MANPRINT BULLETIN

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Artificial Intelligence for Training High-Tech Skills: The MACH III Maintenance Tutor

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As weapon systems become more sophisticated, the technicians who maintain them need increasingly higher levels of knowledge and skill. Given limitations on training time and access to operational equipment, traditional Army platform instruction is straining to produce skilled maintenance technicians. The Army Research Institute (ARI) has developed an intelligent maintenance tutor, the MACH III, to support instruction for the HAWK air defense guided missile system. The MACH III is designed to lessen the burden on HAWK equipment while helping students acquire expertise in complex troubleshooting.

Problem: The Cost of Hands-on Training

Maintenance mechanics need years of experience to master the firing section of the HAWK, which includes the intricate AN/MPQ-57 High Powered Illuminating Radar (HIPIR). Training for firing section mechanics at the U.S. Army Air Defense Artillery School (USAADASCH), Fort Bliss, Texas, has relied on lecture, hands-on training on the HIPIR, and intensive mentoring by instructors. The cost of a single HIPIR exceeds $3 million, and its use in training reduces the supply of radars ready for operational deployment. Moreover, if an instructor is unavailable during a hands-on exercise, students must sift through a library of technical manuals to find explanations of system functions.

INSIDE THIS ISSUE . . .

A variety of subjects is covered in this last issue of 1990:- everything from MANPRINT and IMA to MANPRINT training through ALMC.

ARI's Approach: Developing a Simulation that Explains Itself

Working with USAADASCH, ARI applied new developments in artificial intelligence (AI) and cognitive science to build the MACH III, a simulator that can replace the HIPIR during training and can explain its functions much as an instructor would.

With MACH III, students can work system controls and observe indicators of system function or malfunction. They can explore simulated faults while being coached by the intelligent tutor. The tutor demonstrates correct troubleshooting strategy, helps to

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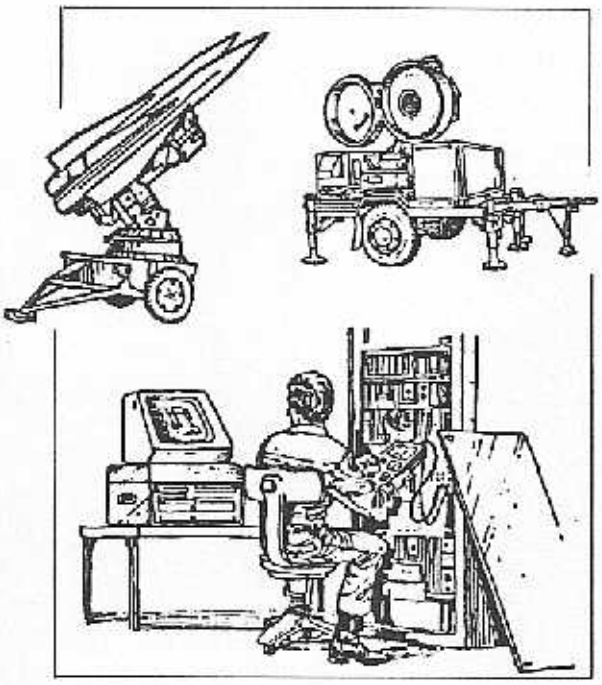
Forgotten Area (continued from page 1)



correct misconceptions, prompts the recall of relevant knowledge, evaluates students' performance, and adaptively generates explanations. The tutor schedules exercises that require graduated levels of expertise so that students gain increasing understanding of how the radar works and develop a basic set of troubleshooting skills.

Expected Savings

Now used in HAWK maintenance instruction at USAADASCH, the MACH III has demonstrated that AI technology can be effectively implemented in the Army training environment. The tutor is being formally evaluated by the TRADOC Analysis Command, U.S. Missile Range, White Sands, New Mexico. For purposes of the evaluation, a MACH-III workstation at $75,000 replaces a $3 million HIPIR. While final replacement ratios await the outcome of the evaluation, estimates are that three of the nine HIPIRs now used in training at the school could be replaced by three workstations, for a total savings of over $8.7 million. In addition, the MACH III is expected to free up valuable personnel resources by relieving instructors of lengthy one-on-one tutoring.

