MANPRINT Quarterly
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Soldier Survivability

by LTC Mitch Howell, Chief, MANPRINT Policy

Effective 28 January 1994, the existing six MANPRINT domains officially welcomed a sibling—Soldier Survivability (SSv). SSv is one of the most exciting and important initiatives in the Army today. It seeks to focus acquisition efforts on the best interest of our most important resource—the soldier. SSv is a logical addition to the MANPRINT family because each of the other six domains also focus on the soldier.

Most people think of fratricide when talking about SSv. This is a common misconception. Fratricide is the employment of friendly weapons and munitions with the intent to kill the enemy, or destroy equipment and facilities, which results in the unforeseen and unintentional death of friendly personnel. SSv addresses much, much more. It is defined in terms of the soldier and the system as follows:

- Soldier—those characteristics that enable them to withstand or avoid adverse military action, effects of natural phenomena, loss of effective mission capability, and loss of life.
- System—those characteristics that can reduce fratricide, detectability, and physical and mental fatigue; prevent attack and damage from attack; and minimize medical injury.

It should be clear from these definitions that SSv and fratricide are not synonymous.

Why Do We Need SSv?

Simply stated, the battlefield has changed and the needless loss of life from friendly as well as enemy fire is unacceptable. Primary contributors to the need for SSv are the greater speed and complexity of modern warfare; the enhanced weapons ranges and lethality; and the increase in joint, multinational, and limited visibility operations. An important lesson learned during Operations Just Cause and Desert Storm was that some casualties could be prevented by the research, development, and acquisition of new or improved systems. Several studies conducted after these conflicts

Continued on page 2

contents

Continued from page 1

indicated that SSv received little to no emphasis in requirements documents. If addressed, it appeared as an ancillary requirement of system survivability, and the orientation was generally on the threat versus friendly delivery systems. SSv seeks to refocus the research effort on the soldier, our most important asset and central component of all systems.

Components

SSv has six components:

- fratricide reduction
- detection reduction
- fatigue reduction
- attack prevention
- damage prevention
- medical injury minimization

These components are based on a simple engagement scenario. Procedures employed during the scenario were examined and countermeasures to enhance SSv determined and placed into six categories. It was also noted that five of the components contributed to the sixth one, fratricide reduction.

Fratricide Reduction. There are seven major contributing factors to fratricide. The first five can be grouped into a category called situational awareness. These are incorrect land navigation, improper fire control measures, inadequate control measures, lack of direct fire control, and reporting/communications errors. The other two factors are weapons errors and battlefield hazards.

When considering this aspect of SSv in requirements documents, the MANPRINTer must consider methods to eliminate these problems. These methods are found in two broad categories—Tactics, Techniques, and Procedures (TTP); and materiel and equipment solutions. Obviously, we want to address the least costly methods of eliminating deficiencies first. In the TTP category, practitioners should evaluate the soldier's or system's ability to enhance situational awareness, risk assessment, training, fire control, positive and continuous command and control, and any other relevant system specific data. If the deficiency cannot be eliminated using the above, then materiel and equipment solutions should be examined. Examples of solutions are combat identification systems, common communications equipment, marking kits, and navigation equipment. In the area of fratricide reduction, the effects of friendly systems must also be included in the damage assessment, and steps taken to minimize effects. It is incumbent on each practitioner to examine any possibility that may reduce fratricide.

Detection Reduction. An enemy must first be detected to be engaged in battle. Detection is defined as the ability to discern the presence, existence, fact of being, or location of friendly or enemy forces. The most common means of detection on the battlefield today are visual, thermal infrared, acoustic, electromagnetic, and radar. In seeking to reduce the probability of being detected, we must understand the technologies and methods an adversary may use. This is normally gleaned from threat assessments and other documents. The need to mitigate the effects of enemy technology on SSv must be conveyed in requirements documents.

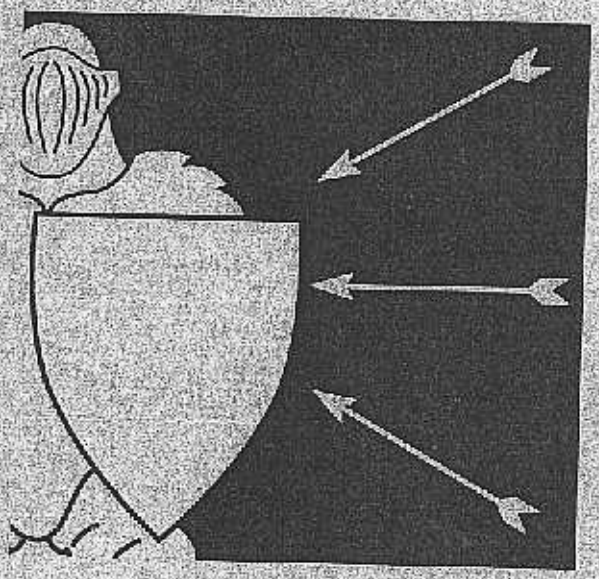
When considering ways to reduce detection, use the least costly methods first. The evolution of detection reduction should proceed from doctrine and training, to low technology, to research and development fixes. Examples of these include position selection, use of camouflage nets, multispectral smoke, and the development of stealth technology or jamming devices.

Attack Prevention. Once detected, the enemy must make the determination to attack. Some of the most common reasons for attack (other than being told to do so) are weapons, munitions and range superiority, lack of countermeasures, incorrect identification, and precedent. We always look for a better widget. But to understand "better" we must understand the characteristics of enemy systems such as range, velocity, capability, timeliness, speed, and maneuverability. SSv seeks to maximize these aspects of ongoing developments to serve as a deterrent from attack, which in turn increases the soldier and system's ability to survive.

As enemy capabilities are evaluated, soldiers in the field must seek to prevent attack through the

use of warning systems, countcrattack systems, and superior combat systems. In the area of fratricide reduction, seek to prevent attack through positive identification systems (electronic and nonelectronic), safety interlocks, and means of enhanced situational awareness.

Damage Prevention. If attacked, how do we minimize damage? First, realize that the effect on soldiers must be considered separately from the effects on vehicles and other systems. Then evaluate the type(s) of threat most likely to be encountered by the soldier and system. Some of the more common battlefield threats are projectiles, biological and chemical hazards, the natural environment, acoustic devices, and laser or other types of directed energy. Of these threats, the natural environment is often overlooked, but history has shown us that it is indeed a formidable opponent.



