demanding tasks show performance decrements. Decreased auditory and visual vigilance and the speed-accuracy tradeoff typify declines in performance. A fatigued subject will sacrifice speed for accuracy to maintain control of the task. With continued lack of sleep, eventually both accuracy and reaction time will decrease. However, highly over-learned, such as routine manual, tasks may not be as affected by sleep loss.

When physical fatigue sets in, it is aerobic capacity that limits the rate of energy expended to continually perform. As work duration increases, relative energy expenditures decrease as a function of VO_2 max. Carrying heavy loads or working in thermally stressed environments will tax energy levels of the untrained more quickly than trained subjects. Trained subjects have elevated aerobic capacities that allow them to work longer at a given rate. Increased load on work levels will lead to physical fatigue more quickly.

The studies on rations and military nutrition suggest that high carbohydrate and protein diets comprise the mainstay of sustenance. There have been many reports of weight loss in military personnel, who have been in field exercises for prolonged amounts of time, because their diets were either insufficient to maintain caloric balance or were unpalatable causing the soldier to decline eating. High caloric content is suggested for both cold and hot environments due to the increases in metabolic activity to regulate thermal balance. For warmer environments, fluid intake is vital and may be also be a method to intake additional calories in the form of a carbohydrate or electrolyte-rich drink. Another reason for high

calorie rations, besides the great demands of physical exertion, is that meals may not always be eaten at regular intervals. In high-risk or intense situations, stopping to eat may not be an option, yet it is critical to have the energy to endure such elevated stress level situations.

Military operations in urban terrain (MOUT) require soldiers and marines to move, shoot, communicate and make decisions. Some examples of these activities are to react to indirect fire, perform movement techniques, and transport a casualty. Subsequently, the physical requirements of these tasks may require a warrior to run long-distances, sprint, crawl, carry loads on their backs or in their arms, lift a person through a window, climb stairs, carry heavy weight while walking or running or climbing, carry a heavy weight for an extended period of time, and lift a heavy weight above the head. To execute these movements efficiently and successfully requires proper training and assistive gear, if available, to lessen the burden on the human body.

In summary, the biggest challenges of MOUT are a lack of sleep from round-the-clock wakefulness, repetition of certain activities such as search and clear exercises in city buildings, unfamiliarity with the surroundings, and a loss of communications that occurs with line-of-sight dependent communications systems. These challenges are a combination of adverse environmental conditions, continuous operations demands and human physical limits that can all determine the outcome of a mission. To ensure the success of task performance, it is critical to avoid the decline of human performance by preventing as best as possible fatigue, slower response times, lack of concentration, and physical or mental failure.

Summary:
1. When these factors are in excess or in combination with each other the resultant may be combat stress or combat fatigue.
2. Combat stress is used as a generic term, which includes all possible reactions to the combat environment.
3. Combat fatigue is defined as a reaction to combat stress in which the stresses of combat and other personal stressors combine to overwhelm an individual's psychological defenses and render him/her unable to perform duties.
4. Purpose: to identify human physiological and biomechanical limits in terms of the conditions that may be confronted in an urban combat environment
5. Required tasks of MOUT: move, shoot, communicate, decide; examples react to indirect fire, perform movement techniques, transport casualty
6. Physical requirements of tasks: run long-distances, sprint, crawl, carry loads on backs/in arms, lift person through window, climb stairs, carry heavy weight while moving, carry heavy weight for extended period of time, lift heavy weight above head
7. Challenges of MOUT: lack of sleep from round the clock wakefulness, repetition of activity such as search and clear exercises in city buildings (slow, repetitive), unfamiliarity with surroundings, loss of communications that may occur with line-of-sight dependent communications systems
8. Effects of challenges of MOUT: perceptions of fatigue, slower response times, difficulty concentrating, physical and mental failure

- Shiftwork-Related Changes In Subjective Fatigue And Mood For A Sample Of Air Traffic Control Specialists - T.E. Nesthus*, L.Dobbins, J.T. Becker, and P. Della Rocco*

FAA Civil Aeromedical Institute, Oklahoma City, OK

Purpose. In a continued effort to investigate the effects of shiftwork on Air Traffic Control Specialists (ATCSs), Congress appropriated funding for a field study directly related to a comprehensive ATCS survey. The field study was designed to evaluate ATCSs' sleep, activity, subjective fatigue, and mood, as well as computer-based test performance during their routine shift schedules. This presentation discusses the subjective fatigue and mood reports from personal logbooks, as related to specific shift schedule features. **Methods.** Eighty informed ATCS volunteers from 2 air traffic facilities participated. Testing began at each facility on the first workday of the volunteer's shift. Pre- and late-shift computer-based tests were performed during the volunteer's first 10 working days. In addition, 24-hour (wrist) activity was collected, even during days off, along with logbook entries. **Results.** Data collection from the first facility was completed in June while data collection will be completed in November at the second site. An agreement with the ATCS union precluded analysis from the first site until the second site data collection was complete. **Discussion.** It is anticipated that changes in reported fatigue and mood would follow patterns associated with specific shift schedule features and with increased fatigue occurring later in each workweek of the shift schedule. Coordinating the findings from this field study with those from both the national ATCS survey and an associated CAMI laboratory study will provide a unique body of data regarding ATCS shiftwork, performance, and fatigue.

- A Laboratory Comparison of Clockwise and Counter-Clockwise Rapidly Rotating Shift Schedules: Effects on Performance, Sleep, and Subjective Ratings - Cruz, C.[A], Detwiler, C.[A], Nesthus, T.[A], and Della Rocco, P[B]. Federal Aviation Administration, [A]Civil Aeromedical Institute, Oklahoma City, Oklahoma, [B]William J. Hughes Technical Center, Atlantic City, New Jersey, USA

Introduction: Many air traffic control specialists (ATCSs) in the United States work relatively unique counter-clockwise, rapidly rotating shift schedules. Researchers recommend, however, that if rotating schedules are to be used, they should rotate in a clockwise, rather than a counter-clockwise direction. Unfortunately, few studies have examined clockwise and counter-clockwise rapidly rotating shifts. The purpose of this study was to examine the effects of both types of schedules on performance, sleep, and subjective ratings of sleepiness. Method: Participants (n=28) worked day shifts for the first week of the study (0800-1600) followed by two weeks of either a clockwise (n=14) or counter-clockwise (n=14) shiftwork schedule. The clockwise schedule rotated from two early morning shifts (0600-1400) to two evening shifts (1400-2200) to one midnight shift (2200-0600). The counter-clockwise schedule rotated from two evening shifts to two early morning shifts to one midnight shift. Participants were tested on the Bakan vigilance test and the Multiple Task Performance Battery. In addition, they recorded sleep data and subjective ratings in daily logbooks and wore wrist activity sensors to provide an objective source of sleep/wake data. Results: Performance on the vigilance task was dependent upon shift and rotation condition, as evidenced by a significant shift by rotation condition interaction, $F(4,23)=4.8$, $p<.05$. Scores (i.e., number of correct responses) on the evening shifts were significantly better for the counter-clockwise rotation (M=113.5) than for the clockwise rotation (M=90.2) but fell more sharply at the end of the midnight shift, with a decline of 14.6% compared with 9.1%. Both groups reported less sleep before the early morning shifts ($M_{clockwise}$=5.1h; $M_{counter-clockwise}$=5.5h) than before the evening shifts ($M_{clockwise}$=7.5h; $M_{counter-clockwise}$=7.9h). The clockwise rotation group reported an average of 7.2h of sleep during the night before the midnight shifts and a nap during the day of 0.9h. In addition to a nighttime sleep of 6.0h, the counter-clockwise rotation group also took a nap before the midnight shifts of 2.2h.

Discussion: These data provide evidence that rapidly rotating clockwise rotations may not result in better outcomes than counter-clockwise rotations. The results of the other variables from the study, however, are needed before making a final conclusion about these kinds of shiftwork schedules.

- Detecting Unwanted Effects of Operational Drugs: Modafinil and the Vestibular System - Dr. James C. Miller, Warfighter Fatigue Countermeasures R&D Program, Air Force Research Laboratory, Brooks AFB, TX (jcmiller@brooks.af.mil)

The safe-to-fly problem. In a safe-to-fly study, our secondary objective is to gain confidence in the efficacy of an operational drug. Our primary objective is to develop an acceptable degree of confidence in the lack of undesirable effects that may be caused by an operational drug. Our general problem then, is to try to prove the negative. There is no safe-to-fly experimental design: we may simply design investigations that emphasize power in rejecting the null hypothesis. *Modafinil.* We examined a eugregoric, under development for over ten years and then marketed in France in 1993. These drugs mimic the effects of amphetamines by producing high quality wakefulness and they lack the typical negative side effects associated with amphetamines. The FDA approved modafinil in 1998 for the management of narcolepsy. Modafinil is thought to hold promise as an effective stimulant for military personnel assigned to sustained operations. *The modafinil problem.* Army helicopter pilots reported vestibular effects, most frequently dizziness, during and after their tasks in a motion based simulator (Caldwell et al., 2000). These effects may have been due to modafinil dosage (400 mg), motion of the simulator coupled with computer-based scenery models (cf., Kennedy et al.), or sleep deprivation (Collins, 1988). We sought to assess the effects, or lack of effects, of modafinil on dynamic and static vestibular function. *Measures.* Visual: saccadic eye movements. Vestibular: the vestibulo-ocular reflex (VOR). Visual-vestibular: smooth pursuit eye movements and the optokinetic response (OKN). Visual-vestibular-somatic: postural stability. *Procedure.* Three groups of six subjects tested on three consecutive Friday nights, 1800 to 0600. Single dose (modafinil 200 mg or 400 mg, or placebo) at approximately 2330 hours; same order within a group, but counterbalanced across groups. Trial 1: vestibular, cognitive and other testing 1800-2300 (evening; pre-dose). Trial 2: vestibular, cognitive and other testing 0230-0530 (pre-dawn trough; post-dose). *Results.* Measures with no Dose- and/or fatigue-related effect detected, and the adjusted power of the test, were visual saccade latency (99%), visual-vestibular fall-off-frequency of OKN (78%), visual-vestibular smooth pursuit symmetry (91.5%), and visual-vestibular-somatic postural stability (99%). Excepting the OKN measure, we are comfortable with the acceptance of the null hypothesis for the other three measures cited. No apparent problems here. Detected effects included a depressant effect of fatigue on visual saccade velocity and on vestibular VOR gain; neither effect was ameliorated by modafinil. We also detected a depressant effect of fatigue on visual-vestibular smooth visual pursuit gain and an amplification effect of fatigue on the smooth pursuit saccadic component; both of these effects were ameliorated by modafinil. Thus, modafinil affected higher CNS locations than the cranial nerve nuclei and the reticular system. The general location and neurochemistry are TBD.