For more information, contact Dr. Melissa Holland, Training Research Laboratory, USARI, 5001 Eisenhower Avenue, Alexandria, VA 22333; AV 284-5540 or COM (703) 274-5540; FAX (703) 274-5616.

? DID YOU KNOW?

- CH-47D safety issues are looked at twice at CH-47D System Safety Working Group meetings. Any MANPRINT-generated safety issue is also considered at the group's quarterly meetings. MANPRINT field survey issues previously addressed by the CH-47D MANPRINT Joint Working Group (MJWG) were also recently addressed by the group for safety impact. This additional review does not diminish or curtail the MJWG's responsibility for safety under the auspices of MANPRINT. The CH-47 Project Manager's MANPRINT coordinator, Bob Thompson, is responsible for ensuring that MANPRINT safety issues are addressed at System Safety Working Group meetings (AV 693-1440, COM (314) 263-1440).

- In the U.S. Navy ship *Vincennes*, there are 23.5 tons of paper—tech manuals!—above the main deck.

- GEN William G.T. Tuttle, Jr. Commander, U.S. Army Materiel Command, in a recent *Army RDA Bulletin*, was quoted reiterating his support of MANPRINT objectives. He asked in an Atlanta conference of senior Army and industry representatives: "Most important of all—will soldiers say good things about the materiel we give them—that it does the job well and keeps them safe?"

The Army Forum - MANPRINT Net

The Army Forum - MANPRINT Net is back in operation. This is an especially useful tool for passing important information about the MANPRINT Program and also for sharing news and items of interest on various projects you may be working on.

If you have been a user of the net in the past, it is time to get active again. If you have never used the net and would like to join, please contact LTC Shaw at AV 225-9213 or COM (703) 695-9213 for more information.

IMA: MANPRINT's Forgotten Area

Robert N. Riviello
HAY Systems, Inc.

The MANPRINT concept has matured greatly since the early days of 1984. The concept is effectively embedded in materiel acquisition regulations and directives, and the Army is using MANPRINT to resolve soldier-machine interface issues that in the past have cost the Army valuable resources. But has there been a forgotten area? What has been done to embed MANPRINT in the Information Mission Area (IMA)?

The IMA consists of five distinct areas: automation, communications, visual information, records management, and printing and publications. Since the formation of the mission area, the Army's investment in it has increased to over $2.2 billion. Over the past three years, however, 119 separate audits and investigations in the information systems arena have reported many unfavorable findings. The application of MANPRINT in IMA might have helped reduce the deficiencies and improved performance and cost factors.

As an example, at a recent In-Process Review (IPR) of a software system being fielded to the total Army, the logistician asked if soldiers would be involved in the operation or maintenance of the system. Although the answer was yes, that "soldier" was not identified. Because a Qualitative and Quantitative Personnel Requirements Information (QQPRI) had not been prepared, the applicable Military Occupational Specialty (MOS) was unidentified. Compounding the problem, because a System Training Plan (STRAP) was never initiated, an effective training strategy or concept was not developed. Although new equipment training teams were fielded for this system, no New Equipment Training Plan (NETP) had been written. As a result, one of the major problems associated with fielding the system was training!

This system is an excellent example of an IMA system gone astray and in serious trouble. Could application of MANPRINT have made a difference? The development of a System MANPRINT Management Plan (SMMP) might have made a impact. The development of a Target Audience Description (TAD) might have better identified the user; perhaps a manufacturer's plan for managing MANPRINT concerns would have resolved some problems.

MANPRINT is not institutionalized in IMA system development and acquisition. Why not? One reason has to do with its governing regulations. MANPRINT is effectively embedded in AR 70-1, System Acquisition Policy and Procedures, and AR 71-9, Materiel Objectives and Requirements, as well as in directives regarding the test and evaluation process. This ensures that MANPRINT will be applied throughout the materiel acquisition process. However, IMA is governed by regulations that make little or no mention of MANPRINT. Also, the IMA requirement document process is different, and as a result, MANPRINT is not adequately addressed. Nor is MANPRINT specifically addressed in the requirement definition or in the acquisition solicitation documents of information systems. One of the safeguards for ensuring MANPRINT issues have been resolved is the Army Systems Acquisition Review Council; however, the decision body for IMA systems is the Major Automated Information Systems Review Council (MAISRC). Further, program managers lack guidance on how to conduct MANPRINT activities. The MAISRC Handbook for Program Managers, for example, does not refer to MANPRINT.