After determining hazards, requirements for survivability can be addressed. Requirements for optical and aural protection, vaccines and prophylaxis drugs, flak vests and armored crew compartments must be considered. Blast doors and compartmented crew stations are examples of damage prevention measures. As technology progresses, new, innovative techniques must be developed to protect soldiers.

Medical Injury Minimization. Now that we have been attacked, how do we minimize medical injury? Addressing SSv in this area requires the practitioner to be both innovative and deliberate. Anything less might result in the needless loss of life. As such, specific efforts to maintain the soldier's life must be generated. Lightweight systems and self treatment must be considered. Prevention of disabilities and fatalities resulting from injury is essential, as is the necessity to identify medical evacuation requirements, procedures, and capabilities.

Studies of soldier injuries during the Viet Nam era show that the probability of survival increases with timely treatment. One of the most immediate methods of treatment is self treatment. Methods of self treatment previously discarded should be revisited. Examples of self treatment methods include medical and environmental considerations on clothing design, environment, automatic control, hatch design, on board life support systems, and bodily function sensors and monitors. Self and buddy treatment have always been factors during combat operations, however, the equipment and techniques can be revised given current technology to minimize injury and enhance the soldier's probability of survival.

Fatigue Reduction. One of the most critical factors affecting the soldier's ability to survive is fatigue. Continuous operations affect both mental and physical conditions. Mental fatigue is exacerbated by complex systems, psychological impacts, complex decisions, and operational stress. As time between rest increases, and tasks become more complex or demanding, fatigue increases. This leads to lack of judgement, improper risk analysis, and, in some cases, fratricide. The physical aspects of fatigue are intensified by factors such as protective clothing, limited work space, task difficulty, and inadequate sustenance. System subject matter experts and task analyses will assist practitioners in identifying others.

To eliminate mental fatigue, evaluate the utility of simple systems and decision aids. Operations should be designed to be as simple as possible, and higher standards for training can lower the associated mental and physical stress. Crew and work space design can reduce physical fatigue. The size should accommodate continuous opera-

Continued on page 8

MANPRINT AND THE T800 HELICOPTER ENGINE

by Matt DeGarmo, Fu Associates, Ltd.

In 1982 the Army needed a replacement for the aging T53 helicopter engine (used in the UH-1 Huey). Its proposed replacement, designated the T800, was to power the Army's next-generation light attack helicopter, the RAH-66 Comanche, as well as other helicopter variants. For the acquisition community, the T800's development was significant becasue it was the first major Army system to be applied the full weight of MANPRINT.

From the onset it was clear that MANPRINT would have a profound and availing influence on the design of this state-of-the-art helicopter engine. Beginning with the concept development stage, MANPRINT molded the T800's design by influencing initial requirements. These requirements, while strenuous, were flexible enough to provide contractor teams latitude in the decision-making process. By communicating performance-oriented objectives and conveying allowable ranges to the design teams, they were given significant creative license to optimize their designs.

Three contractor teams initially submitted proposals to the Army. During the source selection process, MANPRINT (combined with Integrated Logistics Support [ILS] and Reliability, Availability, and Maintainability [RAM]) was given equal visibility to technical, cost, and production issues. In October 1988, the evaluation process led to the selection of one contractor, the Light Helicopter Turbine Engine Company (LHTEC), a partnership of the Allison Gas Turbine Division of General Motors and the Garrett Engine Division of AlliedSignal Aerospace Company.

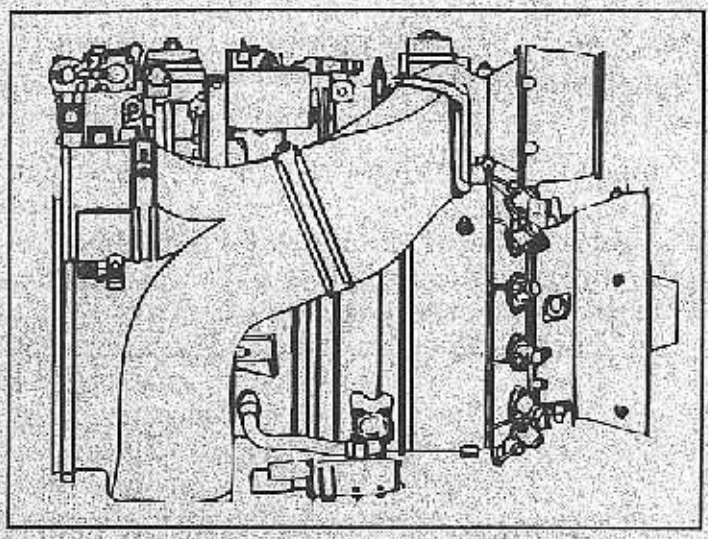
The LHTEC team devoted a large share of their design effort to supporting the MANPRINT concept. This required a high level of commitment and a unique organizational structure that allowed for an efficient and organized flow of information. To facilitate cooperation, personnel from many organizational disciplines were collocated. In addition, all personnel, including users, were free to express their concerns or to solicit design modifications during joint working group meetings. Nobody was excluded from the process.

To help LHTEC achieve their MANPRINT objectives, a variety of analytic methodologies were used including a cognitive requirements model, a functional allocation analysis, a human-engineering design approach document, a math model, and task analyses. These methodologies enabled designers to obtain a wide range of information on available human resources and human performance characteristics. This information was used to improve, validate, and assess the effectiveness of the T800 design on total system performance.

Numerous benefits emanated from LHTEC's human-oriented approach to systems integration. The culmination of these benefits are reflected in the T800's ability to effectively meet its technical requirements while fully supporting the needs of the soldier. The costs of implementing MANPRINT were reportedly low, while the life-cycle costs savings are expected to be significant. Following are examples of a few of these benefits as presented within each MANPRINT domain.

Manpower: The T800 engine was able to reduce manpower requirements by eliminating many of the labor intensive tasks seen in predecessor engines. LHTEC achieved this by such design innovations as reducing the number and complexity of engine parts, using modular components, increasing system reliability, and improving diagnostic, repair and replacement capabilities. By one estimate, the savings in manpower reductions alone could reach $172 million over a 20 year life cycle.

Personnel: The LHTEC team undertook a variety of measures to ensure that required maintenance tasks would not exceed the mental capabilities of present and future maintainers. Information derived from cognitive analyses were merged with other design criteria to develop an



engine that could be supported at specific skill levels without degrading technical performance. Designs developed to support this effort included non-interchangeable parts (to avoid incorrect installation), technical instructions written at the appropriate reading grade level, and simplification of user-level tool requirements.