System Safety/Health Hazards/Survivability

A Comparison of Woodland, Urban, and Student Developed Camouflage. Cadets are designing a new urban camouflage based on higher spatial frequencies, geometric shapes and different urban colors. They will compare detection latencies of the current Woodland camouflage, the current civilian marketed urban camouflage, and the "coat of many colors" that they are manufacturing. They are receiving assistance from the **Cadet Uniform Factory** in the manufacturing of their camouflage uniform.

The Effect of Water Availability and Water Consumption. Cadets are exploring the differences in water consumption for three different experimental conditions. Participants will be on a treadmill in the Arvin Gym carrying a load similar to the current Land Warrior weight so that the cadet researchers can compare the Camelback watering system, to open watering systems, to the current 2-quart LBE configuration. This study is being done with the help of DR Todd Crowder in DPE. Results should show not only the differences in total water consumption but also duration and frequency of water intake.

The Integration of Environment, Safety and Occupational Health into Army Acquisition. The presenter will be Mr. George Murnyak, a consultant with the U.S. Army Center for Health Promotion and Preventive Medicine, Health Hazard Assessment Program, Aberdeen Proving Ground, MD. Mr. Murnyak is involved in the leading edge of interfacing these areas of expertise.

U.S. Army Medical Department Center & School
ATTN: MCCS-FCC-P (Mr. Gibson)
1400 E. Grayson St, Suite 219, Room 226H
Fort Sam Houston, TX 78234-5052
(210) 221-1622 DSN 471-1622
FAX (210) 221-0121
email: ben.gibson@cen.amedd.army.mil

Technical Society/Industry

The Technical Society/Industry (TS/I) SubTAG met twice during TAG #46 on 15 and 17 May 2001. Fifteen participants attended the meetings, representing eight technical societies/industry groups. Steve Merriman (**scmerriman@home.com**) chaired the meetings. Attendees first introduced themselves and then reviewed and updated the TS/I membership lists.

Old Business:
DoD TAG Hot Issues: The TAG's Hot Issues document is being updated to version III from version II. It should be published in the Summer of 2001.

New Business:
HFE Standards, Specs and DIDs - Adoption by Industry. Lou Adams indicated that the EIA would not adopt the Human Engineering Test Plan and Human Engineering Test Report DIDs.

Non-Government Standards Update. Alan Poston indicated that the Index of Non-government standards (NGS) posted on the TAG's website is in need of updating. Teresa Alley indicated that she would take responsibility for having the existing entries validated. This will leave checking for new entries to either industry on government.

2001 GEIA Emerging Technology Conference: Human Machine Interface. Steve Merriman briefly described the white papers to be authored in support of the Government Electronics and Information Technology Association (GEIA) conference this coming Fall in the Washington, D.C. area. Steve is looking for inputs in areas of Human Centered Computing, Bio-Metrics for Security, Augmented Reality and Voice Interaction.

Technical Society/Industry Charter: Steve Merriman presented a revised TS/I charter which updates reference to the TAG (used to be TG). The TS/I members in attendance agreed with suggested changes. The revised charter was presented to the Operating Board for approval.

Technical Society/Industry Updates:

Society for Computer Simulation (Susan Archer): In April, Ms. Archer chaired the 2nd annual Human Performance Modeling Track at the Advanced Simulation Technologies Conference, sponsored by SCS. The sessions were well attended, and SCS has now committed to include a permanent human performance-modeling track at the annual conference. Additionally, Susan submits an annual committee report to SCS that summarizes the DoD HFE TAG meetings for the year and the benefits to SCS of representation (notably, to expand their exposure to human factors and human performance modeling). Susan can be reached at susan.archer@maad.com.

IEEE Reliability Society (Dr. Kenneth P. LaSala): Ken reported that a committee web site is under development: http://ewh.ieee.org/soc/rs (go to technical operations). An IEEE human performance reliability standard is under development; this will eventually be an IEC standard. A Human Performance Reliability Video tutorial is now complete. It is titled: Designing Systems and Processes for Reliable Human Performance. It is available from IEEE (coming soon also as a CD). A Human Performance Reliability tutorial, which is given annually at the "Annual Reliability & Maintainability Symposium", can be given per special request. Readers are invited to join the committee. Please contact Dr. LaSala, (301) 713-3352, x118.

AeroSpace Medical Association (AsMA)/Aerospace Human Factors Association (Dr. Tom Nesthus): The annual AsMA meeting was held in Reno, NV on May 7-10, 2001. The Aerospace Human Factors Association Henry Taylor Founder's Award was presented to Dave Schroeder for his luncheon presentation – on the history of air traffic control. Charles Billings was selected for the 2002 award presentation. The Stanley Roscoe award for a Human Factors dissertation was presented to Kristen Ligget, Dayton University. There were two Aerospace HFA panels at the 2001 annual meeting: 1) Air Traffic Control, Shift Work and Fatigue, and 2) Human Error in Medicine. Topics for the 2002 meeting include: glass cockpits in general aviation, flight issues in Alaska, HF aspects of space flight and ATC operational concepts.

The AsMA Human Factors Committee (Tom Nesthus, Chair) completed the final draft of a 3-year plan including a hot topics list. Plan topics include:

- Human Factors in medicine
- Aging and operator performance
- Measuring and evaluating cultural and organizational factors in aviation.
- Flight crew duty/rest rules and schedule
- Human Factors in space flight (long duration)
- Human factors familiarization and training programs for pilots.
- Human Factors in accident investigation
- Human factors in systems development/automation – impact on General Aviation-Commuters, Air Carriers, ATC, Maintenance and Space
- General Aviation.

AsMA-requested position papers have been developed by the HF committee in the recent past, including the following:

- Crew Coordination (report in *Aerospace and Environmental Medicine*)
- Flight Deck Automation (no report published)
- Use of Cognitive Test Battery to Predict HIV Performance Deficiencies (AsMA resolution)
- Civilian Use of NVGs – coordinated with the Aviation Safety Committee.

The HF committee also revised the definition/description of "Aerospace Human Factors" for the AsMA brochure.

Tri-Service Workload Coordinating

- The Effect of Cognitive Load, Friendly Target Signature and Target Exposure Time on Friendly Fire Incidences and Shooting Performance - David R. Scribner, U.S. Army Research Laboratory, Human Research & Engineering Laboratory, Aberdeen Proving Ground, MD 21005, Ph: (410) 278-5983, Email: dscribner@arl.mil

The dismounted soldier of the future will be “loaded” with more information processing tasks while performing shooting tasks. It is conceivable that increased levels of cognitive tasking will coincide with future dismounted warrior systems. The effect of shooting under cognitive load has not been studied to date. It is imperative that the soldier not be overburdened mentally resulting in decreased soldier survivability, lethality, and potential increased friendly fire incidents. A series of two studies were performed to address these issues which would be performed at ARL HRED small arms shooting research facility.

The first study would examine the ability of the soldier or Marine to perform various cognitive tasks while shooting. Participants were 16 US Marine Corps test participants. Ages ranged from 18 to 25 years old. Additionally, the study examined the ability of soldiers or Marines to maintain the primary task of shooting pop-up friend-or-foe scenarios while performing secondary tasks of mathematical problem solving and situational awareness (SA) memory recall tasks. Lastly, the study examined the effect of cognitive workload levels upon the ability of soldiers to correctly make shoot-don’t shoot decisions in a friend-or-foe target environment.

The shooting task consisted of a 24-target pop-up scenario using friendly (white circular marking on the chest of the target) and enemy (olive drab green) E-type silhouette targets. Half of the targets were friendly and half were enemy. Ranges consisted of 50, 100, 150, 200, 250, and 300-meter targets. Target exposure time was 4 seconds. Soldiers were in a foxhole supported standing position for all trials. The M16A2 with iron sights was used.

Two types of secondary tasks, which were provided aurally, were given to subjects to attend to while performing shooting scenarios: mathematical problem solving (addition problems), and a situational awareness memory recall task. Each type of task consisted of three levels of difficulty.

ANOVA analyses revealed significant findings were for both math and SA tasks under shooting versus non-shooting (baseline) conditions. Additionally, multiple regression analyses yielded significant regression models for predicting performance, workload ratings, and stress ratings under certain conditions.

A second study was conducted using 12 US Army mechanized infantry soldiers (MOS 11M). This study did employ cognitive load, however only one secondary task was used, math

problem solving task from the previous study. The friendly target signature was varied between white and gray 6-inch circles. Target exposure times were varied among 4, 3, and 2 seconds.

ANOVA analyses revealed significant findings were friendly fire shots between cognitive load and no-load conditions. Additionally, secondary task completion rates were significantly affected by the primary task of shooting.

- Cognitive Integration: A Study of How Tactical Decision Makers Construct Understanding in Evolving Contexts - LTC (P) Lawrence G. Shattuck, Ph.D., LTC James L. Merlo, Engineering Psychology Laboratory, United States Military Academy, West Point, NY.

Technology provides military decision makers with more data than they can possibly use. Commanders and staffs must sort through and combine relevant data to develop understanding. This process, which we call *cognitive integration*, was investigated in three tactical simulations, each using 21 active duty Army officers. The first study used 21 experienced (former battalion commanders) officers as participants in a defensive scenario. The second study used 21 novice officers (no battalion command experience) in the same defensive scenario. The third study used another 21 experienced (former battalion commanders) officers as participants in an offensive scenario. Quantitative and qualitative data yielded differences between the experienced and novice groups and between defensive and offensive scenarios. In addition, data analysis led to the development of several important design principles that should be considered in building a decision aid prototype to assist commanders in integrating data.