How do we fix this deficiency? The new AR 602-2 addresses insertion of MANPRINT in IMA very lightly. Under defined responsibilities, the Director of Information Systems for Command, Control, Communications and Computers and the CG, U.S. Army Information Systems Command, are tasked with implementation of MANPRINT. But revising AR 602-2 will not suffice. MANPRINT must be embedded in IMA regulations and addressed at system milestones to ensure its application. If MANPRINT procedures and techniques must be modified for IMA, this modification should be accomplished to assist developers in their successful application of the program.

Future trends are very clear. Quantum leaps are being made in hardware and software technologies associated with automated systems. The use of cryogenics to lower the temperature of chips to increase speed and storage space, the need for better ergonomics in workstation design, increased health and safety issues, and the increased complex-

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MANPRINT NOTES

From the MANPRINT Program Office

■ **DOD Standardization Areas of Human Factors (HFAC) and Integrated Logistics Support Standards (ILSS).** MANPRINT recently helped to arbitrate a solution to a long-term standardization issue between the HFAC and ILSS communities regarding responsibility for Task Analysis. The issue has been how to present unique human factors task analysis requirements without creating confusion or duplication with existing standards. A 5 June 1990 meeting hosted by the Defense Quality Standardization Office (DQSO) addressed the relationship between a proposed HFAC standard, MIL-STD-1478, and ILSS standards, MIL-STD-1388/1A/2B. The MANPRINT recommendation, which was adopted, was to accept certain portions of the new standard and to modify the existing ILSS to incorporate the rest. Consequently, it was determined that the human performance analysis aspects of Task Analysis will appear in HFAC MIL-STD-1478 (Task Analysis) and the Task Taxonomy and Inventory will appear in Task 301 of MIL-STD-1388-1A (a section of Logistic Support Analysis). MIL-STD1388-2B (part of DOD Requirements for a Logistic Suppport Analysis Record) and its associated Data Item Descriptions (DID) will be modified to include the required Task Inventory language so as to provide both the HFAC and the ILSS communities with their data requirements at the appropriate time. Both standards will be submitted to their lead standardization activities. Then, the DID and standards will be submitted for publication.

■ **Integration of Hazardous Materials Considerations into the Acquisition Process.** The Construction Engineering Research Lab, Corps of Engineers, (under contract with SARD-TT) is looking at how to integrate hazardous material issues into the materiel acquisition process. Focus would be on reducing environmental hazards through optimization of system design. This includes pushing technology to discover alternative materials having fewer environmental impacts, as well as exploring different methods for disposing of environmentally hazardous waste material. They are interested in using the MANPRINT Program to serve as a model for their program to provide a process for: 1) affecting system design, 2) playing successfully in the ASARC/IPR decision process, and 3) institutionalizing this concept. The MANPRINT Directorate will continue to provide assistance, as needed.

■ **Line of Sight Forward Heavy (LOS-F-H) Integrated Logistics Support Review (ILSR).** Subject review was held on 28 June 1990. Some of the more pertinent concerns included failure to attain projected RAM growth, TMDE, significant increase in training time for MOS 27R, and use of interim contractor support vice organic support. Failure to attain projected RAM growth, combined with low BIT/BITE performance, could lead to the program not being supportable from a manpower perspective with programmed personnel. MANPRINT Assessment has been drafted addressing the impact of these issues. The ASARC, upon reconvening, is likely to approve the proposed restructuring of the program, which delays the FUE by two years (to FY 95).

■ **Howitzer Improvement Program.** A special ASARC was convened on 4 Sep 90 to reevaluate the cost (three-fold increase since 1985 estimate), production readiness of the contractor (BMY), the government's acquisition strategy, and operational requirements. Numerous changes have been instituted to effect improvements in these areas. ASARC leadership decided to award letter contract to BMY, allowing for 44 howitzers (LRIP) to be produced. However, before the FY91 option for another 60 vehicles is exercised, another ASARC will be held to review the program. Full and Open Competition has been moved up from FY 95 to FY 92. HIP will allow the Army to realize a savings, both projected and avoidance, in the MANPRINT domains of manpower, personnel, and training.

