REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	October 1989	Magazine

4. TITLE AND SUBTITLE
Gateway: Volume I Number 1

5. FUNDING NUMBERS
SPO900-94-D-0001

6. AUTHOR(S)
Robert T. Hennessy
Chris Wickens
Lt. Col. John O. Edwards, Jr.
Donald J. Polzella

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Human Systems IAC
2261 Monahan Way, Bldg. 196
WPAFB OH> 45433-7022

8. PERFORMING ORGANIZATION REPORT NUMBER
GWI1

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Defense Technical Information Cntr.
DTIC/AI
Cameron Station
Alexandria, VA 22304-6145

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.
Free to public by contacting the Human Systems IAC.

12b. DISTRIBUTION CODE
A

13. ABSTRACT *(Maximum 200 Words)*

This issue contains articles on the following subjects:1.CSERIAC: Gateway to Ergonomic Information; 2.Head-up Displays and 3-D Technology; 3.Crew System Ergonomics Technologies; 4.Chief Scientist's Report

14. SUBJECT TERMS
CSERIAC Ergonomics Head-Up displays 3-D Technology
Crew Systems Crew Station

15. NUMBER OF PAGES
12

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

VOLUME 1: NUMBER 1 OCTOBER 1989

CSERIAC GATEWAY

PUBLISHED BY THE CREW SYSTEM ERGONOMICS INFORMATION ANALYSIS CENTER

Letter from the Editor:

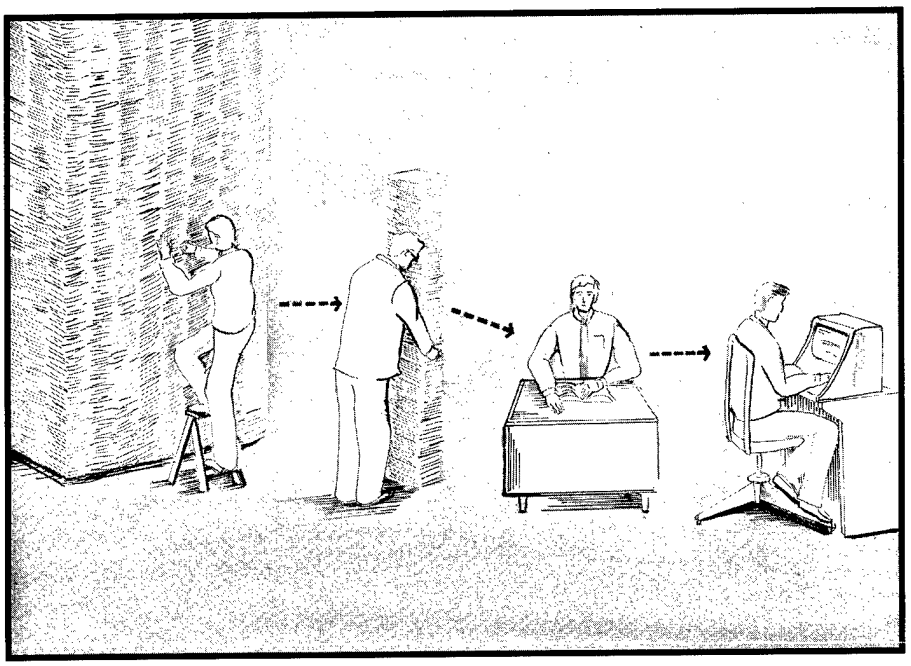
Deborah Licht

If I had been asked nine months ago whether I would ever be the editor of a newsletter for an Information Analysis Center (IAC), I would have said, "What's an Information Analysis Center?" I am sure that I was not alone in my ignorance of what an IAC is and I hope that after reading this first issue of the **CSERIAC Gateway** you will have a better understanding of what IACs are and specifically what CSERIAC can do for you.

The CSERIAC staff heartily believes that the services we offer are high quality and worthwhile, and our customers agree. After finishing each technical inquiry we send a "User Evaluation Form" to our customers, and the majority of those who return them are very satisfied with our services. In spite of the fact that we only opened our doors to customers eight months ago, and are still working out the bugs, I think that we have been

EDITOR, on page 11

In this issue:



CSERIAC: Gateway to Ergonomic Information

Robert T. Hennessy

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

On September 30, 1988, the Defense Logistics Agency established a new national resource, the Crew System Ergonomics Information Analysis Center (CSERIAC). Its mission is to provide ergonomic information analysis services to support research, design, and development of space, air, surface, and subsurface crew systems. In effect CSERIAC is a gateway to worldwide sources of behavioral, biomedical, and engineering information for engineers, designers, and human factors specialists.

CSERIAC is hosted by the Harry G. Armstrong Aerospace Medical Research Laboratory (AAMRL), Human Systems Division, Wright-Patterson Air Force Base, Ohio, and is operated for the Department of Defense (DoD) by the University of Dayton Research Institute (UDRI). Its staff consists of professional analysts who are expert in crew system ergonomics. Drs. Jay G. Pollack, Lawrence D. Howell, and Donald J. Polzella, all with UDRI, are the CSERIAC director, associate director, and chief scientist, respectively. Dr. Kenneth R. Boff and Lieutenant Colonel John O. Edwards, Jr., both with AAMRL, are the DoD technical director and program manager, respectively.

A steering committee monitors and guides CSERIAC to ensure that it serves the broad community of users and does not become parochial in its activities. The steering committee is composed of members from the Army (Human Engineering Laboratory; Army Research Institute;

HENNESSY, on page 5

TECH TRANSFER

It's no news that the government saving money is of utmost importance. But many people aren't aware of some of the innovative government programs being implemented to achieve this goal. One of these programs, and one of the most important activities of CSERIAC, is the transfer of technologies between developers and potential users. CSERIAC's goal is to promote the mutually beneficial exchange of crew system ergonomics technical products and services. Such technologies may include computer-based system analysis tools and models, research methodologies, databases, handbooks, directories, and conference proceedings. Although CSERIAC may itself develop technologies, its primary role in technology transfer is as "gatekeeper" for facilitating access to potentially useful technologies that already exist but may be unknown or inaccessible.

The principal vehicle for accomplishing this mission is a CSERIAC "compendium" of technologies available for transfer. This compendium, containing descriptions and procedures for access to the technologies, will be distributed as part of CSERIAC's current awareness program. Currently, the compendium includes 16 technologies, most of which were developed at our host organization, the USAF Armstrong Aerospace Medical Research Laboratory (AAMRL). As we increase our contacts with other Tri-Service, NASA, and government R&D facilities, additional technologies will be added. User access to the technologies is provided by CSERIAC on a cost-recovery basis. The following technologies are currently available for access.