- Exploring the Use of Mental Workload and Situation Awareness Metrics in Future Air Force Systems: Moving Beyond Test & Evaluation - Michael Vidulich, Air Force Research Laboratory, AFRL/HECP, 2255 H Street, Wright-Patterson AFB, Ohio 45433-7022, Phone: (937) 255-8734, DSN: 785-8734, email: michael.vidulich@wpafb.af.mil

Throughout the 1980s and 1990s much effort was expended in trying to define and measure mental workload and situation awareness. The general consensus is that mental workload is the mental cost placed on the human by performing the necessary mental processing to accomplish a mission and situation awareness is the human's momentary understanding of the situation and its implications. These concepts have typically been used in two main fashions: as design inspiration and as test and evaluation (T&E) metrics. The underlying logic is that a human performing at a comfortable level of mental workload and with a good broad understanding of the situation will not only be able to perform the expected missions well, but will have a better chance of adaptively responding to contingencies unanticipated by the system designer. The proposal of this presentation is that the current state of the art encourages the use of the mental workload and situation awareness concepts not only as design inspiration and T&E metrics, but as measures that can be assessed in real-time to help guide the most effective adaptation of automated systems. In 1965, Alphonse Chapanis described human engineering as "designing machines, operations, and work environments so that they match human capabilities and limitations." As design inspiration and T&E metrics, the mental workload and situation awareness concepts assisted designers and system evaluators in achieving this goal. The next step is to determine if these concepts can lead to aids that help the human engaged in performing the task. In other words, it is time to determine if mental workload and situation awareness will provide a basis for moving from traditional human engineering to real-time human engineering. Some preliminary research conducted at the Air Force Research Laboratory along these lines will be discussed.

- Visual Scanning and Workload - Christopher D. Wickens, University of Illinois, Aviation Human Factors Division, Savoy, Illinois.

Workload, the demand of tasks for the limited resources of the human operator, has aspects that are both quantitative (the overall workload imposed) and qualitative (how those resources are allocated). Visual scanning provides powerful information regarding the latter aspects; informing as to the strategic manner in which operators deal with high workload situations. This latter aspect is closely related to issues of strategic task management.

Visual scanning, as employed in workload research involves four primary concepts: the area of interest (AOI) is a region, defined by the analyst, within which multiple visual fixations may occur, to serve a single common task. The dwell duration is the time that the eye remains within an AOI before departing. It is assumed to reflect both the difficulty of extracting information within the AOI, and the amount of information extracted. The percentage dwell time, is the time the fixation remains within an AOI divided by the total time of observation, and hence is a measure of the relative allocation of visual attention. The event-fixation latency is the delay between the occurrence of a critical event, and the first fixation into an AOI relative to that event.

While these scanning measures can provide a great amount of information in highly visual dynamic environments, certain constraints and limitations must be acknowledged. (1) scanning cannot pick up changes in attention allocation within an AOI, particularly if that AOI is small. (2) scanning cannot assess the allocation of attention to non-visual sources (auditory channels, internal cognitive activities). (3) In many vehicular control environments, scanning cannot account for attention allocated to peripheral vision (e.g., peripheral flow fields). (4) As noted above, increases in dwell duration are inherently ambiguous, either signaling that more information is extracted, or that the same information is more difficult to extract. (5) in many instances, the failure to scan an AOI at all (total neglect), is of considerably greater importance than differences in the (non zero) percentage dwell time that an AOI is fixated.

We describe, briefly, five aviation studies that have employed visual scanning measures to draw inferences about pilot task management in high workload situations. In the first two studies, we compare task management between novice and expert pilots in conventional non-automated aircraft as they engage in (1) simulated landing (2) simulated flight in instrument meteorological conditions (IMC). In both studies we reveal skill differences in qualitative task management, and in the simulated IMC study we reveal skill differences in the workload required to extract information from the attitude indicator. Training implications of these results are discussed. In the remaining 3 studies, we use scanning to infer workload management strategies induced by various levels of cockpit automation. In study 3 we describe task management strategies of automation monitoring on the commercial “glass cockpit” aircraft (747-400), using scanning measures to reveal the “neglect” of critical aspects of the automation system. In study 4, we use visual scanning to understand how task management is moderated by the introduction of pilot-controller data link into the flight deck. In study 5 we use scanning to understand how task management changes with the introduction of the responsibilities for traffic self-separation (free flight) and the availability of a cockpit display of traffic information.

We conclude by presenting a model of the effects of task variables on visual scanning.

User-Computer Interaction

1) The subtag addressed herein is the User-Computer Interaction.
2) There were 31 attendees.
3) Twenty-two organizations were represented.
4) The agenda covered an introduction by the acting chair, LT Jim Patrey, three presentations, a vote for the UCI subtag chair, and a survey of current issues.
5) The three presentation abstracts are as follows:

- The Effects of Highlighting Validity on Accuracy of Memory of Text-based Displays - Rachael L. Westergren & Capt Heather L. Pringle

Because highlighting is used in so many kinds of informational displays in the military (e.g., computers, and cockpits), it would be to our benefit to see how it affects our attention, and thus, memory of material. One early study suggested that observers have shorter search times when looking at an informational display, but only if the validity of that highlighting (i.e., how likely it is that the highlighted information is the desired information) is greater than 50 percent (Fisher & Tan, 1989). However, the degree to which observers recognize, or remember, the highlighted information has not been explored. We examine these issues using measures of eye tracking and accuracy of memory. In this experiment, eleven participants studied forty text-based web pages, and subsequently answered one multiple-choice question pertaining to each previously viewed web page. Participants were informed of the highlighting validity, 90%, 70%, 50%, or none, prior to each block of ten trials. It was hypothesized that increasing the level of highlighting validity would affect the subjects' expectation that the highlighted material was more likely to contain the desired information, and thus, would affect their accuracy in responding and dwell time on the highlighted information. Results showed improved accuracy for the highlighted information, eye tracking results are pending. Potential implications for DoD applications will be discussed.

- Command 21: Decision Support for Operational Command Centers (Command 21) - Principle Investigator / Researcher**:** Jeffrey G. Morrison, Ph.D., SPAWAR Systems Center – San Diego, D44210, 53570 Silvergate Ave., A33 / 1405, San Diego, CA 92152-5143, 619-553-9070, jmorriso@spawar.navy.mil.

The Knowledge Wall is one part of a concept of operations that enables "Knowledge-Centric Warfare" and increased "Speed of Command" among staff decision-makers in a command center. As implemented for the Global 2000 war game, the Knowledge wall is a web-enabled dynamic status board. The wall uses an IT-21 / GOTS-D computer with COTS video boards that allow ten-21" CRT monitors and two-50" rear-projectors (Smart Boards) to work as a single, integrated desktop. While any application that runs in an IT-21 (Windows NT) environment can be used, (e.g. C2PC, MS PowerPoint, MS Word, etc.), there is a shell application that opens up to 12 graphical browser windows, each of which is pointed to different summary page in a "Knowledge Web". Content for the wall is created at command anchor desks using several external applications that allow the command staff to create pages for the knowledge web without having to be familiar with HTML. Content is structured consistently through a template – based authoring tool, called "SumMaker". "TacGraph" allows the command staff to quickly created annotated tactical, map-based drawings to provide value-added information in an web-

friendly form. Together, these tools allow information to be packaged around operational problems, and "push" that information to other decision-makers through the Knowledge Web. In effect, the Knowledge Wall tries to capture knowledge traditionally generated by the creation of watch turn-over briefs in the knowledge web, thus increasing the "speed of command" by allowing the best available information to be created and disseminated in a distributed, asynchronous manner rather than waiting until the watch turnover brief every eight hours.

- 3D Touch for Visually Impaired - Sudhanshu Kumar Semwal, Ph.D., Department of Computer Science, University of Colorado, Colorado Springs

Abstract: We provide a systematic study for generating interactive, virtual environments for the blind. We present our system as a tool for shape recognition and mobility training for the blind. In our system, head movement can be detected to indicate horizontal and vertical motion. Audio feedback is used for reinforcement. Our experiments for shape learning can guide the user in tracing the surface of a sphere by using audio feedback. We also present a compelling case for using force feedback devices for the visually impaired, and our experience with the PHANToM(TM) force feedback device is summarized. Some recent results in the area of wayfinding in virtual environments will also be presented.

Summary of the three presentations:

The UCI presentations focused on visual and haptic interface design issues and basic, applied, and prototype development research. Two presentations discussed visual issues in user-computer interaction. First, the potential advantages of text highlighting was presented and highlighting was demonstrated to improve the recall of information. Further analysis of accompanying eye-tracking data is pending to discern whether this is improved recall is due to an increase in dwell time on highlighted stimuli. The other visual interface addressed the development of a 'knowledge wall' aboard an aircraft carrier. A thirteen display, customizable 'wall' of visual information was fielded and determined to eliminate the requirement for repeated briefings and turnover by providing immediate situational awareness via the knowledge wall. The presentation on haptics addressed the development of computer interfaces for visually impaired individuals and the merits relative to auditory interfaces in this capacity. This raised many questions on the potential of using similar haptic interfaces in poor visibility operational military settings.

6) No issues, concerns or actions were discussed.
7) Election of a new chair was held and LT Jim Patrey was voted new chairperson.
8) No open actions.
9) New chair:

LT Jim Patrey
HQ USAFA/DFBL
USAF Academy, CO 80840-6228
Phone: 719-333-9891/DSN 333-9891
Fax: 719-333-6711/DSN 333-6711

Human Factors in Training Interest Group

Executive Summary: The training special interest group met for the first time as part of the HFE TAG meeting. Each service took responsibility for a topic area, with the Air Force coordinating a session on C4ISR training, the Navy coordinating a session to discuss ADL/DMT issues, and the Army organizing a session that focused on basic research. About 35 people attended at least one session with most attending all three. There were 15 presentations across the three sessions, with each service providing at least one presenter for each topic area. Considerable flow of technical information occurred across and within services. Feedback from participants at the end was unanimously positive regarding both the value of interacting with other training researchers and the benefits of meeting as part of the HFE TAG.

C4ISR--Dr. Becky Brooks (AFRL/HEA) coordinated participation from C4ISR researchers in all three services. The session was chaired by Lt Col Bill Wimpee (Dr. Becky Brooks could not attend). Some common themes and issues across the briefings included learning strategies, training delivery, and performance measurement for teams in the C4ISR environment. Also discussed by several presenters were challenges in defining the domain of work (both team and individual) within the different operations centers, such as the tactical or air operations centers. It was decided to continue to address this area at future meetings.