Training: Lowering the training burden was another benefit of the MANPRINT-influence design effort. The LHTEC team successfully blended design features of the T800 with a comprehensive training package that included a computer-based training and interactive video disk system. By simplifying maintenance tasks, consolidating line replaceable units, and designing other maintainability improvements, the T800 successfully and significantly reduced training requirements.

Human Factors Engineering: In an effort to optimize the performance of human-machine combinations in the T800, LHTEC considered the complexity, accessibility, visibility, and physical and mental compatibility at each development phase. Results of this effort included a number of design innovations such as a reduction in the number of user-level tools (from 134 to 6 common hand tools), improved component accessibility, and the elimination of torquing requirements, "O" rings, gaskets, safety wires, complicated variable geometry, and actuators.

System Safety: To ensure that the T800 engine would be safe to operate and to maintain, LHTEC continually sought to identify, track, and resolve safety risks. Safety features of the T800 engine include high foreign object damage tolerance, ground safety warning placards, six minute power reserve after oil loss, drains for combustible fluids, and low-exposure fuel lines. In addition, LHTEC has augmented its safety measures by contractually imposing safety requirements on their subcontractors and suppliers.

Health Hazards: Throughout the development of the T800, LHTEC worked aggressively to minimize the potential for exposure to short- and long-term health hazards such as toxic materials, noxious fumes, and excessive levels of noise, vibration, and temperature. This was achieved through a process of hazard analysis, hazard tracking and risk resolution. As with system safety, controls were placed on LHTEC's suppliers and subcontractors to ensure compliance with health hazard objectives.

Soldier Survivability: While soldier survivability was not a MANPRINT requirement during the early development of the T800, it is clear that the LHTEC team had incorporated many aspects into their initial design. Examples include an emergency oil system, low total engine noise signature, and minimal vulnerable area.

The T800 engine offers the Army a sensible solution to what was a challenging problem. For LHTEC and the Army, this solution came through diligence, creativity, organization, and a willingness to succeed. By adhering to the MANPRINT principle, a highly effective, human-oriented engine was designed within the constraints of costs, schedule, and available technology. The result is a light helicopter engine that will meet the current and future needs of the Army and the soldier.

Matt DeGarmo is the project manager for a contract currently supporting the DCSPER, MANPRINT Directorate. He holds a commercial pilot license and has a B.A. in Geography and a M.A. in International Transactions.

Army Analytical Tools for System Design: Two Affordable Approaches

by Beverly A. Van Hoff, US Total Army Personnel Command (PERSCOM)
Deputy Chief of Staff for Plans, Force Integration and Analysis (DCSPLANS), MANPRINT Office

Today's diminished resources dictate far fewer system new starts. Future materiel solutions will focus on fine tuning, or otherwise improving the design of systems already fielded. Army decision makers will need affordable analytical tools to identify cost-effective strategies for improving existing system design. This article examines two such tools: the Early Comparability Analysis (ECA) and the Army Occupational Survey Program (AOSP) Resource Intensive Task Data.

Early Comparability Analysis

The ECA is a 12-step, lessons learned approach that has been applied to models for proposed new Army systems (see figure 1). This approach identifies "high-driver" tasks that are costly in manpower, personnel, and training (MPT) resources. The ECA can have continued utility in the future as a "post-fielding" methodology to help fine-tune system redesign. The new focus on modification and non-developmental item (NDI) acquisition instead of new starts, and the application of post-fielding strategies for system redesign, may also shift some of the cost burden for analysis from combat developers to project managers (PMs). The Army will continue to require analyses to identify and resolve MPT issues and battlefield deficiencies. However, a different Army entity may be paying for it.

The ECA is an affordable post-fielding alternative when compared to the high cost of other more complex analytical or expensive engineering methods. Since the costs of MPT resources are high, eliminating, or designing-out a single high driver task from a system could conceivably recoup the cost of an ECA.