Computer-based technologies include two systems analysis toolkits: the *Generic System Analyst Workstation* (GENSAW), which comprises a large set of sophisticated analytical capabilities, and the *User-Assisted Test and Evaluation Methodology Assistant Program* (TEMAP), which provides links between critical test and evaluation issues and potential problem-solving procedures and guidelines.

Models include computer-aided design (CAD) simulations of the human operator, such as the *Computerized Biomechanical Man-Model* (COMBIMAN) and *CREW CHIEF* (these are fully described elswhere in the **Gateway**.); biodynamic simulations of human bodily response to abrupt accelerations and impacts, such as the *Head-Spine* and *Articulated Total Body* (ATB) models; and a model for calculating air vehicle detectability for man-in-the-loop electro-optical or visual sensor systems, the *Optical Signature, Acquisition and Detection System* (OSADS).

CSERIAC can provide access to three human factors/ergonomics databases. The *Biodynamics Data Bank* (BDB), a repository for data from impact acceleration experiments conducted at the Biodynamics Division of AAMRL, contains a variety of bibliographic, methodological, and statistical data. The *STRES Battery Data Base*, when implemented by 1990, will contain the records of experiments using the battery of seven tests of cognitive and motor performance. This data base was developed by the NATO Advisory Group for Aerospace Research & Development (NATO/AGARD) for use in evaluating the effects of stressors on human performance. The *Anthropometric Data Base*, developed by the Center for Anthropometric Research Data at AAMRL, is an on-line data base containing several hundred measurements of the human body across large population samples from numerous published anthropometric surveys.

TRANSFER, on page 10

THE COTR SPEAKS

Lt. Col. John O. Edwards, Jr.

Welcome to an exciting new approach to information dissemination tailored to the human factors community! Thanks to the talent and perseverance of Dr. Ken Boff at AAMRL, CSERIAC became a reality last fall with the award of a contract to the University of Dayton Research Institute (UDRI) to operate CSERIAC for the next five years. Since that time, I have been the COTR (Contracting Officer's Technical Representative), working closely with Ken Boff and the UDRI personnel to ensure that Ken's vision survived through CSERIAC's infancy stage. An essential cornerstone in CSERIAC's foundation was provided by Mr. Charlie Bates, the Director of the Human Engineering Division at AAMRL. His support both financially and as a mentor was often the difference between success and failure. It's been an interesting year: identifying and hiring a very capable staff at CSERIAC, finding sufficient funding to keep the doors open and pay the telephone bills, and developing an approach to ensure the continued viability of CSERIAC in the current fiscally anorexic environment in DoD. I am proud to announce that we have now survived to our adolescent stage and are eager to expand our customer base and the menu of services we offer. One of the serendipitous features of getting involved with CSERIAC now is that individuals and organizations still have the opportunity to influence the future direction of CSERIAC's activities. As funding ceilings are approached, there will be less

COTR, on page 4

CHIEF SCIENTIST'S REPORT

Donald J. Polzella

CSERIAC provides a variety of products and services in fulfilling its "core" mission to acquire, analyze, and disseminate specialized crew system ergonomics technical information. These products and services include handbooks and data books, state-of-the-art reports and technology assessments, research directories, abstracts and indexes, symposia, workshops and short courses, and customized responses to technical and bibliographic inquiries from engineers and designers. Current core activities of the CSERIAC technical staff are summarized below.

Each year CSERIAC issues at least two state-of-the-art reports (SOARs). The primary objective of these SOARs is to provide readers with timely summaries of the status of crew system ergonomics technologies that are pertinent to current research, development, test and evaluation (RDT&E) decision-making. The SOARs' usefulness extends from the bench to all levels of RDT&E management. Most important, the material in each SOAR is developed and presented in a form that is useful and understandable to those who plan, develop, and design crew systems.

CSERIAC plans to issue three SOARs this year. Chris Wickens of the University of Illinois is preparing an interesting SOAR on "3-D Display Technologies," which will include perceptual analysis and evaluation of aviation flight path guidance displays, tactical and other situation awareness displays, and meteorologic, geographic, and cartographic displays. A detailed article by Chris Wickens describing issues addressed in his SOAR is included in this issue of the CSERIAC Gateway. Dan Weintraub of the University of Michigan's Human Performance Center is preparing a similar SOAR on "Head-Up Display (HUD) Technologies." Finally, Phil Duncan of Search Technology, Inc. is completing a SOAR on "Group Decision Making" in complex operational person-machine environments. His SOAR will include a review of the literature, an analysis of three gripping real-world events—the Three-Mile Island, Iranian Airbus, and Tenerife accidents—and concrete prescriptions for enhancing group decision-making.

CSERIAC regularly sponsors symposia, workshops, and short courses to apprise scientists and engineers of important developments in crew system ergonomics and to provide opportunities for professional development. A recent example (27 February - 3 March 1989) was the "Advanced Cockpit Displays and Controls" short course for engineers, scientists, and program managers. This course was coordinated by Lawrence Tannas (Tannas Electronics) for the University of Dayton School of Engineering and was co-sponsored by CSERIAC. The demand for this short course was so great that the course was offered a second time in June. The response from attendees of both sessions was overwhelmingly positive.

This summer we conducted two workshops for the Harry G. Armstrong Aerospace Medical Research Laboratory. The first (10-12 July) was a presentation of "Research Methods for Measurement of Heart Rate and Respiration in Laboratory, Simulator, and Flight Environments" and involved the participation of scientists from Germany, Holland, the U.K., Canada, and the U.S. There were vigorous discussions during the workshop concerning issues of data collection, reduction, analysis, problems, and recommendations for

CHIEF, on page 7

Head-Up Displays and 3-D Technology

Chris Wickens

In many systems the human operator must navigate through and maintain positional awareness of a continuous space. Piloting an aircraft or driving a vehicle is a typical example. So also is the task of monitoring the value of three interacting flight stability parameters, as a helicopter performs a dynamic maneuver. These tasks impose a tremendous load on the human visual system which receives most of its information through foveal vision. Two new display technologies are rapidly evolving to address these issues. First, head-up displays (HUDs) may be used to superimpose critical instrument information on the view of the outside world so that both may fall within foveal vision at one time. Second, synthetic three-dimensional displays are being developed to convey a sense of the three-dimensional world, even in the absence of the direct visual viewing. While both techniques make good intuitive sense, many issues remain to be resolved regarding their utility, implementation, and optimization.