- Dr Carl Lickteig, ARI, Ft Knox: Digital Command and Control Training and Evaluation
- Dr John Stewart, ARI, Ft Rucker: Use and Management of Digital Information by Army Aviation Battalion Battle Staff Members
- Dr Mike McCluskey, Navair, Orlando: Intelligent Agents and Learning Methodologies to Enhance Learning in Large Scale Modeling and Simulation Exercises
- Dr Alan Ashworth, AFRL/HEAI, Brooks AFB, TX: Command and Control Training Research; Modular Control Equipment Training Research

ADL/DMT--Dr. David Ryan-Jones (NAWCTSD) assembled a session comprised of seven Advanced Distributed Learning and Distributed Mission Training (ADL/DMT) researchers. Presentations covered topics ranging from OSD and ONR initiatives through demonstrations and model programs to development of guidelines for designing effective ADL, with Bob Hays describing the development of guidelines. He solicited lessons learned from the participants in this session and received considerable input.

- LCDR Dylan Schmorrow, ONR, OSD-ONR Advanced Distributed Learning Initiative
- LT Joseph Cohn, NAWCTSD, Orlando: Building A Virtual Distributed Mission Trainer: A Case Study
- Dr. Peter Crane, AFRL, Mesa: Air Force Distributed Mission Training
- Dr. Ron Tarr, IST, Orlando: Air Force M&S Education ADL Model Program
- Dr. Terry Clark, Global E-Medicine, Peter Kincaid, IST, Orlando: Web-based Instruction for Military Medical Training
- Dr. Kara Orvis, ARI, Alexandria Collaborative Learning Research at the Army Research Institute.
- Dr. Robert Hays, NAWCTSD, Orlando: Guidelines for Design of Effective ADL

Basic Training Research--Dr. Michael Drillings (ARI/RACO) chaired a session on basic training research and described ARI's basic research areas, emphasizing the relationships between Army research areas and the activities of the other services. Again, presenters represented all three services. Air Force presenters described the basic research in command and control,

focusing on team training. The Navy presentation covered cognitive models, intelligent training systems, and the DARPA/ONR information cockpit. Recurring themes included solutions to technology transition challenges and the need for mechanisms to define training requirements.

- Dr Alan Ashworth, AFRL/HEAI, Brooks AFB, TX: Command and Control Training Basic Research
- Dr. Barry Goettl, AFRL/HEAI, Brooks AFB, TX: Air Force Basic Research in Team Training
- LT Joseph Cohn, NAWCTSD, Orlando
- Dr. Mike Drillings, AFI/RACO, Alexandria: Army Research Institute Basic Research Program in Learning and Instruction

Following the last technical session, the training special interest was convened to gather feedback and solicit recommendations for the future. About 15 researchers participated. There was unanimous agreement that the HFE TAG provided a valuable forum for information exchange among training researchers, and that such meetings should continue. The response to this inaugural training special interest group meeting was strong enough to fill all available meeting times with training sessions. Unfortunately, this precluded much interaction with other TAG sessions for most participants. There was broad agreement that the training "foot print" should be smaller at future meetings to allow more involvement by training researchers in other sessions, and that a reasonable mechanism to achieve this is to reduce number of training areas covered at each meeting, perhaps rotating among topics. Within the special interest group, C4ISR seems to be particularly fertile topic area, and the consensus was that enough issues remained to warrant a follow-on C4ISR session this fall, chaired again by Becky Brooks. A theme that ran through all three sessions this time was the need for team performance measures. Dan Dwyer and Bob Nullmeyer volunteered to assemble a team performance measurement session.

Conclusions/Recommendations: The training SIG was, by all accounts, very successful. All three services provided substantial support. SIG participants uniformly reported that they saw the value of cross-service interaction, and felt the HFE TAG meeting was an excellent vehicle for facilitating these interactions. The HFE TAG executive committee appeared to be equally positive about the value to the TAG of adding training as a technical area. SIG and Executive Committee all felt that a tighter focus resulting in fewer training presentations would help integrate the training researchers into the larger HFE context. The SIG recommended two sessions for the upcoming HFE TAG meeting in October, C4ISR and team performance measurement. This appeared to be well received by the executive committee. The executive committee further recommended holding a few more training SIG meetings before defining a charter and establishing a formal training sub-TAG.

- Command and Control Training and Evaluation in Virtual Simulation- Dr. Carl W. Lickteig, Senior Research Psychologist, U.S. Army Research Institute, Bldg. 2423 Fort Knox, Kentucky 40121-5620, Phone: Commercial 502-624-6928/DSN 464-6928, Email: Carl.Lickteig@knox.army.mil

SYNOPSIS: The presentation provides a sample of research on command and control conducted by the U.S. Army Research Institute's unit at Fort Knox. This four-part sample is organized around value-added methods for addressing C^4ISR training and evaluation issues. Value-added methods include user-in-the-loop virtual simulation, performance-based structured training packages, and the expansive ability of digital technology to mediate the interplay of people and work. First, the Combat Vehicle Command and Control (CVCC) research program leveraged the potential of virtual simulation to conduct an iterative, multi-echelon series of baseline versus experimental group evaluations that supported C^4I acquisition. Second, the

Structured Training Program developed an extensive set of training support packages, including a subset for C^4I equipped platoon-to-brigade training audiences. Third, ongoing research on automated measures is exploiting the ability of digital technology to track and assess C^4ISR performance, particularly at command and staff levels. And fourth, our unit in conjunction with DARPA is initiating a program of research on the command and control of robotic forces in the Army's Future Combat Systems. To guide future efforts, the presentation closes with a makeshift "A" list of potential C^4ISR research issues that includes: adaptation, allocation, authority, and autonomy.

- Use and Management of Digital Information by Army Aviation Battalion Battle Staff Members - John E. Stewart, II, Research Psychologist, Army Research Institute, Rotary Wing Aviation Research Unit (Attn. TAPC-ARI-IR), Building 5100, Fort Rucker, AL 36362-5354, DSN 558-9109, stewartj@rwaru.army.mil.

SYNOPSIS: An observational study was embedded within a training simulation exercise at Fort Rucker, AL, to determine how U.S. Army Aviation battalion level battle staff use, interpret, and manage information in a digital tactical operations center (TOC). Battalion battle staff conducted mission planning and execution functions in a virtual simulation, in response to orders from a simulated brigade staff. A ten member observer staff recorded events during mission planning, execution, and during after action reviews. Despite constraints in the design of the exercise, the study yielded useful information about problems that can be solved by developing new tactics, techniques and procedures. Some representative findings: Problems with planning time and distribution of planning tasks indicated a need for more formalized workload distribution and time management. Planning activities that can be carried out concurrently should be specified. Cross training battalion battle staff members would also be helpful. The study did not indicate that the addition of a specialized information manager to the battle staff would improve the way in which information is managed in the TOC. In addition, lessons were learned about methodology. In future exercises, battle staff members should receive comprehensive training on the digital systems.

- Command and Control Training Research - Dr. Alan Ashworth, the Intelligent Systems Branch of the Air Force Research Laboratory, AFRL/HEAI, 2509 Kennedy Circle, Brooks AFB, TX 78235-5118, DSN 240-5535.

SYNOPSIS: The Intelligent Systems Branch of the Air Force Research Laboratory at Brooks Air Force Base, San Antonio, Texas (AFRL/HEAI), has a fully integrated suite of command and control research initiatives. These initiatives begin with basic research and terminate with validated instructional methods for training modern warfighters. Based upon cognitive science, models of team performance, learning, and decision-making are derived and tested in the C2 Training Research Laboratory and over the Distributed Mission Training Research Network (DMT-Rnet). Both Facilities provide high bandwidth interconnectivity with a dozen university and private research institutes for collaborative C2 data collection. The models and subject matter expertise acquired from basic research is instantiated in a formal model of human knowledge by the Knowledge Representation Technology (KR-Tech) initiative, and can then be used to drive training (initial, maintenance, just-in-time) or provide operational performance support using intelligent agents. The Modular Control Equipment Training Research (MCETR) initiative tackles the immediate training requirements of forward command and control operators by integrating Joint Semi Automated Forces (JSAF) directly into the operators' electronic control equipment. All of these initiative feed into the primary AFRL/HEAI Command and Control Training Research (C2TR) program, which provides the unifying vision. The C2TR Program is building and testing a reliable distributed team C2 practice environment with embedded performance assessment,

agent-based coaching, and rapid scenario development. To this end AFRL/HEAI regularly participates in exercises such as the Joint Expeditionary Forces Experiment (JEFX). Through participation with the C2 warfighter, AFRL/HEAI gleans the necessary validation and feedback to continually fine-tune C2 research to better met the warfighters' needs.

- Team Training Research and the DMT-Rnet - Barry P. Goettl, Ph.D., Research Psychologist, AFRL/HEAI, 2509 Kennedy Circle, Brooks AFB, TX 78235-5118, Phone: 210/536-5499 DSN: 240-5499

The Information Systems Training Branch of the Air Force Research Laboratory (AFRL/HEAI) is pursuing an integrated research program that incorporates human factors considerations into team training by applying a cognitive engineering approach that has been successfully applied to individual learning. This cognitive engineering approach uses formal methods for designing systems, procedures, and technologies that capitalize on human information processing strengths and remediate against human information processing weaknesses. It starts with a general learning theory specifying a full range of acquired knowledge and skills to create a cognitive taxonomy for categorizing team tasks into knowledge and skill types. Then criterion tasks that sample from the taxonomy are used for systematic research on acquisition of knowledge and skill types. This research is directed toward domain specific modifications to general theory of learning and toward the development of a general instructional model specifying how acquisition can be enhanced for team knowledge and team skill types. This research is supported by the Distributed Mission Training – Research Network (DMT-Rnet), a foundation utilizing Internet II infrastructure to conduct real-time collaborative research in Command and Control environments to improve warfighter training effectiveness in the Global Battle Space. The DMT-Rnet is also a vehicle through which government, university, and industry scientists collaborate on topics related to team knowledge and skill. Such topics include: mission execution, adaptive problem solving, knowledge representation, training, mission execution versus learning skills, embedded training & aiding, mission rehearsal, and generalizability of tactics, strategies, and skills.

- Army Research Institute Basic Research Program in Learning and Instruction - Michael Drillings; Chief, Research & Advanced Concepts; U.S. Army Research Institute, TAPC-ARI-BR; 5001 Eisenhower Ave.; Alexandria, VA 22333; (703) 617-8641; DSN 767-8641; drillings@ari.army.mil

Synopsis: The presentation described the U.S. Army Research Institute basic research (6.1) program in training (learning and instruction) and leadership development. The training research includes research on skill acquisition and transfer and on information and situation comprehension. Other characteristics of the program are also described: its size, investment strategy, and drivers. Also summarized are the results of the 2000 Army Science Board panel on training dominance.