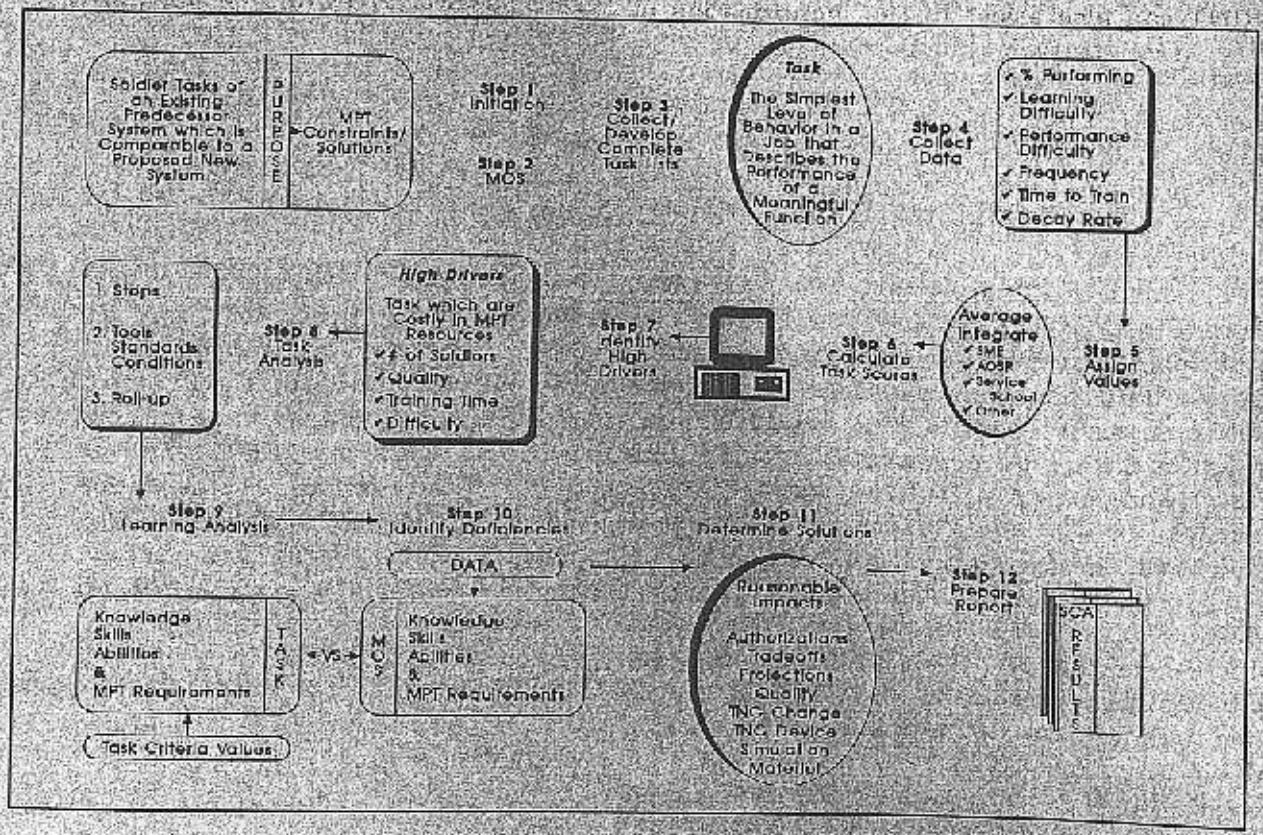


Figure 1: ECA 12-Step Approach

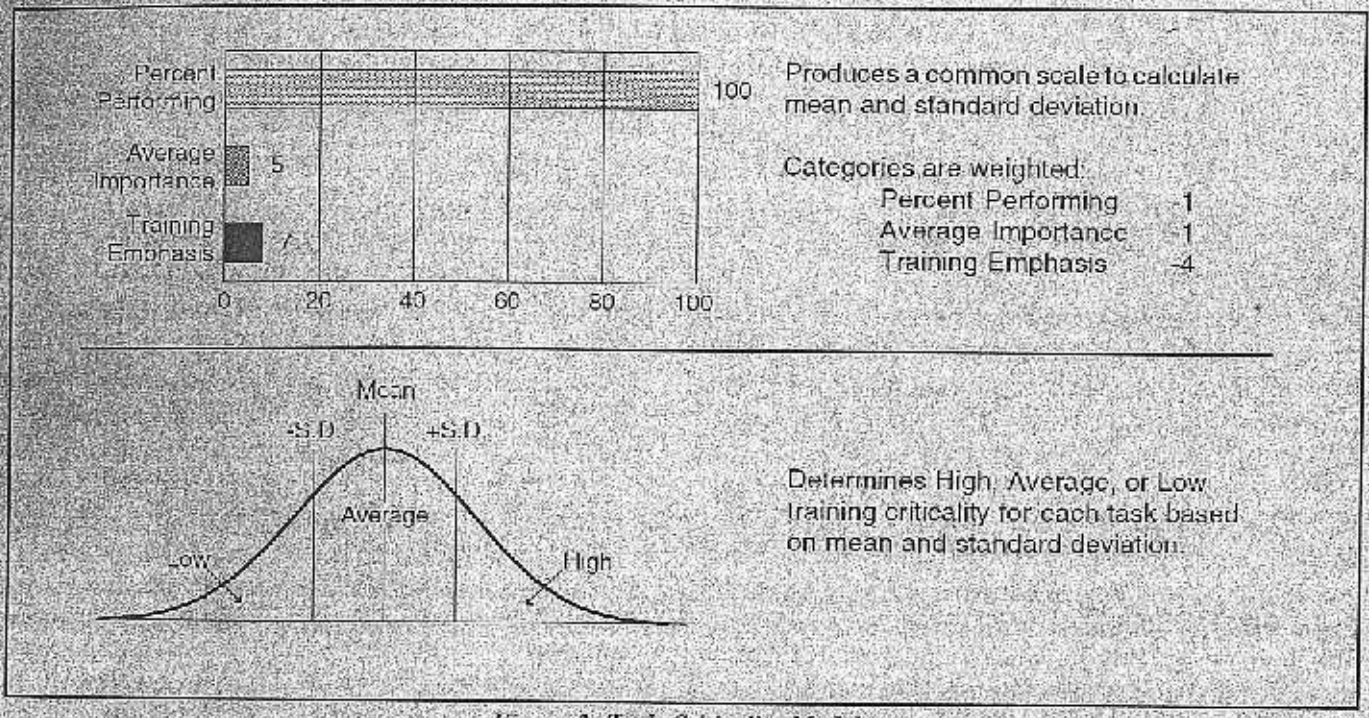


Figure 2. Task Criticality Model.

Army Occupational Survey Program Tasks on FOOTPRINT

The AOSP resource intensive task data on FOOTPRINT can also assist in the identification of alternative strategies for system design. (The AOSP was part of the U.S. Total Army Personnel Command [PERSCOM], but now the program belongs to the Army Research Institute.) The AOSP produces computer-assisted compilations of Army tasks costly in terms of MPT resources. PERSCOM has enhanced the AOSP's data delivery options to make survey task data available to users of the FOOTPRINT Relational Data Base. In the past, survey results were only provided to users in hard copy Comprehensive Occupational Data Analysis Program (CODAP) reports. FOOTPRINT is the Army's primary military MPT data base in support of MANPRINT.

The AOSP, in accordance with AR 611-3, conducts task based, Army-wide surveys of selected Military Occupational Specialties (MOSs) and officer branches. At some future date, survey data may be available for all the MOSs associated with an Army system. Currently, selected MOSs are surveyed as resources permit. The AOSP will use the survey and CODAP processes (to include a task criticality model, see figure 2) to identify resource intensive tasks. The results of this analysis for past, present, and future AOSP surveys will become part of the FOOTPRINT data base on the Decision Support System (DSS). FOOTPRINT users with a HQDA or TRADOC DSS password/ID will eventually have access to resource intensive tasks from 75 officer and enlisted occupational surveys designed specifically to collect data from Operation Desert Storm. This data will be made available on FOOTPRINT as it is generated during FY94. The AOSP develops a new survey schedule on an annual basis.

ECA or AOSP Tasks in FOOTPRINT: It's the PM's Choice

When a PM pays a contractor to conduct an ECA, the contractor performs the 12-step ECA process to identify and analyze the high driver tasks. The product of the analysis is the identification of the MPT deficiencies for each of these tasks, followed by recommended solutions for or observations on needed system design changes. Note that this methodology simply provides recommendations; not actual engineering solutions.

If a PM would rather use AOSP Tasks in FOOTPRINT as a source for proposed or potential resource intensive tasks, an analysis would still be needed to determine trade-offs and associated

Continued on page 8

Continued from page 3

tions (i.e., 50% security), or the work area may be large enough to prevent stooping, squatting, or other unnatural positions. A task analysis, while contributing to crew design, can also lead to a redistribution of physical tasks.