Regarding the HUD, for example, at what distance should the HUD image be projected? At optical infinity, or closer? Will problems arise if too much symbology is presented on the HUD and it obscures the world beyond? More seriously, is there danger that the pilot or driver might "tunnel in" on the HUD information, while forgetting to monitor the visual world beyond, in a way that would be unlikely with head-down instrumentation? Some of these and other questions have hard answers, based on solid empirical data.

HEAD-UP, on page 10

COTR, from page 2
flexibility in programming.

What is this heavenly vision concerning ergonomics information, one might reasonably ask, especially since most data generating, gathering, analyzing, and disseminating dreams these days tend to turn into nightmares from Dante's domain? The ultimate goal is to provide to every designer, researcher, decision maker, and manager who has a crew system ergonomics problem a ready link to individuals, organizations, and data bases throughout the world who can solve their problem. Notice I didn't say "answer their question." Answering questions is a satisfactory first step, but ideally CSERIAC will function to examine the situations and problems behind the questions, ensure that the right questions are being asked, and then deliver the correct solutions in the most timely and efficient manner possible. All central and peripheral activities at CSERIAC will contribute to achieving this goal in some fashion. This past year those activities have ranged from answering scores of technical inquiries; conducting several workshops which provided answers to specific technical questions from users; sponsoring courses that provided relevant human factors information to those who actually use it in their daily jobs; distributing the *Engineering Data Compendium,* a landmark reference tool on human sensory, perceptual, and performance data; establishing a relationship with crew system ergonomics experts worldwide as part of CSERIAC's expert network; and conducting several special tasks for DoD organizations. This list is by no means comprehensive of all the products and services provided to date. Other articles in this and future newsletters will provide more information on completed and ongoing activities.

Recently we welcomed Dr. Larry Howell as the new Associate Director for CSERIAC. His military, aviation, and joint service experiences complement his relevant education in such areas as engineering and operations research. Under his capable leadership we plan for CSERIAC to truly "go public" in the coming year, significantly increasing its scope of activities. Our staff will continue to grow as we undertake new special tasks for our users and expand our technical inquiry and technology transfer services. Feedback from our customers to date has been excellent; they are often surprised that a government entity can provide such quick response to their needs. Satisfying our customers is the number one goal at CSERIAC; all other considerations are secondary. We look forward to meeting and serving more of you in the coming year. Give us a call and you may be surprised that we can make your daily workload a little lighter! ●

A Landmark Human Engineering Reference for System Design

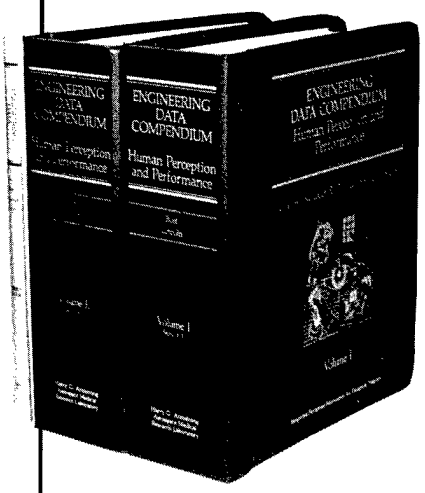
We are pleased to announce that the *Engineering Data Compendium: Human Perception and Performance* (edited by Kenneth R. Boff, Ph.D. and Janet E. Lincoln, Ph.D.) is available through CSERIAC. The *Compendium* is a professional reference tool that consolidates human sensory/perceptual and performance data in a form useful to system designers. It provides comprehensive information on the capabilities and limitations of the human operator, with special emphasis on those variables that affect the operator's ability to acquire, process, and make use of task-critical information. The *Compendium* has been developed specifically for system designers who need an easily accessible and reliable source of human performance data. Scientists and engineers involved in research and development will also find the *Compendium* useful.

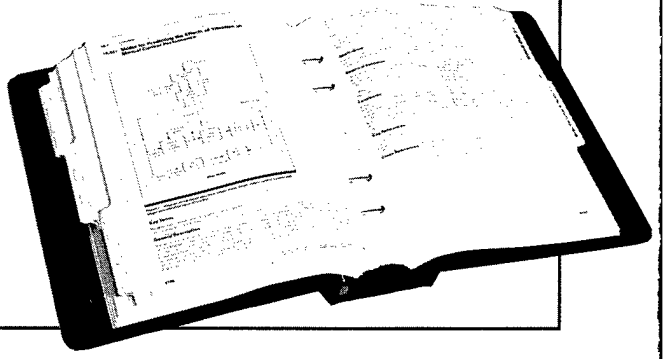
The *Compendium* consists of brief, encyclopedia-type entries incorporating the following types of information:

- basic human performance data
- summary tables integrating data from related studies
- descriptions of human perceptual phenomena
- models and quantitative laws
- background information and tutorials on specific topics

The *Compendium* contains over 1100 entries incorporating nearly 2000 figures, tables, and illustrations.

The cost of the three-volume set with the *User's Guide* is $295.00. U.S. orders are shipped postpaid, while foreign orders are charged for shipping. For further information contact the CSERIAC Program Office.





HENNESSEY, from page 1

MANPRINT), Navy (Naval Air Forces Atlantic Fleet; Naval Ocean System Center), Air Force (AAMRL), and NASA (Johnson Space Center).

Information Analysis Centers

Most human factors specialists working on defense systems have had occasion to use the services of the Defense Technical Information Center (DTIC) or the National Technical Information Service (NTIS). Both store and, on request, provide copies of documents produced at government expense and supply specialized bibliographies based on key word searches of their data base.

Although these are valuable services, the users must decide what documents and bibliographic search strategies will yield the needed information. A common problem is the uncertainty that the documents relevant to a particular need have been found. Moreover, users are burdened with the analytical and interpretive tasks of extracting, evaluating, and integrating the information contained in the source documents. These tasks are especially difficult for users whose expertise differs from that of the authors of the documents.

To alleviate these burdens, the DoD has established a network of over 20 Information Analysis Centers (IACs) to provide services that go well beyond basic document retrieval functions. IACs perform the time-consuming and difficult search, analysis, and interpretation tasks and supply users with up-to-date information in the desired form. The type of information covered by each IAC encompasses a clearly defined content area or specialized field of significant DoD interest or concern.