Caucus Reports

Air Force Caucus

The Air Force caucus was convened by Dr. Grant McMillan, with 10 members attending. In a continuing effort to increase USAF participation, the caucus set a goal of each member bringing or sending one new person to the fall meeting in San Diego. Caucus members all supported the new meeting schedule, with the plenary session as the opening event. Members also felt that holding the caucuses earlier in the schedule would increase participation. Support was expressed for the core 3-½ day schedule of this meeting, while retaining the option for facility tours on the afternoon of the last day.

Dr. Robert Nullmeyer, who organized the first meeting of the Human Factors in Training Interest Group, expressed his strong desire to have a “smaller footprint” at the next meeting. This will permit Training Interest Group members to attend other subTAGs and vice-versa. Caucus members who attended some of the Training Group sessions concurred that it was off to an excellent start.

Army Caucus

There were 7 attendees at the Army Caucus meeting. Discussion focused on the site for the next Army hosted TAG. We agreed to recommend the greater Washington DC area for November of 2002. Potential hosts include Aberdeen or Huntsville. Or it will be a no-host meeting in the Baltimore area.

Navy Caucus

Meeting of the Navy Caucus at the DoDHFETAG, May 01, Colorado Springs, CO.

- LCDR Schmorrow called the session to order.
- Group had discussion about fall 2001 meeting.
  - LT Walter Carr volunteered to set up the site visit at the SPAWAR System Center.
  - Group discussed the need to attract Navy speakers to the San Diego meeting.
  - Theme for San Diego meeting will be C4I.
  - Several members volunteered to solicit line officer participation at the San Diego meeting.
  - LT Loukopolous will attempt to attract a larger NASA-Ames contingent.
  - LT Carr will attempt to attract a flag officer from the sub community.
  - LT Carr will try to arrange a sub tour for the Navy folks at the meeting.
- Discussed locations of future TAG meetings
  - NOV 01, San Diego
  - MAY 02, Houston
  - NOV 02, DC
  - MAY 03, ??
- LCDR Schmorrow proposed holding future Navy Caucus meetings at some non-conflicting time during the first three days of the TAG meeting. All in attendance agreed. Will present this idea to the operating board.
- LCDR Schmorrow discussed the Navy position on badge colors. All agreed that the Navy contingent has no strong opinions about the badge colors.
- Discussed nominations for the Navy TAG chair.
  - LT Loukopolous nominated LCDR Sean Biggerstaff.
  - LT Carr seconded the nomination.
  - LCDR Biggerstaff was voted in unanimously.
- Eric Muth discussed efforts to attract more academics and the possibility of creating an academic sub-TAG.
- LCDR Schmorrow moved to adjourn the meeting.

TAG Operating Structure

DEPARTMENT OF DEFENSE
HUMAN FACTORS ENGINEERING TECHNICAL ADVISORY GROUP*

GOALS

- Provide a mechanism for exchange of technical information in the development and application of human factors engineering.
- Enhance working-level coordination among Government agencies involved in HFE technology research, development, and application.
- Identify human factors engineering technical issues and technology gaps.
- Encourage and sponsor in-depth technical interaction, including subTAGs as required in selected topical areas.
- Assist as required in the preparation and coordination of triservice documents such as Technology Coordinating Papers and Topical Reviews.

SCOPE

Because of the diversity of subject matter covered by the HFE discipline, the scope of technical areas addressed by the Technical Advisory Group (TAG) is necessarily broad. In general HFE, as defined for purposes of TAG operation, deals with concepts, data, methodologies, and procedures which are relevant to the development, operation, and maintenance of hardware and software systems. Subject matter subsumes all technologies aimed at understanding and defining the capabilities of human operators and maintainers and insuring the integration of the human component into the total system to enhance systems effectiveness. Technologies directed toward improved manpower utilization through selection, classification, and training are included as appropriate.

TOPICAL AREAS

The TAG will address research and technologies designed to impact man-machine system development and operation throughout the complete system life-cycle. The general topics of concern to the TAG include, but are not limited to:

a. Procedures for use by HFE specialists, system analysts, and design engineers involved in the provision of HFE support during system development or modification.

b. Methodologies oriented toward the identification and solution of operator/maintainer problems related to equipment design, operation, and cost/effectiveness.

c. Mechanisms for application of developed HFE technologies, including formal and informal approaches to validation and implementation, and the determination of time windows for application.

GROUP COMPOSITION

The TAG will consist of technical representatives from Government agencies with research and development responsibility in the topical areas specified above. Additional representatives from activities with allied interests may affiliate with the TAG as appropriate. Attendance at specific meetings may be augmented by technical experts in special topical areas.

OPERATING BOARD

The TAG Operating Board is responsible for the conduct of TAG business and the implementation of TAG policies. The Board consists of an Executive Committee and the chairpersons of all subTAGs and committees. Operating Board meetings are called at the discretion of the TAG Chair.

The Executive Committee will be responsible for providing required continuity and acting for the full TAG between regular meetings. Regular members of the Executive Committee will be:

- Current Chair
- Immediate Past Chair
- Chair Select
- Army Representative
- Navy Representative
- Air Force Representative
- NASA Representative
- FAA Representative

CONDUCT OF BUSINESS

Meetings of the TAG will be held semi-annually, in the Spring and the Fall. Chairing of the group will rotate annually among the Army, Navy, and the Air Force. The Chair Select will be chosen by a caucus of the service whose turn it is to chair the DoD HFE TAG. Advice and counsel will be provided by the Operating Board. The Service Representatives will be selected by service caucus at the Spring meetings in even-numbered calendar years. Advice and counsel will be provided by the Operating Board. Minutes of each meeting will be compiled by the Chair. Minutes will be distributed to all plenary session participants, to appropriate OSD offices, and to other agreed-upon agencies. Minutes shall serve as the principal mechanism for the reporting of group activity. A file of Minutes and relevant correspondence shall be maintained by each Chair. This file shall be passed to the succeeding Chair together with any additions to the file.

TAG SubTAGS

The DoD HFE TAG is composed of two categories of associated groups: SubTAGs and Committees. SubTAGs will be sponsored by the TAG as appropriate to respond to needs for more detailed interchange and coordination in specific technical areas. SubTAGs will address problems of a general or continuing nature within a specific field of technology and are to develop their own working charters and operating procedures. SubTAGs may be disestablished upon recommendation by the Executive Committee. Committees will serve at the pleasure of the Operating Board and will address specifically defined tasks or problems. These committees will be disestablished on completion of those tasks or upon recommendation by the Executive Committee. Reports from each subTAG and committee will be published separately and included as a regular item of business on each TAG meeting agenda. Current subTAGs and committees are identified in the TAG Operating Board.

AMENDMENTS

Amendments may be recommended by submitting the suggested change(s) in writing to the TAG Chair. The Operating Structure may be amended by a majority vote of those attending the Operating Board meeting at which recommended amendments are voted upon.

1. Name change from Department of Defense Human Factors Engineering Technical Advisory Group to Department of Defense Human Factors Engineering Technical Group by request of OUSD approved on 19 November, 1987.

2. Amended 14 November, 1989 at TG-23, Killeen, Texas.

3. Amended 3 May 1994 at TG-32, Oklahoma City, Oklahoma.

4. Name change from DoD HFE TG back to DoD HFE TAG on 3 May 1994.

5. Name change from subgroup on 8 May 1996.

TAG Policies

1. Membership (General membership policies are outlined in the Operating Structure, under "Group Composition.")

1.1 Individuals who are not affiliated with Government agencies (but who are associated with technical societies or industrial associations with a stated interest in human factors engineering) wishing to affiliate with the TAG may contact the current Technical Society/Industry subTAG Chair to ascertain eligibility under the TAG Operating Structure. Once eligibility has been ascertained, the individual should submit a letter on the organization's letterhead, confirming his/her status as the organization's representative, to the current Chair of the Technical Society/Industry subTAG.

1.2 Attendance at the plenary session is limited to:

- US Military/Government employees
- Official technical society/industrial association representatives
- Specifically invited plenary presenters/guests.

1.3 Employees of National Laboratories or Federally Contracted Research Centers and foreign nationals may attend plenary sessions if they have received a personal invitation from the TAG Chair.

1.4 Those individuals eligible to attend plenary sessions may attend all subTAG sessions.

1.5 Emeritus Membership may be approved by the Executive Committee on a case-by-case basis for a former TAG member who is retired from government service or defense industry. Emeritus Membership is automatically deactivated during any period or re-employment with the government or defense industry.

2. Meeting Sites (Sites are recommended by the service caucus whose turn it is to host the TAG with a view toward a balance in geographic location and meeting facilities.)

2.1 TAG members are encouraged to recommend potential meeting sites.

2.2 Organizations who wish to host the TAG should contact their Service Representative or the current TAG Chair.

3. Agenda (The agenda is determined approximately three months before the scheduled meeting. The Chair Select selects the topics from those recommended by the Service Representatives, hosting agency and the TAG Coordinator.)

3.1 TAG members are encouraged to suggest potential agenda topics or topics suitable for tutorial sessions to their Service Representative, the current TAG Chair, or the TAG Coordinator.

4. Registration (Registration fees and the date of the close of registration are announced in an information letter sent approximately two months before the scheduled meeting.)

4.1 All attendees are expected to pre-register and prepay by mail.

4.2 Only individuals receiving late travel approvals may pre-register by FAX/phone by contacting the TAG Coordinator identified in the TAG invitation letter. Payments made at the meeting site must be in cash.

4.3 A late fee will be assessed to individuals registering after the announced close of registration date.

5. Minutes (The Minutes of each meeting serve as the principal mechanism for the reporting of TAG activities. The Minutes are published as a draft document and distributed to plenary session attendees and other selected agencies.)

5.1 Individuals or agencies desiring to be included on the distribution list for a specific meeting should contact the TAG Coordinator.

5.2 Amendments to the Minutes are to be made to the TAG Chair in writing prior to the succeeding meeting.

5.3 All presenters are expected to submit an abstract of their presentations to the TAG Coordinator for inclusion in the Minutes.

6. SubTAGs and Committees (See the Operating Structure, section entitled "TAG SubTAGs," for specific information regarding the purposes and operating procedures of subTAGs and committees.)

6.1 All subTAGs and committees are encouraged to meet in conjunction with the TAG at least once each calendar year.

6.2 All subTAGs and committees meeting in conjunction with the TAG are required to provide a chairperson for the specific meeting.