Assessments

The assessment process for SSv is the same process used to evaluate other domains. The Project Manager (PM) requests and funds the assessment conducted by the Army Research Laboratory's Survivability/Lethality Analysis Directorate (SLAD) at Aberdeen Proving Ground, MD. (The Point of Contact [POC] at SLAD is Mr. Rich Zigler, [AMSRL-SL-I], DSN 298-8625.) This assessment is then forwarded to the Human Research and Engineering Directorate (HRED) at Aberdeen for integration into the MANPRINT report. (The POC at HRED is Mr. Frank Paragallo [AMSRL-HR-M], DSN 298-5879.) The final integration report is then sent to HQDA MANPRINT for completion of the DCSPER's ASARC/MAISRC position.

Assessment criteria and parameters, plus a user handbook are being developed jointly by SLAD and HRED. Publication is expected no later than 1 June 1994. Any requests for assistance prior to publication should be addressed to the organizations above.

This article will not make you a SSv expert. However, the examples given will provide an idea of the types of considerations required for the new domain. SSv is critical for future developments and acquisitions. It is here to stay and must be integrated into existing systems. Parts of SSv are addressed by the other domains. This will continue, however, SSv as a domain produces a synergistic effect which focuses on the soldier. Quick fixes to SSv problems during Operation Desert Storm showed that the analysis of problems and the application of existing or emerging technologies saves lives. If we are to realize the full potential of this new sibling, we must approach it energetically, innovatively, and with an open mind.

REMEMBER THE SOLDIER!

LTC Mitch Howell is the Chief of MANPRINT Policy, Training and Education in the ODCSPER MANPRINT Directorate.

Continued from page 7

MPT costs. A hybrid of the two tools could be accomplished by applying the analytical steps of an ECA (steps 8-12) to the AOSP derived tasks, either in-house or by contract. The AOSP tasks on FOOTPRINT are derived from larger samples than the subject matter expert sample sizes typically used for an ECA. These AOSP tasks are collected Army-wide, making the choice of whether to pay for an entire 12-step ECA application or utilize AOSP tasks on FOOTPRINT a trade-off in itself. If larger sample sizes are necessary, the AOSP tool should be the method of choice.

Conclusion

The ECA and AOSP tasks on FOOTPRINT will continue to evolve, possibly supplementing each other. The ECA may be enhanced at some future date to streamline the methodology. The AOSP process may be enhanced to link or cross-reference survey task inventories to logistics support analysis record (LSAR) task inventories under MIL-STD-1388-2B, *DOD Requirements for a Logistic Support Analysis Record*. Both the ECA and AOSP tasks in FOOTPRINT could provide valuable, cost-effective information to help choose alternatives for Army system design.

An *ECA Procedural Guide* and *FOOTPRINT User's Guide* may be obtained from the U.S Total Army Personnel Command, Deputy Chief of Staff for Plans, Force Integration and Analysis (DCSPLANS), ATTN: TAPC-PLM (Mr. Harold Robinett), 200 Stovall Street, Alexandria, VA 22332-1345, DSN 221-2092 or Commercial (703) 325-2092. Information on the AOSP Program, to include surveys planned or in progress, can be obtained from Mr. William Badey, DSN 221-3255 or Commercial (703) 325-3255.

MANPRINT—The Expanding Challenge

The MANPRINT Practitioner's Conference is scheduled for 9-11 August 1994 in the Washington, DC area. Other conference information will be forthcoming. Our theme this year is **MANPRINT—The Expanding Challenge.**

The world of MANPRINT continues to expand on a near daily basis. Several new challenges are on the horizon. All must be fully integrated into our existing world. These include soldier survivability, dual use technologies, acquisition, education, automated information initiatives, tools, and policy revisions to name a few. Our objectives are quite ambitious this year. We are planning to highlight our expanding world while providing a forum to exchange information and ideas. A hands-on/ participative workshop will address critical problems and issues requiring resolution. Selected PMs and industry representatives will show how they have incorporated MANPRINT into programs with outstanding results.

The structure of this year's conference will allow each practitioner the opportunity to actively participate in problem solving and policy generation. Day one will begin with a keynote speaker providing the HQDA perspective, and follow up with a "State of MANPRINT" address. This will be followed by presentations in the morning, and workshops in the afternoon. Attendees will participate in the workshop of their choice. Some of the proposed topics for the hands-on workshops are: MANPRINT tools and methods of use; how to address MANPRINT in acquisition documents; MANPRINT deficiencies and practitioner feedback; dual use technologies; joint/tri-service integration; and MANPRINT and training devices. Day two will follow a similar schedule. Day three will encompass the issue generation and consolidation process followed by a closing address featuring a HQDA principal. If you have suggestions for workshop topics or other aspects of the proposed agenda, please call LTC Mitch Howell at DSN 225-9214 or COM (703)695-9214.

Attendees should anticipate a registration fee. The amount will be minimal and will assist in the professional administration of the conference. Participants from outside the metro DC area will not underwrite the conference with room reservations. You can stay anywhere you wish.

So come one, come all! This is your chance to make a difference. Please mark your calendars. Let's ensure that we all do our part to **REMEMBER THE SOLDIER** as we address **MANPRINT—The Expanding Challenge.**

MANPRINT Training Change Notice

The date has been changed for the MANPRINT for Managers Course #707 ADA School, Ft. Bliss, Texas. It is scheduled for 28-29 June 1994.

Articles & Comments

Articles, comments, and suggestions are welcomed. Submit to: MANPRINT Quarterly, HQDA (DAPE-MR), Washington, DC 20310-0300, USA; DSN 225-9213, COM (703) 695-9213, FAX (703) 695-3195.

MANPRINT Information

POLICY: MANPRINT Directorate, HQDA (DAPE-MR), Washington, DC 20310-0300. DSN 225-9213, COM (703)695-9213.

MANPRINT TRAINING: US Total Army Personnel Command, ATTN: TAPC-PLM, 200 Stovall St., Alexandria, VA 22332-1345. DSN 221-2098, COM (703)325-2098 FAX (703)325-7927.

PROCUREMENT & ACQUISITION: US Army Material Command, ATTN: AMCDE-AQ, 5001 Eisenhower Ave., Alexandria, VA 22333-0001. DSN 284-5696, COM (703)274-5696.

HSI AND OUSD (P&R) RESEARCH INFORMATION/DIRECTORY OF DESIGN SUPPORT METHODS: Defense Technical Information Center, MATRIS Office, DTIC-AM, 53355 Cole Road, San Diego, CA 92152-7213, (619)553-7000, DSN 553-7000, FAX (619)553-7053.

HUMAN FACTORS ENGINEERING STANDARDS & APPLICATIONS: Human Research Engineering Directorate - MICOM Field Element, ATTN: AMSRL-HR-MO, Redstone Arsenal, AL 35898-7290, DSN 746-2048, COM (205)876-2048.