Crew System Ergonomics Information

Crew System Ergonomics (CSE) information meets the test of being a specialized area of significant concern to the DoD. CSE information is the joint product of human-oriented data and knowledge that come from research and the engineering lessons learned from existing equipment. CSE information focuses on human and equipment characteristics that enhance and support, or degrade and debilitate, crew performance and well being in complex, real-world military situations and activities.

The domain of CSE information accessible through CSERIAC is the interaction of humans with equipment in aerospace, land, and sea environments. It extends in the human direction to the fields of biomedical, physiological, behavioral, and cognitive functions. The core scientific and technical knowledge and data include human characteristics, abilities, limitations, physiological needs, performance, body dimensions, biomechanical dynamics, strength, and tolerances. CSE information extends in the equipment direction to engineering and design data about equipment used by or supportive of military crew members. The data cover visual and auditory displays, manual and voice controls, automated and intelligent aiding systems, the operational and functional characteristics of mission systems, and those intended to support the well being, survival, and escape of crew members.

Need and Justification for CSERIAC

The motivation to create CSERIAC came from the evident need for CSE information that is more than abstractions or extractions from the primary human factors, biomedical, and engineering literature. Prior to CSERIAC no central activity was dedicated to the sifting, distillation, and reformulation of data from the scientific and engineering literature that is a prerequisite to making CSE information accessible and applicable to individual design and development projects.

The possibility of establishing a DoD Information Analysis Center for CSE was first raised by Kenneth Boff of AAMRL. As a primary user and generator of CSE information, AAMRL frequently encounters difficulties and delays in compiling CSE information to meet the needs of its own divisions and the Air Force activities it supports.

To determine the extent of the problem of obtaining usable CSE information, AAMRL conducted a questionnaire survey of the community of CSE information users in 1985. The primary purpose of the survey was to determine the prevalence and importance of problems encountered in obtaining CSE information, what CSE topics are of primary concern, what services in what form would best fulfill the needs for CSE information, and whether a DoD IAC would be accepted and used as an appropriate mechanism for obtaining CSE information. A secondary purpose was to discover what sources of CSE information were currently used.

A 14-item questionnaire was mailed to 3705 individuals within the DoD and industry likely to have an interest in aerospace CSE. Of the 1022 returned, 829 questionnaires were usable for analysis. The background data on the respondents confirmed their interest in and use of CSE information. Of the respondents, 79% work in research and development, management, or design. In all, 97% use CSE information.

The principal results of the questionnaire survey are easily summarized. Of the 829 respondents, 87% agree that a central source of CSE information services is needed and 67% agree that a DoD CSERIAC is the appropriate mechanism to meet this need. Of the total, 78% are willing to pay fees for CSERIAC services. Over 4000 requests per year for CSERIAC services would be made by the survey respondents alone.

The most frequent or important CSE information problems were the following (percentages of respondents agreeing are shown in parentheses):

HENNESSEY, on page 9

Crew System Ergonomics Technologies

The following article includes detailed information on two of the technologies available for transfer through CSERIAC. Each **CSERIAC Gateway** will feature similar articles, highlighting other crew system ergonomics technologies available through CSERIAC.

COMBIMAN

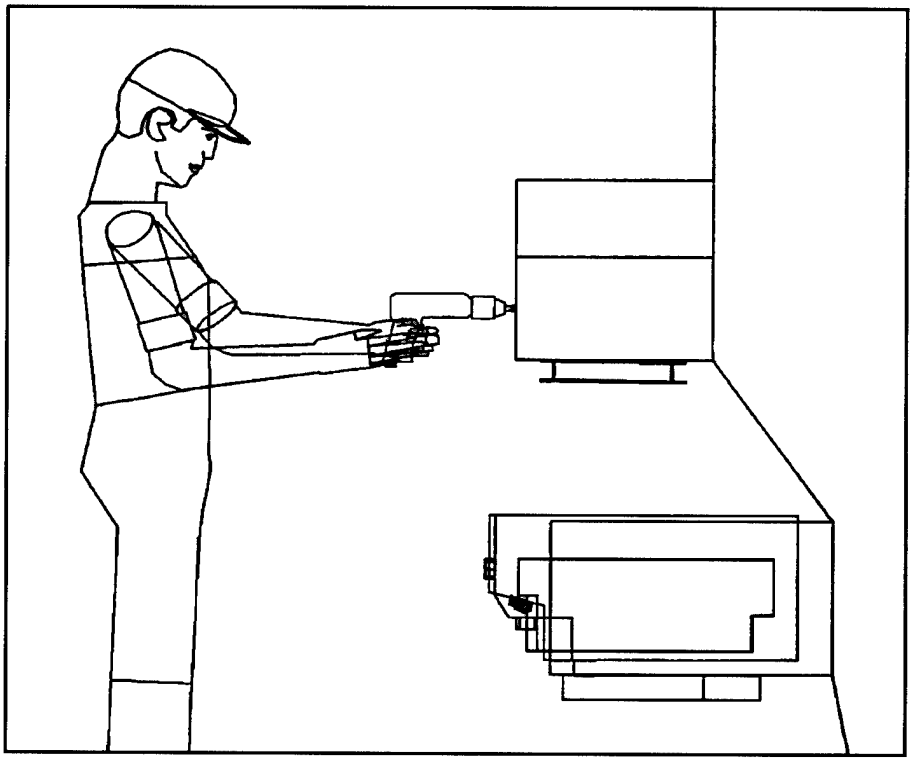
During the design and analysis stages of crew station development, it is important to determine the capabilities, inadequacies, and dangers of the crew station environment with respect to the human operator. The conventional method for accomplishing this has been to build mockups and to use test pilots to evaluate the work environment and control placement. The mockups generally are costly and time-consuming to build, as well as somewhat inflexible during testing.

The COMputerized BIomechanical MAN-Model (COMBIMAN) system of programs has been developed by the Harry G. Armstrong Aerospace Medical Research Laboratory to assist in the design and analysis stages of crew station development. COMBIMAN is a three-dimensional interactive computer-graphics model of an aircraft pilot, which can be used to evaluate the physical accommodation of the pilot to existing or conceptual crewstation designs. COMBIMAN performs four types of analyses: fit analysis, visibility analysis, reach analysis, and analysis of strength needed for operating controls with the arms and legs. The designer is given complete control over the body size and proportions of the man-model, which is specified using a 35-segment link system that functionally corresponds to the human skeletal system. The crewstation is evaluated by interaction with the man-model. Although presented on a two-dimensional display, the crewstation and man-model are three-dimensional and can be rotated for viewing at any angle. The COMBIMAN should reduce the need for building mockups, as the designer can construct a crew station in three dimensions on a CRT and can assess interactions using man-models of various body sizes and proportions.