6.3 All subTAG and committee chairpersons are to submit a brief report of each meeting to be included in the set of TAG Minutes covering the subTAG/committee meeting time frame.

6.4 All subTAGs and committees are required to provide the TAG Coordinator with an up-to-date list of their membership for use in the distribution of TAG announcements.

6.5 All subTAGs are required to submit to the Executive Committee a Charter including, but not limited to, statements regarding:

- objectives
- scope
- membership policies
- chair selection/tenure
- meeting schedule

6.6 Committees are required to submit to the Executive Committee a document including, but not limited to, brief statements regarding:

- objectives
- membership policies
- chair selection/tenure

6.7 Rotation of the chair position is determined by subTAG charter. If the position cannot be filled by the appropriate service at the election meeting, the subTAG may progress to the next service willing to chair the subTAG

7. SubTAG Establishment

7.1 Groups interested in addressing technical areas not covered by existing subTAGs may request the TAG Chair to provide meeting time.

7.2 Formal subTAGs and committees may be established by recommendation of the Executive Committee.

8. Chair/Representative Selection (General selection procedures are outlined in the Operating Structure under "Conduct of Business.")

8.1 A Service caucus may be called by the TAG Chair or the current Service Representative.

8.2 Methods of determining the Chair Select and Service Representatives are Service dependent.

8.3 Unexpired terms of office will be filled by appointment by the Executive Committee, until a caucus of the Service can be called at the next regularly scheduled TAG meeting.

9. Funding The funding required for the organization, conduct, franking, and documentation of all TAG meetings shall be done jointly by the three Services and other selected agencies. The specific mechanisms to obtain and allocate funding from the Services/agencies shall be arranged by the Current Chair, Chair Select, and Immediate Past Chair.

10. Policy Changes

10.1 Additions to or amendments of the above policies may be recommended by submitting the suggested change(s) in writing to the TAG Chair.

10.2 Policies may be amended by a majority vote of those Operating Board members in attendance at the Operating Board meeting at which amendments have been proposed.

Amended 14 November 1989 at TG-23, Killeen, Texas.

Amended 3 May 1994 at TAG-32, Oklahoma City, Oklahoma.

Amended 8 May 1996 at TAG-36, Houston, Texas.

Meeting Location Summary

MTG	DATE	LOCATION	CHAIR	HOST
1	9 - 10 Aug 1977	Ft. Washington, PA	LCDR Norman Lane	Naval Air Development Center
2	24 - 24 Jan 1978	Alexandria, VA	LCDR Norman Lane	Army Research Institute
3	22 - 24 Aug 1978	Dayton, OH	Lt Col Joseph Birt	Human Engineering Division, Wright-Patterson AFB
4	6 - 8 March 1979	San Antonio, TX	Lt Col Joseph Birt	Aerospace Medical Division, Brooks AFB
5	4 - 6 Dec 1979	Sunnyvale, CA	Dr. Edgar Johnson	NASA Ames Research Center Moffett Field
6	17 - 20 Nov 1980	New Orleans, LA	Dr. Edgar Johnson	Naval Biodynamics Lab, Michoud Station
7	18 - 21 May 1981	Monterey, CA	CDR Norman Lane	Naval Postgraduate School
8	12 - 14 Jan 1982	Orlando, FL	CDR Norman Lane	Naval Training Equipment Center
9	27 - 29 July 1982	Colorado Springs, CO	Dr. Richard Schiffler	US Air Force Academy
10	8 - 10 May1983	El Paso, TX	Dr. Richard Schiffler	US Army Research Institute, Ft. Bliss
11	4 - 6 Oct 1983	Atlantic City, NJ	Mr. Clarence Fry	FAA Tech Center
12	15 - 7 May 1984	Oxnard, CA	Mr. Clarence Fry	Pacific Missile Test Center, Point Mugu
13	6 - 8 Nov 1984	West Point, NY	Mr. Paul Linton	US Military Academy
14	7 - 9 May 1985	San Antonio, TX	Mr. Paul Linton	USAF Aerospace Medical Div/Brooks AFB
15	5 - 7 Nov 1985	San Diego, CA	Mr. Cyrus Crites	Navy Personnel Research and Development Center
16	6 - 8 May 1986	Cocoa Beach, FL	Dr. Michael Strub	NASA - Kennedy Space Center
17	18 - 20 Nov 1986	Monterey, CA	Dr. Michael Strub	Army Research Institute/Presidio of Monterey Field Unit
18	11 - 14 May 1987	Boston, MA	Dr. Michael Strub	Electronic Systems Division/Hanscom Field AFB
19	16 - 19 Nov 1987	Oxnard, CA	Dr. John O'Hare	Pacific Missile Test Center, Point Mugu
20	9 - 12 May 1988	Baltimore, MD	Dr. John O'Hare	US Army Human Engineering Lab, Aberdeen Proving Ground
21	31 Oct - 3 Nov 1988	Albuquerque, NM	Lt Col Thomas McCloy	USAF Operational Test and Evaluation Center, Kirtland AFB
22	15 - 18 May 1989	Orlando, FL	Lt Col Thomas McCloy	Navy Personnel Research and Development Center

MTG	DATE	LOCATION	CHAIR	HOST
23	13 - 16 Nov 1989	Killeen, TX	LTC Gerald Krueger	Darnell Army Hospital, Ft. Hood
24	7 - 10 May 1990	Ft. Walton Beach, FL	LTC Gerald Krueger	US Air Force Munitions Systems Division, Eglin Air Force Base
25	12 - 15 Nov 1990	San Diego, CA	CDR Thomas Mitchell	Naval Health Research Center
26	13 - 16 May 1991	Natick, MA	CDR Thomas Mitchell	US Army Research Institute of Environmental Medicine
27	4 - 7 Nov 1991	San Antonio, TX	Dr. Stephen Rokicki	USAF Armstrong Lab, Brooks AFB
28	21 - 24 April 1992	New Orleans, LA	Dr. Stephen Rokicki	Naval Biodynamics Lab, Michoud Station
29	3 - 6 Nov 1992	Huntsville, AL	Mr. Richard Armstrong	US Army Research Lab, HRED MICOM Field Element
30	11 - 14 May 1993	Dayton, OH	Mr. Richard Armstrong	Human Engineering Division/Crew System Directorate, Armstrong Lab
31	15 - 18 Nov 1993	San Diego, CA	Dr. Carl Englund	Naval Health Research Center and Naval Command Control and Ocean Surveillance Center RDT&E Division
32	2 - 5 May 1994	Oklahoma City, OK	Dr. Carl Englund	FAA Civil Aeromedical Institute
33	31 Oct - 3 Nov 1994	Orlando, FL	Dr. Joe McDaniel	Army Research Lab Field Element and Army Research Institute
34	1 - 4 May 1995	Colorado Springs, CO	Dr. Joe McDaniel	USAF Academy
35	6 - 9 November 1995	Monterey, CA	Dr. James C. Geddie	Naval Postgraduate School
36	6 - 9 May 1996	Houston, TX	Dr. James C. Geddie	NASA - Johnson Space Center
37	4 - 7 November 1996	Baltimore, MD	Dr. Robert Smillie	US Army Research Laboratory, Human Research Engineering Directorate
38	5 - 8 May 1997	San Antonio, TX	Dr. Robert Smillie	Armstrong Laboratory, Brooks AFB
39	3 - 6 November 1997	Kissimmee, FL	Dr. Grant McMillan	Naval Air Warfare Center – Training Systems Division
40	11 - 14 May 1998	Alexandria, VA	Dr. Grant McMillan	Federal Aviation Administration
41	16 – 19 Nov 1998	Waltham, MA	Mr. Richard Armstrong	US Army Soldier and Biological Chemical Command, Natick
42	10 – 13 May 1999	Alexandria, VA	Mr. Richard Armstrong	N/A

MTG	DATE	LOCATION	CHAIR	HOST
43	1 – 4 November 1999	Albuquerque, NM	LCDR Russell Shilling	Air Force Operational Test and Evaluation Center and the Safety Center, Kirtland AFB
44	1 – 4 May 2000	Arlington, VA	LCDR Russell Shilling	Office of Naval Research, Arlington, VA
45	6 - 9 November 2000	El Paso, TX	MAJ Scott Smith	ARL-HRED Ft. Bliss Field Element, TX
46	14 – 17 May 2001	Colorado Springs, CO	MAJ Scott Smith	Air Force Space Command, Peterson AFB, CO

Registered Meeting Attendees

Commander
USACHPPM, ATTN: MCHB-TS-OHH (G. Murnyak)
5158 Blackhawk Rd
Aberdeen Proving Ground, MD 21010-5403
(410) 436-2925 DSN 584; FAX (410) 436-1016
george.murnyak@amedd.army.mil

Director
U.S. Army Research Laboratory
Attn: AMSRL-HR-SC (Chris Smyth)
Aberdeen Proving Ground, MD 21005-5425
(410) 278-5833 DSN 298; FAX (410) 278-8828
csmyth@arl.mil

Ms. Lisa Achille
NAVAIR
21544 Breton View Court
Leonardtown, MD 20650
(301) 342-9706 DSN 342; FAX (301) 342-9305
achillelb@navair.navy.mil

Mr. Louis Adams, EIA Rep
Lockheed Martin Aeronautics
PO Box 748, MS 1730
Fort Worth, TX 76101
(817) 777-9821 FAX (817) 777-2500
lou.adams@lmco.com

Ms. Teresa K. Alley
DISA MATRIS Office, DTIC
NAS North Island Box 357011, Bldg 1482
San Diego, CA 92135-7011
(619) 545-7384 DSN 735; FAX (619) 545-0019
talley@dticam.dtic.mil

LT Jeff Alton
US Navy
8917 N. Davis Hwy #32
Pensacola, FL 32514
(850) 857-7892
jalton@worldnet.att.net

Ms. Susan G. Archer, SCS Rep.
Micro Analysis & Design Inc.
4900 Pearl East Circle, Suite 201 E
Boulder, CO 80301
(303) 442-6947 FAX: (303) 448-1913
sarcher@maad.com

Mr. Richard Armstrong
3363 Augusta St.
Enterprise, AL 36330
(334) 347-3600 pdebpage@aol.com
dickmar@ala.net

LT Rick Arnold
NOMI, Code 341
220 Hovey Road
Pensacola, FL 32508
(850) 452-2257x1090 FAX (850) 452-2144
rdarnold@nomi.med.navy.mil