TEST & EVALUATION: Operational Test & Evaluation Command, 4501 Ford Ave., Alexandria, VA 22302-1458, COM (703)756-2487.

HEALTH HAZARD ASSESSMENT: US Army Environmental Hygiene Agency, Health Hazard Assessment Office, ATTN: HSHB-MO-A, Aberdeen Proving Ground, MD 21010-5422, DSN 584-2925, COM (410)671-2925, or E-mail: HSHBMOA@AEHA1.APGEA.ARMY.MIL.

Harold R. Booher

Harold R. Booher
Director for MANPRINT

The MANPRINT Quarterly is an official bulletin of the Office of the Deputy Chief of Staff for Personnel (ODCSPER), Department of the Army. The Manpower and Personnel Integration (MANPRINT) program (AR 602-2) is a comprehensive management and technical initiative to enhance human performance and reliability during weapons system and equipment design, development, and production. MANPRINT encompasses the seven domains of manpower, personnel, training, human factors engineering, system safety, health hazards, and soldier survivability. The focus of MANPRINT is to integrate technology, people, and force structure to meet mission objectives under all environmental conditions at the lowest possible life-cycle cost. Information contained in this bulletin covers policies, procedures, and other items of interest concerning the MANPRINT Program. Statements and opinions expressed are not necessarily those of the Department of the Army. This bulletin is prepared quarterly under contract for the MANPRINT Directorate, Office of the Deputy Chief of Staff for Personnel under the provisions of AR 25-30 as a functional bulletin.

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MANPRINT AND THE ALL SOURCE ANALYSIS SYSTEM

by H. J. Grohman, Jr.

Once upon a time, in the land of Confusion, a concept, called MANPRINT, arose from the constant fog of the Materiel Acquisition Process. This MANPRINT concept was conceived to tame the hardware dragon which was terrifying the procurement process by allowing items to be produced that could not be operated, maintained, or supported by the common man.

After numerous applications of MANPRINT to emerging systems, *The Concept* ruled the hardware acquisition realm. Soon a new challenge arose from the dark world of the Wizard of Hardware and Software. *The Concept* wrestled with the realization that software, a potent force in all realms, required the same attention as given the hardware fiefdom. Could, or should, *The Concept* reconfigure itself to meet the challenge? MANPRINTers from across the land debated and jousted with the issues and finally declared: Reconfiguration was not necessary, as *The Concept* was a thing of principles. Over the horizon came the leading contender of intelligence information systems from the Kingdom of ATCCS (Army Tactical Command and Control Systems). The All Source Analysis System (ASAS) was declared omnipotent and became the first of the new breed of dragon to be tamed.

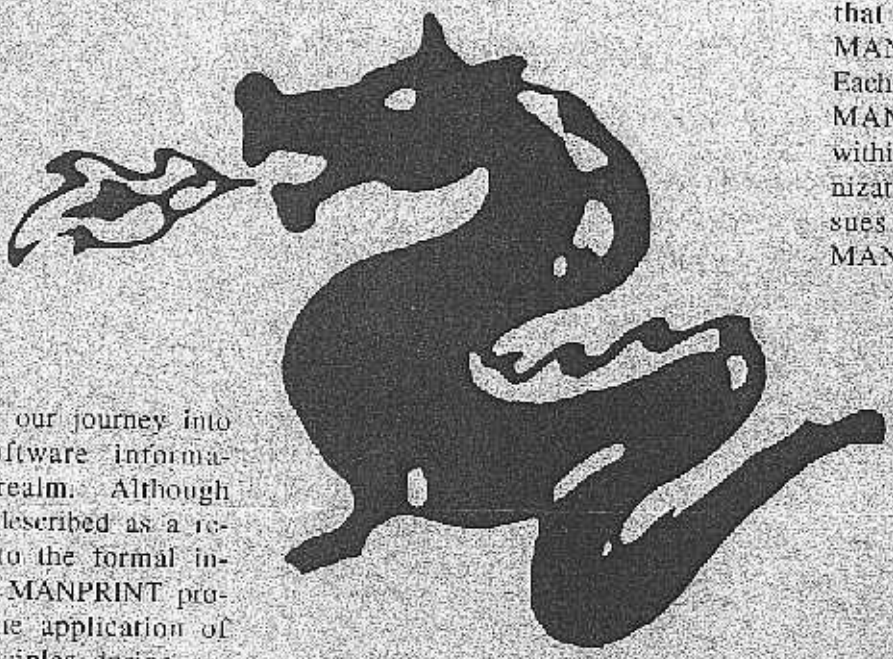
The Concept, in its usual aggressive manner, conducted a front end analysis and gleaned information invaluable in understanding the hardware/software dragon. Several forays were undertaken to further understand the nature of the beast. These forays to identify the goals and constraints of the ASAS dragon were given names such as: Hardware vs. Manpower (HARDMAN) analysis; Human Factors Engineering Analysis (HFEA); Reliability, Availability, and Maintainability (RAM) rationale study; and a modified Manpower, Personnel, and Training model. Once all information was gathered and compiled, the dragon was presented with the results. The conclusions caused the dragon to modify its form and behavior, resulting in a user-friendly dragon.

Continued on page 2

contents

Continued from page 1

This bit of fiction contains many truths. Automated information systems and decision support systems are replacing the old manual methods almost on an hourly basis. Hardware and software advancements present many challenges to our MANPRINT community. We have become adept at applying our MANPRINT expertise to hardware systems such as the RAH-66 Comanche and the T 800 engine. Now a new challenge: How can we apply what we have learned in the hardware arena to the world of hardware/software combinations and the mystical world of software systems?



ASAS offers a starting point for our journey into the hardware/software information processing realm. Although ASAS was first described as a requirement prior to the formal inauguration of the MANPRINT program in 1985, the application of MANPRINT principles during recent stages of ASAS development has assisted greatly in increasing total system performance.

The current system of intelligence collection and analysis at the Division Tactical Operations Center Tactical Support Element (TSE) involves several manual operations. ASAS will place many of these manual operations into a computer-assisted environment, thereby expediting the flow of intelligence required for timely and accurate decisions on the battlefield. The payoff for the tactical commander receiving this near real-time information is a common picture of the battlefield for all echelons of command; a picture of enemy intent and the identification of high-value and high-interest targets.