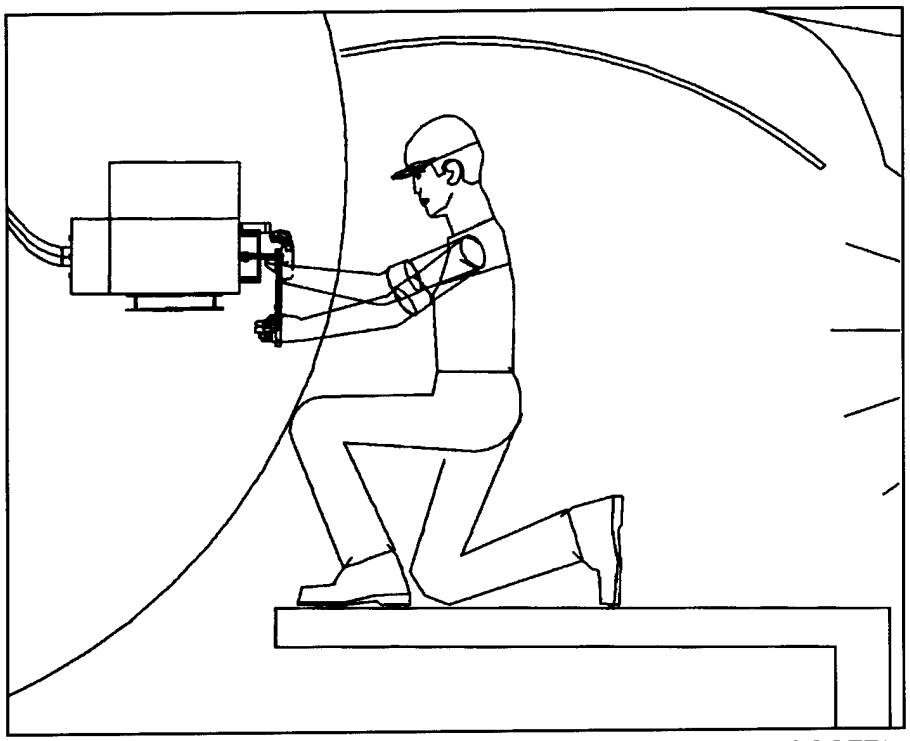
CREW CHIEF

An estimated 35% of the lifetime cost of a military system is expended on maintenance. Excessive repair time is often caused by inadequate consideration of maintenance during the system design stage. Design problems are often discovered only after a detailed hardware mockup has been constructed, when changes are difficult and costly. CREW CHIEF, an interactive Computer Aided Design (CAD) model of an aircraft maintenance technician, will reduce the incidence of such problems by providing designers a tool for early identification of design-related maintainability problems. CREW CHIEF will aid the designer by analyzing the interaction of maintenance technicians' physical capabilities and the design elements related to specific maintenance tasks. The correction of design defects in aircraft maintenance crewstations will be possible early in the design stage.

CREW CHIEF was developed by the Harry G. Armstrong Aerospace Medical Research Laboratory and the Air Force Human Resources Laboratory. The CREW CHIEF system of programs is designed to interact with those Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) software packages often used by aerospace manufacturers. CREW CHIEF is actually an expert system that allows the designer to simu-



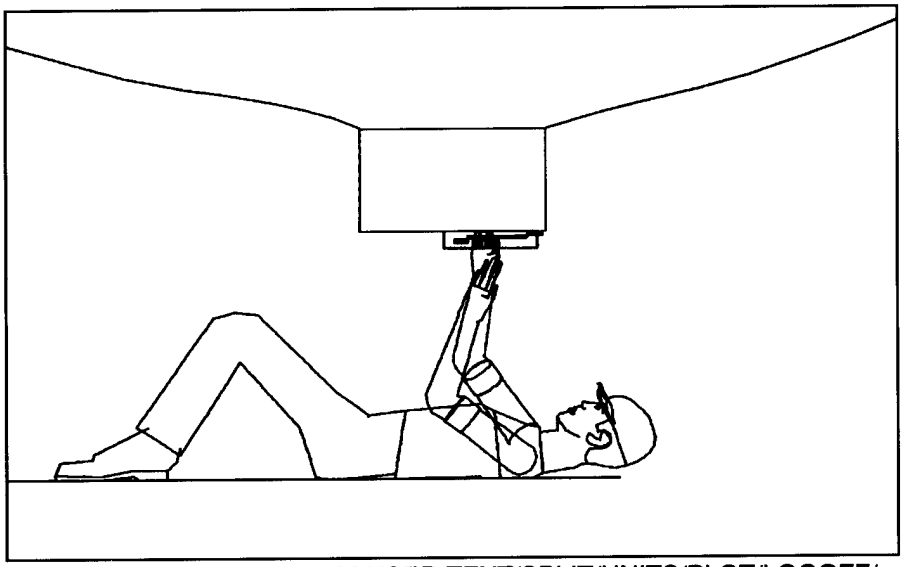
/START/CALL/FILE/DATA-M/USER/TEXT/SPLIT/UNITS/PLOT/LOGOFF/



/START/CALL/FILE/DATA-M/USER/TEXT/SPLIT/UNITS/PLOT/LOGOFF/

late a maintenance activity using computer-generated imagery and to determine whether required activities are feasible for a given crewstation configuration. CREW CHIEF creates a three-dimensional man-model that incorporates (1) correct body size and proportions of both male and female operators; (2) the presence of clothing and personal protective equipment; (3) mobility limitations of particular working postures; (4) access limitations for reaching into confined areas with hands, tools, or other objects; (5) visual limitations; and (6) strength requirements.

For further information on CREW CHIEF or COMBIMAN contact the CSERIAC Program Office. ●



/START/CALL/FILE/DATA-M/USER/TEXT/SPLIT/UNITS/PLOT/LOGOFF/

CHIEF, from page 3
current and future applications. The second workshop (24-25 July) concerned "Future Metrics and Models for Assessment of Human/System Performance in Advanced Military Systems." This workshop resulted in productive discussions of new models of human performance assessment to be used in advanced military systems (e.g., super cockpit, virtual world). These two workshops were held at the Bergamo Center in Dayton, Ohio, a unique educational center. Both of these efforts will result in published proceedings, which will be available for general distribution.