Dr. Alan Ashworth III
AFRL/HEAI
Brooks AFB, TX 78235
DSN 240-5535

Mrs. Debra Bardine
NSWC DD, Dahlgren Division (NAVSEA)
17320 Dahlgren Rd, Code G53
Dahlgren, VA 22448
(540) 653-3735 DSN 290; FAX (540) 653-7440
bardinede@nswc.navy.mil

Ms. Diane Barnette
US Army Research Lab, HRED
ATTN: AMSRL-HR-S
Aberdeen Proving Ground, MD 21005
(410) 278-9523 DSN 298; FAX (410) 278-9525
dbarnett@arl.army.mil

Mr. Walter P. Benesch
OSD/C3I Software Management Division
1225 Jefferson Davis Hwy, Suite 910
Arlington, VA 22202-4301
(703) 604-1571 (703) 604-1493
walter.benesch@osd.mil

LCDR Sean Biggerstaff, MSC, PhD
Bldg. 2187, Suite 1280-F2, NAWC-AD
48110 Shaw Rd, Unit 5
Patuxent River, MD 20670-1906
(301) 342-8395 DSN 342; FAX (301) 342-8801
BiggerstaffS@navair.navy.mil

Dr. Sheryl Bishop
University of Texas Medical Branch
301 University Blvd. Rt. 1150
Galveston, TX 77555
(409) 747-6027 FAX (409) 747-6129
sbishop@utmb.edu

Mr. Clete Booher
MC SF5 NASA - JSC
2101 NASA Rd One
Houston, TX 77058-3696
(281) 483-8951 FAX: (281) 483-1847
cletis.r.booher1@jsc.nasa.gov

Dr. Mark M. Brauer, PE, CSP
IIE/IAE Representative
P.O. Box 1851
Corpus Christi, TX 78403-1851
(361) 387-0748 FAX (361) 387-0748
m.m.brauer@worldnet.att.net

Mr. David Britton
ASC/ENOI, Bldg 560
2530 Loop Rd West
Wright-Patterson AFB, OH 45433-7101
(937) 255-8718 DSN 785; FAX (937) 255-5597
david.britton@wpafb.af.mil

LT Walter Carr
NHRC
PO Box 85122
San Diego, CA 92186-5122
(619) 553-0479 DSN 553; FAX (619) 553-8551
carr@nhrc.navy.mil

LT Cheryl Casey, PhD, MSC, USNR
NAMRL
51 Hovey Road
Pensacola, FL 32508
(850) 452-3287x1121
ccasey@namrl.navy.mil

Ms. Lisa Chavez
BCI, Inc.
PO Box 1748
Dahlgren, VA 22448
(540) 663-3321 FAX (540) 663-3307
lisa_chavez@teambci.com

Dr. Terry Clark
Global eMedicine
1352 E. Logan
Salt Lake City, UT 84105
(801) 244-7287
terrykclark@hotmail.com

LT Joseph Cohn
Naval Research Laboratory, Code 5580
4555 Overlook Ave. SW
Washington, DC 20375-5320
(202) 253-1291
cohn@ait.nrl.navy.mil

Mr. Brad Collie
US Navy Coastal Systems Station, Code E31
6703 West Highway
Panama City, FL 32407-7001
(850) 234-4744 FAX (850) 235-5152
colliebe@ncsc.navy.mil

Dr. Stefan Constable
USAF School of Aerospace Medicine
USAFSAM/FEP
2602 West Gate Rd.
Brooks AFB, TX 78235-5252
(210) 536-4613 DSN 240; FAX (210) 536-3683
stefan.constable@brooks.af.mil

Ms. Sheryl Cosing
TAG Coordinator
10822 Crippen Vale Ct.
Reston, VA 20194
(703) 925-9791 FAX (703) 925-9694
sherylcosing@earthlink.net

Mr. Anthony Cowden
Fuzzy Systems Solutions, Sonalysts, Inc.
215 Parkway North, PO Box 280
Waterford, CT 06360
(860) 447-8091 FAX (860) 447-8883
cowden@sonalysts.com

Dr. Peter Crane
AFRL/HEA
6030 S. Kent St.
Mesa, AZ 85212-6061
(480) 988-6561 DSN 474; FAX (480) 988-6285
peter.crane@williams.af.mil

LtCol Darrell Criswell
HQ AFOTEC/TSH
8500 Gibson Ave., SE
Kirtland AFB, NM 87117-5558
(505) 846-1357 DSN 246; FAX (505) 846-1357
darrell.criswell@afotec.af.mil

Ms. Crystal Cruz
FAA CAMI
PO Box 25082
Oklahoma City, OK 73125
(405) 954-7471 FAX (405) 954-4852
crystal_cruz@mmacmail.jccbi.gov

LtGen Roger E. Dekok
Vice Commander
Air Force Space Command
Peterson AFB, CO 80914

Dr. Harry Delugach
Computer Science Dept. TN-351
University of Alabama
Huntsville, AL 35899
(256) 824-6614 (256) 824-6239
delugach@cs.uah.edu

Capt Linda Dinndorf
HQ USAFA/DFBL
2354 Fairchild Dr., M2
USAFA, CO 80840-6228
(719) 333-2093 DSN 333; FAX (719) 333-6711
linda.dinndorf@usafa.af.mil

Ms. Siv Dresher
NAIC/TATV
4180 Watson Way
Wright-Patterson AFB, OH 45433-5648
(937) 257-3837 DSN 787; FAX (937) 656-1746
mg275@naic.wpafb.af.mil

Dr. Michael Drillings
TAPC-ARI-BR
5001 Eisenhower Ave.
Alexandria, VA 22201
(703) 617-8641 DSN 767; FAX (703) 617-5162
drillings@ari.army.mil

Ms. Marilyn Dudley-Rowley
OPS-Alaska c/o Sociology Dept., Sonomo State Univ.
1801 E. Cotati Ave.
Rohnert Park, CA 95928
(707) 730-1037
MD_R@hotmail.com

Dr. Dan Dwyer, PhD
NAWC-TSD, Head, Training Tech. Dev. (AIR-4961)
12350 Research Parkway
Orlando, FL 32826
(407) 380-4139 DSN 960
DwyerDJ@navair.navy.mil

LT Jeff Dyche
Naval Sub Research Lab
Sub Base, New London Box 900
Groton, CT 06349-5900
(860) 694-2533 DSN 694
dyche@nsmrl.navy.mil

LT Sidney Fooshee
NAWCTSD, Air 4962
12350 Research Parkway
Orlando, FL 32826-3224
(407) 380-4258 DSN 960; FAX (407) 380-4793
sidney.fooshee@navy.mil

Chris Forsythe
Sandia National Labs
MS 0829
Albuquerque, NM 87185-0829
(505) 844-5720 (505) 844-9037
jcforsy@sandia.gov

Mr. Benjamin Gibson
AMEDDC&S
14723 Oak Briar
San Antonio, TX 78232-4679
(210) 221-1622 DSN 471; FAX (210) 221-0121
ben.gibson@amedd.army.mil

CDR Dave Gleisner
Bldg 2187, Suite 2280 NAWCAD
48110 Shaw Rd, Unit 5
Patuxent River, MD 20670-1906
(301) 342-9195 FAX (301) 342-2623
gleisnerdp@navair.navy.mil

Dr. Barry Goetl
AFRL/HEAI
Brooks AFB, TX 78235
DSN 240-5499

Dr. Steven Goldberg
US Army Research Institute
12350 Research Parkway
Orlando, FL 32826
(407) 384-3980 DSN 970; FAX (407) 384-3999

MAJ John M. Graham
Information and Space Superiority Directorate
3992 E. Bijou Street
Colorado Springs, CO 80909
(719) 554-1134 DSN 692; FAX (719) 554-1319
john.graham@us.army.mil

LT Chris Hart, MSC, USNR
48110 Shaw Rd., Unit 5
Bldg 2187, Suite 2280
Patuxent River, MD 20670-1906
(301) 342-9254 DSN 342; FAX (301) 342-9308
hartcl@navair.navy.mil

Col Albert Hartzell
8845 Heathermore Blvd
Apt 104
Upper Marlboro, MD 20772
(202) 767-4200 DSN 297; FAX 754-8089
albert.hartzell@usafsg.bolling.af.mil

Mr. Wolf J. Hebenstreit, Emeritus
1402 151st Pl. NE
Bellevue, WA 98007-4257
(425) 746-3591
hebenw@aol.com

CAPT Dwight Holland, PhD
4827 Glenbrook Dr.
Roanoke, VA 24018
(540) 774-3465 FAX (540) 772-6367
dwightholl@aol.com

Maj Glenn Hover
AFRL/XPH
1864 4th Street, St 1
Wright-Patterson AFB, OH 45433-7131
(937) 255-0708 DSN 785; FAX (937) 255-4816
glenn.hover@wpafb.af.mil

Mr. Lester Jee
OPM Crusader
ATTN: SFAE-GCSS-CR-E, Bldg 171
Picatinny Arsenal, NJ 07836
(973) 724-5208 DSN 880; FAX (973) 724-2221
ljee@pica.army.mil

Mr. Todd Jones
Army Evaluation Center
4501 Ford Ave., Suite 920
Alexandria, VA 22302
(703) 681-0766 FAX (703) 681-9787
jonestodd@usaec.army.mil

Mr. Richard Kozycki
Army Research Lab-HRED
AMSRL-HR-MB Bldg 459
Aberdeen Proving Ground, MD 21005
(410) 278-5880 DSN 298; FAX (410) 278-5032
rkozycki@arl.mil

Dr. Kenneth P. LaSala, IEEE
KPL Systems
703 Cannon Road
Silver Spring, MD 20904-3323
(301) 625-9457 FAX (301) 625-9457
kplsys@prodigy.net

Dr. David Lenorovitz
Crown Consulting, Inc.
7247 South Ingalls Way
Littleton, CO 80128
(303) 979-2748 FAX (303) 979-7308
drlenorovitz@acm.org

Dr. Carl Lickteig
US ARI
2423 Morande Street
Fort Knox, KY 40121-5620
(502) 624-6528 DSN 464; FAX (502) 624-8113
carl.lickteig@knox.army.mil

LT Loukia Loukopoulos, PhD, MSC
NASA-Ames Research Center
HF Res & Tech. Div, MS 262-4
Moffett Field, CA 94043
(650) 604-2843 (650) 604-3323
llouko@mail.arc.nasa.gov