■ **Mailing List Update.** We are continuing to update the *MANPRINT Bulletin*/POC mailing list. Use the Renewal Request form found on page 11 to send us correct mailing information, and to indicate your desire to be listed as a POC for your organization. The Bulletin and POC List will continue to be sent ONLY to those who respond. Mail or FAX the completed form to the MANPRINT Directorate using address or FAX number found on the form. Thanks!

■ **Bulletin Mailing Delay.** We apologize for the absence of a September/October issue. Production funds were reallocated to support our troops--a worthy cause we feel sure that our readers will understand! We hope to be back on track with this issue. Please bear with us.

DOD HFE Technical Group Looks to the Future

Joseph A. Birt
Universal Energy Systems

Editor's Note: This article was reprinted with permission from the August 1990 issue of the Human Factors Society Bulletin.

In early May 1990 at a plenary session, the Department of Defense Human Factors Engineering Technical Group (DOD HFE TG) turned the attention of its subgroups toward "future directions in a changing defense environment" and hot issues for research, development, training, and education.

Since its inception in the mid-70s, the DOD HFE TG has been affectionately dubbed "Mother Tag" by its government participants. The Mother Tag meets semiannually to bring together the "grass roots movers" across the services, the Coast Guard, and NASA. Participants share their ideas, plans, and ongoing RDT&E to enhance their future work and to avoid duplications. The TG organization does not formalize this cooperation in any bureaucratic way.

Subgroups often meet in conjunction with the Mother Tag, but some periodically hold independent sessions. These subgroups include the areas of: Systems Acquisition; Controls and Displays; Designing for the User; Human Factors in Aviation Screening; Manpower, Personnel, Training, and Safety (MPTS) Integration; Human Factors Test and Evaluation; Manned Systems Modeling; Sustained Operations/Continuous Operations; User-Computer Interaction; Workload Coordination; Human Factors Standardization Steering Committee; and Technical Society/Industry. Mother Tag's special interest groups include the areas of Human Factors and Systems Safety, and Human Engineering Biomedical Devices.

Perspectives and input from outside the government come through invited representatives to the Technical Society/Industry subgroup. About 20 professional and industrial associations, including the Human Factors Society, have sent representatives to the technical group meetings.

Highlights of Invited Presentations

The May plenary session was hosted by the Air Force Munitions Systems Division of Eglin Air Force Base. Invited presentations covered the following areas:

Crew System Ergonomics Information Analysis Center (CSERIAC). Philip Irish covered CSERIAC's products and services, including bibliographic and technical inquiries and software products. (Government and industry may participate in CSERIAC.) One software product, CREW CHIEF, permits computer graphic simulation of an aircraft maintenance technician to evaluate accessibility, strength and visibility.

Naval Health Research Center Research Program Overview. Steve Nice's overview described heat, hydration, cold, high altitude, sleep, and drug studies at the Point Loma (San Diego) lab and at remote locations such as the Persian Gulf.

Speech Intelligibility Testing Research. Astrid Schmidt-Nelson addressed the activities of a digital voice processor consortium. She stressed the need for comparability and repeatability in speech testing.

Performance Assessment Methodology (effects of drugs). In Fred Hegge's presentation on drug-related performance assessment, he asked how performance and risk assessment tools fare in terms of performance, return to duty, missions affected, information management, and quality assurance.

Human Factors after the Cold War. Grace Waldrop suggested future emphases on low-intensity threats, off-the-shelf technology, automated manufacturing, total quality management, training systems, and operational systems--especially timely given the considerable attention focused on defense cuts and peace dividends. The future of human factors capabilities within DOD and associated industries was also discussed. Concern is emerging about

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Mother Tag (continued from page 5)

maintaining such capabilities as national assets that have developed under DOD.

Review of International Standards Organization (ISO) Documents. Gerald Chaikin discussed DOD HFE TG subgroup reviews of new and revised ISO ergonomics standards and programs.