Much of the day-to-day activity of the CSERIAC technical staff is concerned with responding to numerous user requests for bibliographic and technical information related to the ergonomics of crew system design. Each request receives the personal attention of expert technical and bibliographic information analysts who compile the requested information and communicate the results to the user. Typically, a user request for information begins with a telephone call to CSERIAC in which the user describes a design problem that requires human performance-related data for its solution-recommended luminance specifications for a particular display, for example. Depending on the problem, CSERIAC may search appropriate computerized bibliographic databases, handbooks or data books from its core library, or may contact leading technical experts within its network who can facilitate access to the necessary information. The CSERIAC staff spends an average of 4-5 hours of technical and/or bibliographic analysis responding to each request.

The following are representative of the more than 60 requests we have received from the tri-services

CHIEF, on page 9

"SPECIAL" TASKS

CSERIAC offers a variety of services to support the incorporation of crew system ergonomics in the design and operation of crew systems. The average amount of time to respond to requests for technical information is approximately 4-5 hours. By special arrangement CSERIAC can also perform more in depth customized studies/tasks that are relevant to crew system ergonomics. These special tasks must be approved by the contract monitor. Two special tasks that CSERIAC is currently performing, Aircraft Mishap Prevention (AMP) Program and Cockpit Automation Technology (CAT), are described below.

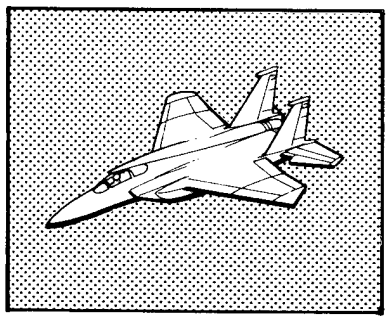
Aircraft Mishap Prevention Program

The tragic crash of Flight 232 in Sioux City, Iowa, drew immediate attention to aviation safety. Predictably, as time passes, attention will fade, until inevitably another catastrophe occurs and the public will once again voice its concern about the safety of aviation. Aircraft safety is also of critical importance to the military. So called "human factors" have been implicated in more than two-thirds of the United States Air Force (USAF) Class "A" aircraft mishaps since 1977. These have led to fatalities as well as being a costly drain on the resources of the USAF in terms of dollars, manpower, and operational readiness. A similar situation exists for the other services. As a result, there is a pressing need for a system to promote effective transfer of human factors information revealed through accident investigation and prevention efforts to the operational community.

The Air Force Inspection and Safety Center (AFISC), at Norton Air Force Base, California, has a validated requirement for such a program, while the Human Systems Division of the Air Force Systems Command is responsible for program development. Overall, the Aircraft Mishap Prevention (AMP) Program will eventually address human factors issues in aircraft mishaps as a key part of its formal mishap prevention program for the USAF. In short, the AMP program is being developed to provide the USAF with a more timely, accurate, and comprehensive understanding of mishap phenomena to facilitate the development of preventive measures. The goals of AMP are to use mishap, safety, and human factors data to:

1) support the investigation of human factors aspects of aircraft mishaps;
2) identify, evaluate, and track human factors countermeasures;
3) analyze the human factors relations among operations employment and maintenance activities and then assess risks;
4) set priorities of human factors problems based on severity and frequency; and
5) assess deficiencies in human factors engineering, training, personnel selection, and supervision.

AFISC and the Human Systems Division (HSD) of the USAF are working to operationally define and programatically develop the concept for a system of staff, hardware, software, and documentation necessary to acquire, store, analyze, and disseminate large amounts of information relating to the human factors of aviation mishaps. The AMP system will provide a means of accessing data from other data bases, local and remote, and will aid in the administration of safety programs by systematically analyzing information and presenting it concisely to the user. Although its purpose is to prevent aircraft mishaps, the AMP system will also record lessons learned that will have broad application in ground and weapons mishap prevention. CSERIAC is contributing information analysis services to the AFISC and HSD for evaluating the requirements analysis from the contractor-prepared deliverables for the AMP system as well as providing human performance data and analyses.



CSERIAC to Host CAT DCADS

CSERIAC has been selected by the USAF Cockpit Automation Technology (CAT) Project Office to host and transition the CAT Designers' Computer-Aided Design System (DCADS) to the user community. The overall objective of the CAT program is to develop and apply a structured process to the design of advanced crew systems to ensure efficient use of pilot abilities, and to make the best use of cockpit automation to improve mission performance. CSERIAC will operate and maintain both hardware and software related to DCADS and act as a central store of expertise, information, and data on CAT. CSERIAC, through the use of the CAT design tools, will assist users in the acquisition and analysis of crew system interface design data.

The CAT process methodology will be made available to the user community as it matures and is delivered to CSERIAC by the CAT

TASKS, on page 11

HENNESSEY, from page 5

1. Difficulty in maintaining awareness of technical analytical information that is available (59%)
2. Information not specific to particular needs (39%)
3. The needed information does not exist (37%)
4. Poor quality of information (36%)
5. Delay time to obtain needed information (35%)
6. Information not clearly and succinctly presented (34%)

The results of the survey confirmed the need to improve the specific applicability and quality of CSE information.

Based on the results of the survey, in 1987 AAMRL submitted a proposal and operational plan to the Defense Logistics Agency to establish CSERIAC. The complete results of the survey and a detailed description of the implementation plan for CSERIAC are contained in an AAMRL technical report (Hennessy and McCauley, 1986).

CSERIAC Operations, Functions, and Services

CSERIAC will not duplicate repository functions nor will it become a giant, meta-data base infringing on the activities of other facilities. CSERIAC will establish links with national and international scientific and engineering data collections and information repositories with holdings relevant to CSE. These sources will be the foundation for CSERIAC to construct reviews, analyses, and summaries of information on CSE topics of interest to its customers.

CSERIAC will produce some information products periodically and on a preplanned basis. These include a newsletter, current awareness bulletins, abstracts and indexes, research directories, technology assessments, and state-of-the-art reviews.

Many of CSERIAC's services will go well beyond traditional information retrieval. For example, CSERIAC will help in revising and developing military standards and specifications and compendia of ergonomic and human factors data.