The ASAS MANPRINT program is guided by a formal charter. The charter establishes the MANPRINT Joint Working Group (MJWG), describes the responsibilities of MJWG members, focuses the continuous integration of MANPRINT domains into ASAS development, outlines procedures for MANPRINT activities, and confirms commitment to the MANPRINT program by MJWG members. It is jointly approved by the Project Manager and the TRADOC System Manager. The MJWG meets semi-annually and reviews software, hardware, and support issues that impact each MANPRINT domain. Each member acts as a MANPRINT advocate within his or her organization to resolve issues and act as a MANPRINT point of contact within that agency.

The ASAS Block I System MANPRINT Management Plan (SMMP) was initiated in 1988 and has been updated every six months by MJWG action. The ASAS Block II version of the SMMP has recently been approved and will be presented to the Defense Acquisition Board as the Army's Human System Integration Plan (HSIP). The most important aspect of the SMMP and the MANPRINT program it documents is the continuous command support and emphasis they receive.

In the areas of ASAS software and hardware design, several improvements can be attributed to applying the MANPRINT process. Keeping the soldier in mind throughout the design and development process resulted in software that aligned the processing and displays with Military Intelligence doctrine and soldier's tasks. It also enhanced the soldier-computer interface through consistent screen layout and key functionality.

timely, accurate, easy-to-understand system feedback; and the inclusion of confirmation prompts to reduce the possibility of lost data and inadvertent workstation shutdown. Additionally, the MANPRINT process established mechanisms for continuous review and improvement of software applications. On the hardware side, the application of MANPRINT principles provided for: enhanced portability, ergonomic workstation design, enhanced maintainability, electrical safety and system safety improvements.

Several tools and analysis techniques have been applied to ASAS including: HARDMAN, Task and Workload Analyses, Human Factors Engineering Analyses, computer screen reviews, Institutional Training Resource Requirements Analysis (ITRRA), Cost and Training Effectiveness Analysis (CTEA), and development of Manpower Estimate Reports. All of these were used to determine the impact of designing, developing, testing, and fielding the system for use by target audience soldiers.

The results of these analyses and the overall MANPRINT program effort are summarized below by domain:

MANPOWER

- Requirements were established by HARDMAN analyses.
- Manpower spaces were documented by DCSOPS Letter of Authorization.
- USAREUR authorizations are now in MTOEs.

PERSONNEL

- ASIs were identified and submitted to PERSCOM for approval.
- AR 611-201 was changed to reflect the need for color perception and heavier lift requirements.

TRAINING

- Early requirements were estimated by HARDMAN, ITRRA, and CTEA.
- The STRAP was approved on 4 March 1993.
- The New Equipment Training Team was resourced and is functional.

HUMAN FACTORS ENGINEERING

- The independent HFEA dated 27 May 1993 states, "... there were no residual problems or concerns which, if taken singularly or in the aggregate, would warrant anything other than a favorable ASARC decision."
- Key to this finding was a stipulation that CECOM continue to trap and resolve the remaining software anomalies, and that the Block II effort would capture Block I lessons learned to insure no repetition of Block I anomalies.

SYSTEM SAFETY / HEALTH HAZARD ASSESSMENTS

- Completed on 5 February 1993 and 6 April 1993 respectively.
- All known high and medium risk hazards have been reduced, controlled, or eliminated.

MANPRINT continues to play a major role in the ASAS development process by instituting human factors design initiatives (software and hardware) in the very early stages of development, emphasizing the review of test results from a MANPRINT perspective, and capturing soldier feedback for system improvement. The utilization of the MANPRINT Joint Working Group as a key player in the Block II effort will be critical to developing a more user-friendly ASAS dragon. The Kingdom of ATCCS will be a more user-friendly environment for the soldier of the future.

Can we apply what we have learned in the hardware arena to the world of hardware/software combinations and the mystical world of software? Methinks we have and are succeeding.

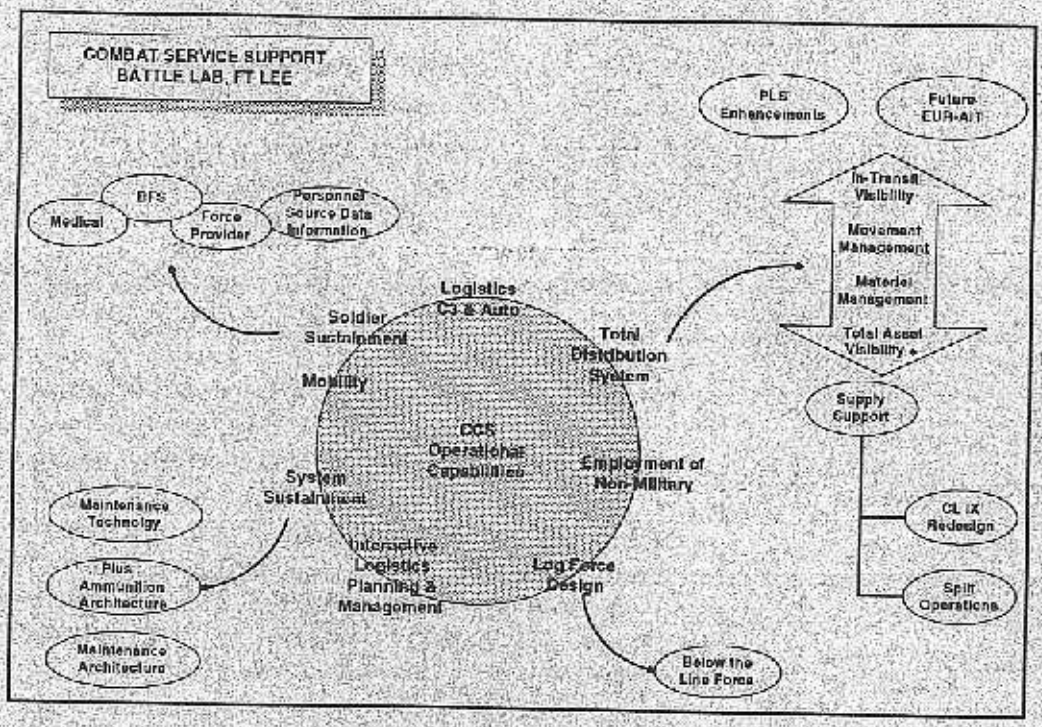
H.J."Stretch" Grohman has more than 28 years of military and Government experience and holds a B.S. degree in Psychology and an M.P.A. in Organizational Behavior.