Designing for Performance-Under-Stress. Jeffrey Grossman discussed a joint program between some Navy centers to develop a technical basis for tactical decision making while under stress. Incidents such as *Stark* and *Vincennes* stimulate this much-needed research. The program will analyze and measure decision-making processes, determine combat-like stress effects, use decision support principles, formulate training methods to counteract stress, and develop interfaces that overcome decision biases.

U.S. Air Force Aircrew Error—A Taxonomy. Alan Diehl discussed errors related to Air Force aviation Class A mishaps in three categories: procedural, perceptual-motor, and decision making. He presented preliminary statistics and case studies to discuss error-chains; decision-making concepts; stress-related, risk-taking, and attitude examples; and performance demands related to ability.

Hot Issues

In the plenary session, each subgroup's chair briefly addressed hot issues that deserve RDT&E emphasis from their perspectives. They also discussed on-going subgroup activities, including:

- Design for improved situation awareness
- Validation of workload measures
- "Adaptive mediation" in user-machine allocation
- Availability, usability, and currency of models
- "Spec-ing" and testing human performance
- Fusion of multisensor information
- Decision making under stress
- Distribution of cockpit automation tools
- Mission application of voice recognition.

Highlights from Subgroup Activities

- The Acquisition Subgroup is attending to the form, substance, and human factors ramifications of acquisition streamlining.
- The MPTS Subgroup is concerned with streamlining DOD-level documents as well as incorporating MPTS integration language. The subgroup was challenged to focus on "macro, multidisciplinary early analyses."
- The Designing for the User Subgroup noted that CSERIAC has sent a survey to 5000 potential users of human factors information.
- The Sustained/Continuous Operations Subgroup interacted with a panel of operational people who gave their views based on operations under stress. Captain Rogers of the *Vincennes* related his experiences in Panama.
- The tri-service Human Factors Standardization Steering Committee (HFSSC) meets with the DOD HFE TG and is responsible for obtaining information from defense and industry organizations for use in drafting a DOD HF Standardization Documents Program Plan. Mike Armstrong, who chairs the HFSSC, noted that DOD's desire to cut back on the use of specs and standards, and the fact that human factors standards don't really reflect current technology, represent hot issues.

For more information, contact the Human Factors Society, Inc., P.O. Box 1369, Santa Monica, CA 90406; (213) 394-9793 or FAX (213) 394-2410.

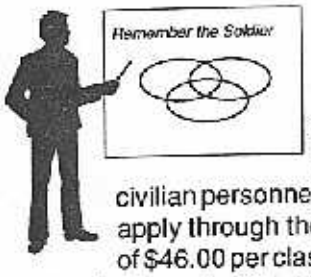
IMA (continued from page 3)

ity of the systems themselves are examples of why MANPRINT must be applied to IMA. Automation touches every aspect of soldiers' daily lives, from eating in the mess hall to movement of household goods to decisions that will guarantee victory on the battlefield. Numerous recent articles have addressed the growing "software crisis" (e.g, *Military Forum*, July 1989). They discuss the use of increased computer code and the resulting complexity not only in soldier-machine interface, but also in the test and maintenance of the software itself.

The MANPRINT and IMA communities must coordinate the steps required to see that this important area of new technology and systems is no longer a "forgotten area."

For more information, contact Bob Riviello, HAY Systems, Inc., 2000 M Street, NW, Suite 600,Washington, DC 20036; (202) 223-3703.

NEXT ISSUE: What's Being Done About It.



Upcoming MANPRINT Training

The Army Logistics Management College (ALMC) will be conducting all MANPRINT Senior Training (MSTC) and Staff Officers (MSOC) courses effective 1 October 1990. This training consists of a 1-week MSTC and a 2-week MSOC. Military and government civilian personnel may apply for these courses through their local training offices. Industry personnel may apply through their government contract administrator. There is a tuition charge for industry personnel of $46.00 per class, per day, unless otherwise waivered. If additional information or enrollment assistance is required, contact the MANPRINT Course Director, Mr. Norman J. Walsh, Jr., or any member of his staff at AV 687-2156/3250 or COM (804) 734-2156/3250. The current FY 91 course schedules are shown below.