One of the most ambitious activities of CSERIAC will be the maintenance, development, and dissemination of computer-based models of human operators. At present most CSE models are developed and used in one location and are not readily accessible to the potentially large community of users. CSERIAC will not necessarily be the arbiter of the contents or function of various models, but it can provide the services of maintaining configuration control and facilitating the transfer of a model to a customer's computer system.

One of the most efficient means to access CSE information is to talk to an engineer or scientist who has been working on a specific problem or project. Through its "expert network," CSERIAC will facilitate contact among CSE information users by keeping abreast of who is doing what and providing referrals for simple requests. ●

References

Hennessy, R. T., and McCauley, M. E. (1986, September). *Proposal and justification to establish a Department of Defense crew systems ergonomics information analysis center (CSERIAC)* (Tech. Report AAMRL-TR-86-022). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

CHIEF, from page 7

and industry since January:

- bibliographic information on the effects of multiple stressors on crew performance
- a review of test procedures and performance characteristics of second- and third-generation night vision goggles
- bibliographic and patent information on anti-fatigue seat cushions
- a content analysis of existing definitions of *human factors, ergonomics,* and *human factors engineering*
- a functional analysis of the relationship between CRT raster scan characteristics and symbol legibility
- performance data comparing thumb-wheel and keypad control interfaces
- selection criteria for helicopter aircrew personnel
- finger/hand injury data with applications to auto-express window system design
- information on the effects of windscreen canopy glare and cockpit lighting on visibility during night flying missions
- range of ambient light conditions encountered on ship bridges
- foot-pedal reaction time
- the impact of locomotive noise on auditory sensitivity

Our customers have included the US Naval Air Development Center, Air Force Inspection and Safety Center, NASA-Ames Research Center, Army Research Institute, Armstrong Aerospace Medical Research Laboratory, Naval Training Systems Center, General Dynamics, ITT, Boeing Military Airplane Company, Northrop, General Motors, and Texas Instruments. ●

TRANSFER, from page 2

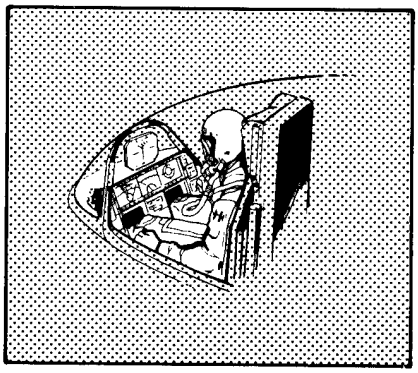
Three computerized technologies are available for support of research design and methodology. SWAT, the *Subjective Workload Assessment Technique*, is one of the best known and most frequently used metrics for assessing human operator workload. The *Criterion Task Set* (CTS) is a battery of nine easily implemented tests designed to measure human performance within a resource allocation framework. The interactive *User-Assisted Automated Experimental (Test) Design Program* (AED) enables the use of optimal designs for test and evaluation.

Finally, there are crew system ergonomics design aids in the form of text and related media. These include (1) the *Proceedings* of a 1988 NATO/AGARD conference on "Applications of Human Performance Models to System Design" and a *Model Directory*; (2) a HyperText (BETA test) version of *MIL-STD 1472D*, developed under sponsorship of the US Army Human Engineering Laboratory; and (3) Boff and Lincoln's (1988) encyclopedic four-volume "*Engineering Data Compendium*," a professional reference tool that consolidates human sensory/perceptual and performance data in a form useful to system designers.

Any questions concerning these technologies should be directed to the CSERIAC Program Office. The compendium of technologies will be available for distribution in the near future. ●

HEAD–UP, from page 3

Others can be answered with less certainty. In an upcoming State-Of-the-Art-Report (SOAR), we will attempt to summarize and integrate these data.



Regarding three-dimensional displays, there are a number of properties a designer may build into a display to convey a sense of depth. These range from relatively graphic factors like incorporating perspective, hidden lines and texture into a two-dimensional picture, to the implementation of a more salient sense of depth through binocular disparity, or holography. Yet vivid, salient depth cues are not obtained without cost. On the one hand the cost will be realized in terms of the extra technology necessary to implement binocular disparity, or the extra computer power necessary to update high-fidelity dynamic three-dimensional scenes in real time. On the other hand it is well known that efforts to convey three-dimensional information on a two-dimensional surface run the risk of illusion and ambiguities, and often make absolute estimations of distance uncertain in a way that they are not with two-dimensional displays, even though the latter present a less "holistic" picture of the relation among the three dimensions. The SOAR will consider the development of 3-D display technology and the nature of these tradeoffs between two- and three-dimensional displays in a variety of domains (e.g., aircraft control, air traffic control, graphic data analysis, tactical situation displays). It will address the characteristics that can be effectively built into 3-D displays to reduce ambiguities. ●

Chris Wickens, Aviation Research Laboratory, University of Illinois, is preparing the SOAR on "3-D Display Technologies." Dan Weintraub, Human Performance Center, University of Michigan, is preparing the SOAR on "Head-Up Display (HUD) Technologies." Both SOARs will be distributed by CSERIAC.

DTIC '89 ANNUAL USERS CONFERENCE

DTIC YOUR KEY TO INFORMATION

The Defense Technical Information Center (DTIC) will host DTIC '89 Annual Users Conference from October 30, 1989 to November 3, 1989 at the Ramada Hotel-Old Town, 901 North Fairfax Street, Alexandria, Virginia, (703)683-6000. The Conference offers a full week of practical sessions and state-of-the-art information. The theme is DTIC - Your Key to Information. The registration fee is $145 for registration until October 20, 1989. Late registration is $170. The American Defense Preparedness Association is handling registration. They can be reached at (703) 522-1820. The Defense Technical Information Center point of contact is Ms. Kay Grigsby, (202) 274-3848 or Autovon 284-3848. Conference notices will be mailed in September. ●

See You In October

EDITOR, from page 1
very successful in meeting the needs of our customers.

This first newsletter is in part designed to enlighten readers as to the products and services that CSERIAC offers. Future newsletters will contain more current awareness information such as new developments in crew systems, upcoming conferences and workshops, newly awarded contracts involving human factors, and many more items to keep you up to date in the field. The **CSERIAC Gateway** will include regular columns on government programs involved in crew system ergonomics, technology transfer products available through CSERIAC, words from the Chief Scientist on CSERIAC core activity, and a feature article written by a national or international expert on crew system ergonomics.