Mr. William Lytle
Reusable Space Transp Sys, Lockheed Martin
MS DC 3005, PO Box 179
Denver, CO 80201-0179
(303) 971-8972 FAX (303) 971-3174
william.b.lytle@lmco.com

Dr. Thomas McCloy
FAA; AAR-100, Rm. 907
800 Independence Ave., S. W.
Washington, DC 20591
(202) 267-7167 FAX (202) 267-5797
tom.mccloy@faa.gov

Mr. Michael McCluskey
NAWC-TSD
12350 Research Parkway
Orlando, FL 32826-3224
(407) 380-4990 DSN 960; FAX (407) 380-4007
mccluskeymr@navair.navy.mil

Dr. Joe W. McDaniel
AFRL/HECI
2210 8th St, Bldg 146
Wright-Patterson AFB, OH 45433-7511
(937) 255-2558 DSN 785; FAX (937) 656-4547
joe.mcdaniel@wpafb.af.mil

Ms. Lori McDonnoll
MS 262-4
NASA Ames Research Center
Moffett Field, CA 94035
(650) 604-0838 (650) 604-3729
lmcdonnell@mail.arc.nasa.gov

Dr. Grant McMillan
AFRL/HECP, Bldg. 33
2255 H St
Wright-Patterson AFB, OH 45433-7022
(937) 255-8750 DSN 785; FAX (937) 255-8752
grant.mcmillan@wpafb.af.mil

Mr. Stephen C. Merriman
The Boeing Company c/o Raytheon Systems
MS-269 P.O. Box 660246
Dallas, TX 75266-0246
(972) 344-7578 FAX (972) 664-0092
stephen.c.merriman@boeing.com,
scmerriman@at tbi.com

Mr. Thomas Metzler
Booz Allen/HSIAC
Bldg. 196, 2261 Monahan Way
Wright-Patterson AFB, OH 45433-7022
(937) 255-6623 DSN 785; FAX (937) 255-4823
thomas.metzler@wpafb.af.mil

Dr. Dwight Miller
Dept. 7733, MS 0746
Sandia National Labs
Albuquerque, NM 87185-0746
(505) 845-9803 (505) 845-9815
dpmille@sandia.gov

Dr. James C. Miller
AFRL/HEPM
2504 Gillingham Dr., Ste 25
Brooks AFB, TX 78235-5104
(210) 536-6371 DSN 240; FAX (210) 536-2761
jcmiller@brooks.af.mil

Dr. Thomas M. Mitchell
CHI Systems, Inc.
12000 Research Parkway, Suite 120
Orlando, FL 32826
(407) 277-0907 FAX (407) 277-0625
tom_mitchell@chiinc.com

LTC(P) Robert Morris
US Army War College
605 Baltzell Avenue
Fort Benning, GA 31905
(706) 545-9623 DSN 835; FAX (706) 545-9623
morrisr@benning.army.mil

Dr. Jeffrey Morrison
SPAWARSYSCEN Code D44210
53570 Silvergate Ave., Bldg A33, Rm 1405
San Diego, CA 92152-5143
(619) 553-9070 DSN 553; FAX (619) 553-9072
Jmorriso@spawar.navy.mil

Ms. Louida D. Murray
4476 W. Ponds View Dr.
Littleton, CO 80123
(303) 798-2048

Dr. Eric Muth
Clemson University
Dept of Psych., 410C Brackett Hall
Clemson, SC 29634-1355
(864) 656-6741 FAX (864) 656-0358
muth@clemson.edu

Dr. Jennifer Narkevicius
ARINC, Inc.
44423 Airport Rd, Suite 300
California, MD 20619
(301) 863-2300 FAX (301) 863-2331
narkeviciujm@navair.navy.mil

Dr. Thomas Nesthus
FAA CAMI, AAM-510
P.O. Box 25082
Oklahoma City, OK 73125
(405) 954-6297 FAX (405) 954-4852
tom_nesthus@mmacmail.jccbi.gov

Dr. Bob Nullmeyer
AFRL/HEA
6030 S. Kent St.
Mesa, AZ 85212-6061
(480) 988-6561 x283 FAX (480) 988-6285
bob.nullmeyer@williams.af.mil

Ms. Barbara Palmer
AFRL/HEC/HSIAC
2261 Monahan Way, Bldg 196
Wright-Patterson AFB, OH 45433-7022
(937) 255-5215 DSN 785; FAX: (937) 255-4823
barbara.palmer@he.wpafb.af.mil

LT Jim Patrey
HQ USAFA/DFBL
2354 Fairchild Drive
USAF Academy, CO 80840-6228
(719) 333-9891 DSN 333; Fax: 719-333-6711
Jim.Patrey@usafa.af.mil

Capt Carlene Perry
HQ USAFA/DFBL
2354 Fairchild Dr.
USAFA, CO 80840-6228
(719) 333-4173 DSN 333; FAX (719) 333-6711
carlene.perry@usafa.af.mil

LT Henry Phillips
NOMI, Code 341
220 Hovey Road
Pensacola, FL 32508
(850) 452-2257x1091 FAX (850) 452-2144
hlphillips@nomi.med.navy.mil

Mr. Alan Poston
Federal Aviation Administration, AND-202
800 Independence Ave. SW, Rm 339
Washington, DC 20591
(202) 493-4519
alan.poston@faa.gov

Capt Heather Pringle
DFBL Executive Officer
2354 Fairchild Dr., Suite M2
USAF Academy, CO 80840
(719) 333-3188 DSN 333; FAX (719) 333-6711
heather.pringle@usafa.af.mil

Col. Daniel P. Redmond
10704 Bucknell Dr.
Silver Spring, MD 20902
(301) 319-9568 DSN 285; FAX (301) 319-9979
daniel.redmond@na.amedd.army.mil

Dr. Tom Rice
Naval Surface Warfare Center, Dahlgren Div.
G20, 17320 Dahlgren Rd
Dahlgren, VA 22448-5100
(540) 653-4076 FAX (540) 653-4166
ricetj@nswc.navy.mil

Leslie Rogers
8915 S. Green Meadows Court
Highlands Ranch, CO 80126
(303) 971-7049
leslie.ja.rogers@lmco.com

Mr. Larry Rouvelas
PMI Inc., Exec. VP
5951 Halpine Rd.
Rockville, MD 20851
(301) 816-9212 x 203 FAX (703) 995-4508
lrouvelas@pmifit.com

Mr. Jack Saxton
NAVAEOMEDRSCHLAB
51 Hovey Rd.
Pensacola, FL 32508-1046
(850) 452-3287x1148 DSN 922; FAX (850) 452-4479
jsaxton@namrl.navy.mil

CDR John Schmidt
Naval Safety Center
1481 Collingswood Trail
Virginia Beach, VA 23511
(757) 444-3520 DSN 564; FAX (757) 444-7049
jschmidt@safetycenter.navy.mil

LCDR Dylan Schmorrow
DARPA/ITO
3701 North Fairfax Drive
Arlington, VA 22203-1714
(703) 696-0360 DSN 754;
dschmorrow@darpa.mil

LTC Larry Shattuck
US Military Academy
Dept of BS&L, Bldg 601, Rm 281 Cullum Rd
West Point, NY 10996
(845) 938-5629
ll6857@usma.edu

Steven Shope
MSC-3ARP, Box 30001
Las Cruces, NM 88003
(505) 646-2221 FAX (505) 646-2149
shope@sandiaresearch.com

Ms. Becky Singer
167 Queens Crossing
Centerville, OH 45458
(937) 255-2477 DSN 785; FAX (937) 255-4823
becky.singer@wpafb.af.mil

LtCol Daryl Smith
HQ USAFA/DFBL
2354 Fairchild Dr.
USAFA CO 80840-6228
(719) 333 4879 DSN 333; FAX (719) 333-6711
daryl.smith@usafa.af.mil

Maj Scott Smith
SAF/AQIC
1060 Air Force Pentagon
Washington, DC 20330-1060
(703) 588-6416 DSN 425; FAX (703)
scottl.smith@pentagon.af.mil

Dr. Alfred Smith Jr.
45824 Matador Terrace
Sterling, VA 20166
(202) 385-7761 FAX (202) 493-2959
alfred.smith@faa.gov

CDR Tim Steele
OUSD (S&T)/Human Systems
1777 N. Kent St., Ste 9030
Rosslyn, VA 22209
(703) 588-7404 DSN 425; (703) 588-7560
timothy.steele@osd.mil

Dr. John Stewart
ARI Rotary Wing Aviation Research Unit
(Attn: TAPC-ARI-IR), Bldg. 5100
Fort Rucker, AL 36362-5354
(334) 255-9109 DSN 558; FAX (334) 255-9025
stewartj@rwaru.army.mil

HM1 Michael Stiney
Naval Aerospace Medical Research Lab
51 Hovey Road
Pensacola, FL 32508
(850) 452-3287x1154; FAX (850) 452-4479
mstiney@namrl.navy.mil

LCDR David Street
Office of Naval Research (ONR 341)
800 N. Quincy St., Rm 817-6
Arlington, VA 22217
(703) 696-4502 DSN 426; FAX (703) 696-8343
david_street@onr.navy.mil

Dr. Michael Vidulich
AFRL/HECP
2255 H St
Wright-Patterson AFB, OH 45433-7022
(937) 255-8734 DSN 785; FAX (937) 255-8752
michael.vidulich@he.wpafb.af.mil

Dr. Donald Weitzman
FAA/Contractor Support
10240 Dunfries Road
Vienna, VA 22181
(202) 366-1826 (202) 646-5700
don.ctr.weitzman@faa.gov

Dr. C. Wickens
University of Illinois
812 Devonshire
Champaign, IL 61820
(217) 356-0194
cwickens@psych.uiuc.edu

Capt (P) Rob Willis
US Army, Aviation (AH-64A), Dept of SE, UVA
258 Turkey Ridge Road
Charlottesville, VA 22903
(804) 296-7350
kibris97@earthlink.net

LtCol Bill Wimpee
AFRL/HEA
Brooks AFB, TX 78235
DSN 240-3607

Ms. Jody Wojciechowski
US Army Research Lab, HRED
ATTN: AMSRL-HR-S
Aberdeen Proving Ground, MD 21005
(410) 278-8830 DSN 298; FAX (410) 278-5032
jqw@arl.army.mil

Ms. Dawn Woods
AMSSB-RSS-E(N)
100 Kansas St.
Natick, MA 01760-5020
(508) 233-5069 DSN 256; FAX (508) 233-6472
dawn.woods@natick.army.mil