MANPRINT Training Schedule

MANPRINT Staff Officers Course (MSOC)
(Length 2 weeks; Course Administration Number ALMC-MS)

Class Number	Class Dates	Applications Due at ALMC	Location
91-002	28 Jan - 8 Feb 91	14 Dec 90	Ft. Lee, VA
91-004	18-29 Mar 91	01 Feb 91	Ft. Lee, VA
91-003	15-26 Apr 91	01 Mar 91	Ft. Lee, VA
91-006	13-24 May 91	27 Mar 91	Ft. Lee, VA
91-007	03-14 Jun 91	19 Apr 91	Ft. Lee, VA
91-008	17-28 Jun 91	03 May 91	Ft. Lee, VA
91-005	08-19 Jul 91	24 May 91	Ft. Lee, VA
91-009	19-30 Aug 91	05 Jul 91	Ft. Lee, VA
91-010	09-20 Sep 91	26 Jul 91	Ft. Lee, VA

MANPRINT Senior Training Course (MSTC)
(Length 5 days; Course Administration Number: ALMC-MT)

Class Number	Class Dates	Applications Due at ALMC	Location
91-001	26-30 Nov 90	12 Oct 90	MICOM, Redstone Arsenal, AL
91-002	10-14 Dec 90	26 Oct 90	Ft. Benning, GA
91-004	14-18 Jan 91	30 Nov 90	Ft. Gordon, GA
91-003	04-08 Mar 91	17 Jan 91	CECOM, Ft. Monmouth, NJ
91-502	11-15 Mar 91	01 Feb 91	Ft. Belvoir, VA
91-005	Cancelled		
91-006	Cancelled		
91-007	01-05 Apr 91	15 Feb 91	AVSCOM, St. Louis, MO
91-008	06-10 May 91	22 Mar 91	Ft. Rucker, AL
91-501	22-26 Jul 91	07 Jun 91	PM TRADE, Orlando ,FL
91-009	29 Jul-02 Aug 91	14 Jun 91	TACOM, Warren, MI
91-010	12-16 Aug 91	28 Jun 91	Ft. Knox, KY

Integrating Soldier/User Concerns in Designing the Individually Carried Record (ICR) System

Chris Occhialini
U.S. Army Soldier Support Center, Combat Developments Directorate

The Individually Carried Record (ICR) system is a soldier-carried record that electronically interfaces with unit automation. To undergo successful implementation and flourish as a system, the ICR must conform to the tenents of MANPRINT. Although the ICR concept appears simple and straightforward, the resultant man-machine equation is quite complex. Several MANPRINT issues must be addressed before the ICR can be fielded. Laying the ICR concept over the MANPRINT grid forces the concept developer and the materiel developer to evaluate the system's impact on manpower, personnel, training, human factors, system safety and health hazards.

The ICR System

The ICR System consists of the Individually Carried Record that each soldier will carry; an interface device that connects to a unit's computer to permit communication with the soldier's ICR; a portable reader/writer that will permit ICR transactions away from the unit's computer; and software to permit application by the functional users. Six functional communities are presently targeted to use the ICR system: personnel, finance, medical, logistics, legal, and military police. Therefore, each hardware component, as well as common and unique user application software, must be reviewed in light of MANPRINT considerations.

During early prototype development of the Soldier Data Tag (SDT), the ICR's predecessor, consideration was given to the size, shape and color of the data carrier, and the application software. Unfortunately, MANPRINT had not yet arrived on the scene, and vendors and concept developers often considered tradition more than the principles of MANPRINT when offering their designs to the Army. Had we implemented the SDT without MANPRINT considerations, the results could have been disastrous. The first concept tests of the SDT did provide several clues to future design of both hardware and software which were later detailed in the ICR System MANPRINT Management Plan (SMMP).

Shaping the ICR System

Manpower. The Army's manpower picture will ultimately affect the outcome of the fielded ICR. Concerns by management in each functional community involve the workload brought on by the introduction of the new system. Most user communities are now having to work with less manpower than they had ten years ago; the forecasts for the next decade do not appear to alleviate this problem. Therefore, the ICR system must be designed to operate effectively with reduced resources, and at the same time, permit more work to be done. As the ICR hardware and software are designed, emphasis must be placed on the speed of each transaction or operation that must be maintained while retaining a high degree of accuracy or proficiency. Transition methodologies also need to be viewed in terms of efficiency and impact on the present workforce.