We would appreciate any feedback you can offer in regard to the **CSERIAC Gateway**. Is there a specific content area you'd like to see covered in the newsletter? Do you have suggestions for ongoing columns? Do you have an idea for a feature article? What do system engineers really need to know about human factors? Articles submitted by our readers are welcomed.

Now that I know what an IAC is and what CSERIAC's potential is, I'd like to share a story that I think will illustrate our greatest strength and our biggest asset to the CSE design community. Several months ago I processed a request for bibliographic information on 6-degree-of-freedom forced-feedback hand controllers. Several weeks later I got a request for bibliographic information on hand controllers with multiple additional manipulation controls. After talking to the second customer it became obvious that these two designers were facing similar problems and would likely benefit from interacting with each other. Subsequent to my intervention (I put them in touch with each other) they had several fruitful discussions. This informal networking service that we offer, as well as our more formal expert network, I think will be CSERIAC's greatest contribution to the CSE design community. ●

Deborah Licht

CSERIAC Program Office

Dr. Lawrence Howell
Associate Director
Dr. Donald Polzella
Chief Scientist
Deborah Licht
CSE Analyst
Cindy Day
CSE Analyst
Thomas Hinson
Computer Analyst
Timothy Medlock
Computer Analyst
Jeffrey Landis
Administrative Officer
Mike Gravelle
Technical Assistant
Ellen Bordewisch
Secretary

TASKS, from page 8
Project Office and Boeing Advanced Systems (BAS). BAS is the prime contractor for the final phase of development and implementation of the CAT methodology. CSERIAC is scheduled to begin receiving hardware for implementing DCADS this month. For further information on hosted CAT process methodology and the current CAT software tools and databases accessible through CSERIAC, contact the CSERIAC Program Office. ●

HOW TO OBTAIN CSERIAC SERVICES

CSERIAC can be accessed by telephone, facsimile, mail, electronic mail, or in person. Below is the information necessary to reach CSERIAC:.

Telephone ..... (513) 255-4842
Autovon 785-4842
Facsimile ..... (513) 255-4823
Electronic Mail
..... CSERIAC%MERLIN@AAMRL.AF.MIL
Address ..... CSERIAC Program Office
AAMRL/HE/CSERIAC
Wright-Patterson AFB, OH 45433-6573

Users are encouraged to request information services directly from CSERIAC when information analyses, evaluations, or judgments are needed. Donald J. Polzella, Ph.D., serves as Chief Scientist and Deborah M. Licht, M.A., serves as CSE Analyst. They process all incoming requests for technical and bibliographic inquiries. Then they assign the request to a member of the technical staff. Polzella also serves as technical director for workshops and conferences organized by CSERIAC, as well as managing technology transfers.

The marketing and sales of CSERIAC products, including the *Engineering Data Compendium,* are handled by Jeffrey A. Landis, Administrative Officer. Mr. Landis also serves as administrator for workshops and conferences.

Special tasks require approval by the Program Manager, Lt. Col. John O. Edwards, Jr. He can be reached by telephone at (513) 255-8868 (Autovon 785-8868).

If you have any questions regarding CSERIAC's services or would like to make a request, please contact us via one of the modes given above. ●

CSERIAC
ARMY NAVY AIR FORCE NASA NATO

NEWS FROM the CREW SYSTEM ERGONOMICS INFORMATION ANALYSIS CENTER

• CSERIAC SERVICES - WHAT ARE THEY AND HOW TO OBTAIN THEM • THE STATE-OF-THE-ART ON HUD DISPLAYS AND 3-D TECHNOLOGY • ACCESS TO CREW SYSTEM ERGONOMICS TECHNOLOGY • AIRCRAFT MISHAP PREVENTION PROGRAM

AAMRL/HE/CSERIAC • WRIGHT-PATTERSON AIR FORCE BASE • OHIO 45433-6573

We Couldn't Have Done It Without You

Our thanks go to the following individuals for their assistance in answering technical inquiries and participating in our network:

Joe McDaniel (Armstrong Aerospace Medical Research Lab./HEG), Judith Hecht (U.D.Research Inst.), Cathy Collins (UDRI), the WRDC Librarians (WPAFB), Chris Wickens (Univ. of Illinois), Frank DaPolito (Univ. of Dayton, Psychology Dept.), Andy Rose (American Institutes for Research), Dick Pew (BBN Laboratories), Ed Rash (U.S. Army Aeromedical Research Laboratory), Roberta Calderwood (Klein Assoc.), Kathleen Robinette (AAMRL/HEG), Jeff McDonald (Ft. Eustus), Frank Malkin (Human Engineering Laboratory), Charles Nixon (AAMRL/BBA), Albert Hughes (FMC Corp.), Julien Christensen (Universal Energy Systems), Baruch Fischhoff (Carnegie-Mellon Univ.), Al Fregley (AFOSR), Lorraine Duffy (A.F. Human Resources Lab./LRG), Mike McFarren (AAMRL/HED), Lloyd Laubach (Univ. Of Dayton), Bob Beecher (Dayton, OH), Jeffrey Sachs (Center for Disease Control, Atlanta), Paul Naitoh (U.S. Naval Health Research Center), David Kobus (NHRC), Tom Moore (AAMRL/BBA), Lee Stroslin (ARI, Environmental Medicine), David Post (AAMRL/HEA), Lew Hann (AAMRL/HEX), and .....

CSERIAC Steering Committee Members

Mr. Charles Bates, Jr., Chairman
Human Engineering Division, Director,
Armstrong Aerospace Medical Research Laboratory

Dr. Kenneth Boff
Human Engineering Division/Technology Integration Office,
Director of Design Technology
Armstrong Aerospace Medical Research Laboratory

Dr. Harold Boober
Headquarters, Department of the Army,
Director MANPRINT Office
Office of the Deputy Chief of Staff for Personnel

Mr. Dean Westerman
U.S. Army Laboratory Command,
Information Manager
Human Engineering Laboratory

Lt. Commander Micheline Eyraud
Aviation Medical Safety Officer, Chief
Naval Air Forces Atlantic Fleet

Mr. Charles Gainer
U.S Army Research Institute Field Unit,
Division Chief
Fort Rucker

Mr. Joseph P. Loftus, Jr.
Lyndon B. Johnson Space Flight Center,
Assistant Director
National Aeronautics and Space Administration

Dr. David Meister
Human Factors & Organizational Systems Laboratory
Naval Ocean Systems Center

Please help with our mailing list by informing us of changes, additions, or corrections. Also let us know if you are receiving duplicate copies of the newsletter.