Personnel. Personnel that are targeted to use the system are those who presently provide soldier and administrative support in the functional communities. These end users will have to demonstrate proficiency using automation instead of paper, in several environments, and wearing different kinds of clothing, to include MOPP gear.

Common software, such as that used to open a file on the ICR or update an entry on the record, will have to be written for and tested by the full range of MOS users from all six functional communities. User-unique software, such as division medical applications, will require medical personnel to judge its functionality before it can be fielded. Fortunately, enough "user friendly" software has been proliferated over the last five years to provide most automation users with a good reference point from which to judge new software.

The handheld reader/writer and the interface device must be designed to accommodate the combat soldier with the same MOS as the soldier who works in garrison. From the early trials of the SDT, it was learned that functional users of the paper system did not have to be computer specialists to use desk top computers. The challenge in the future development of the ICR system will be to provide a small handheld ICR reader/writer that can be used by the target audience without requiring a higher quality workforce or MOS skill level.

Training. With some unit automation already in place, trainers may already be aware of what training will be necessary when introducing the ICR system. An early discovery during SDT testing was the amount of formal training required by users to become proficient with the application software. The time allotted for initial training was approximately three times as long as needed to obtain proficiency. During future ICR testing, trainers will continue to review the training needs of the end user. Embedded training on the functional user's host system, tutorial software, and unit training during the early stages of implementation are now forecasted for the ICR system.

Human Factors. Both the soldier who carries the ICR and the user of the handheld reader and the interface device will be concerned with the size, shape, weight, color and technology used. Field use and acceptance of the portable unit will depend in part on its size, weight, material composition, key pad, display screen, power requirements, and how it can be carried and operated. Soldiers will revert back to the "stubby pencil" mode if the automated system is difficult to use or too cumbersome. One consideration in the design of the ICR is how it will be carried or worn by each soldier and any problems associated with any particular mode of carrying. During the 1983-84 SDT concept tests, it was learned that there was no criticism by the soldiers in how they carried the SDT, whether carried around their necks on a chain, placed on their key chains or in wallets or purses, or carried in pockets. However, the only soldiers to lose or not have the SDTs during testing were those who carried the SDTs in their pockets. User groups, that is, medical, finance and personnel, did not object to how the SDT was presented for use at the unit's computer, but most of the applications were not time-sensitive and reflected a peacetime scenario. Future tests of the ICR must explore where and how the ICR will be worn or carried both on and off the battlefield.

Safety and Health Hazards. The safety of the soldier who carries or wears the ICR, as well as users of the ICR hardware, will require an evaluation of the "signature" that is produced by the equipment, that is, the electronic emissions that might be detected by the enemy. In the case of the ICR system, this is certainly applicable, especially if a radio frequency technology is considered for the transfer of information from the ICR to the reader.

Other factors such as size, color and detectability of material used to encase the electronic memory of the ICR also need to be considered. Protection from electric shock or other physical injury from the interface device and the handheld reader/writer, as well as the data carrier, must be built into the ICR hardware design.

Security. An additional issue, although not considered a MANPRINT domain, is security. ICR system users must be concerned with protecting data security to ensure its integrity in order to reduce risks to the soldier. Concerns over who will have access to the data, as well as who may be able to alter, delete or add information stored within the record, create special challenges for hardware designers and concept developers. The data security issue is perhaps the most common ICR system concern expressed by the Army today. This will necessitate a data carrier design with on-board logic, as well as implementation procedures that require audit trails and supervisory reviews of critical data changes. Portable reader/writers and unit computers will have to use software that limits the use of the ICR system to authorized personnel only.

In summary, there are many MANPRINT concerns relevant to the development of the ICR system. Applying the MANPRINT principles to hardware and software design at each stage in the development cycle will ensure that the ICR system is a solution rather than a burden to both the soldier and the functional user.

For more information, contact Chris Occhialini, Soldier Support Center, ATTN: ATSG-DDB, Ft. Benjamin Harrision, IN 46216-5700; AV 699-3792 or COM (317) 542-3792.