CSS Battle Lab Focuses on Capabilities

by Charles Beall

Reprinted with permission from the ***Logistics Technology Bulletin****, March 1993.*

The CSS Battle Lab identified eight key CSS operational capabilities that will transition us to a CONUS-based force projection Army. The figure below shows these capabilities. The "Vision of Combined Arms Support" and its companion, "Technology: A CSS Vision," are the basis for these capabilities. We are now "peeling" back our capabilities to identify the science and technology base, tinkering, development, and procurement efforts we need to get these capabilities. Below is a summary of technology base efforts needed to support some of these capabilities. Below is a brief description of the TRADOC top priority capabilities.



(1) Total Distribution System (TDS). The CSS community needs TDS to integrate materiel management and movement management. The overarching issues are containerization and packaging, distribution management, assured communications, in-transit visibility, total asset visibility, and peace versus war operations. Science and technology base efforts to support this capability are in the areas of microelectronics, robotics, advanced materials, communications, and decision aids. Advanced Identification Technology (AIT), Microcircuit Technology in Logistics Application (MITLA), and Radio Frequency (RF) tags are keys to this capability.

(2) Logistics Command, Control, Communications and Automation. This capability supports force projection, theater maturation, and highly mobile forces on a fluid battlefield. Advances in microelectronics will provide the insertion of communication technology enhancements and computer management systems necessary for this capability. The proposed Total Distribution Advanced Technology Demonstration (TD-ATD) is a tech base effort to demonstrate an integrated approach to total distribution. It will use total asset visibility and in-transit visibility methods for mobilization and deployment, sustainment, and redeployment. In other words, the logistics managers will have the ability "...to get the right 'stuff' to the right place at the right time in the right quantities."

(3) Soldier Sustainment. This capability will provide the logistics support for the individual soldier in forward areas. The Army is focusing its technology base investments in areas of rations, clothing, navigation, communications, individual equipment, shelters, health and field services, and speed and strength enhancements.

(4) System Sustainment. CSS units need improved capability to sustain Army joint and coalition forces without the luxury of a well developed, mature theater. Technologies, such as advanced materials and tribology, and reliability and maintainability enhancements, can yield a 100 percent

Continued on page 7

The Benefits of MANPRINT on the Longbow Apache Program

By Jan Jantzer, McDonnell Douglas MANPRINT Organization

In a joint effort, McDonnell Douglas Helicopter Company and Westland Helicopters Limited are preparing a proposal to the United Kingdom Ministry of Defence (MOD) for an attack helicopter contract. Of particular interest to the MOD was the application of the MANPRINT process to AH-64A Apache and AH-64D Longbow Apache design and development phases.

A comparison of the two programs, in terms of user-system design processes, was performed. The majority of AH-64A design occurred prior to the inception of MANPRINT, while the Longbow Apache design effort included a fully developed MANPRINT program from the beginning of the design phase. McDonnell Douglas examined MANPRINT domains efforts (Human Factors Engineering, Manpower, Personnel, Training, System Safety, and Health Hazards, as well as Reliability and Maintainability) for integration and influence in AH-64A development.

MANPRINT personnel reviewed AH-64A archive files and reviewed the relevant material. McDonnell Douglas personnel who had worked on the early AH-64 program were contacted and interviewed for additional information pertinent to the study.

The study uncovered parallels between the program plans of each domain and current MANPRINT methodology. The AH-64A development incorporated MANPRINT domains, but it was apparent that there were inadequacies in the coordination of the user-system design effort which resulted in the following:

1) No central database for tracking of user-system and design changes
2) Redundancy of effort in some cases
3) No documentation of group interface activities
4) No summary of efforts
5) Minimal documentation of Maintainer interface evaluations.

While users have, in general, been satisfied with the AH-64A Apache design, the above findings indicate that the implementation of MANPRINT on the Longbow Apache program have resulted in a more efficient design process and more effective user-system interface. No incidents of redundant efforts were found on the Longbow Apache program, which was attributed to coordination of the domains through ongoing MANPRINT Working Group meetings. Also, user-system issues have a higher priority and receive more visibility at the program management level on the Longbow Apache Program due to a centralized database and a dedicated MANPRINT Organization.

For more information, contact Annette Hampton, McDonnell Douglas Helicopter Company, 5000 East McDowell Rd., Mesa, AZ 85205; (602) 891-6756.

Liveware Survey & Database Progress

by Frank C. Gentner, David E. Kancler, and Dr. Mona J. Crissey

The following article is an updated version of the summary from the CSERIAC Gateway, Vol IV Number 2 (1993) pages 8-9. Reprinted with permission from authors.

The DoD Liveware survey and database has now surpassed 500 technologies. At the 500 point, project manager Dr. Mona Crissey of the Army Research Laboratory, Human Research and Engineering Directorate, STRICOM Field Unit (ARL-HRED-STRICOM) and subject matter expert Frank Gentner of the Crew System Ergonomics Information Analysis Center (CSERIAC), conducted an analysis of the technologies in the database. Meanwhile surveys continued to arrive, and an updated database has been transitioned to the Defense Technical Center's Manpower And Training Research Information System (MATRIS). These are just a few of the happenings during the past year. We'll address each below.

Findings

Liveware survey sponsor, Mr. Mike Pearce of OASD(P&R)/(R&R)(TFM) HSI office, Dr. Crissey, and Frank Gentner would like to thank those 579 people who have participated in the Liveware survey to date. Participants include 258 technology owners, 221 owner/user/developers, 74 users, and 26 distributors.

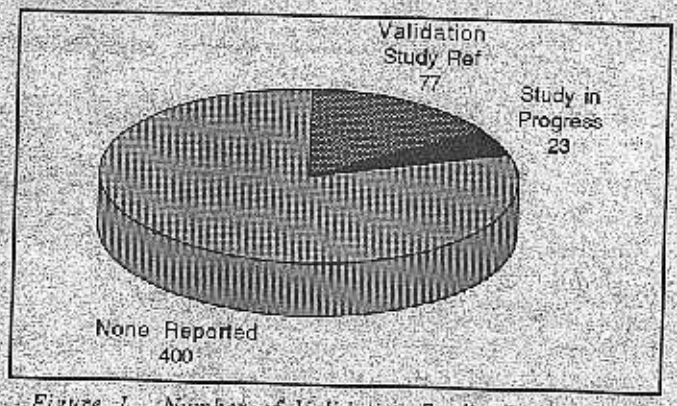


Figure 1. Number of Validation Studies/References

The table below presents the number of technologies in the Liveware database by Service or organizational affiliation for each of the Liveware domains. Of the 500 technologies in the Liveware database on April 15, 1993, 62 percent were "tools," 25 percent databases, and 13 percent techniques. Most were non-proprietary and available for use. These technologies supported all system types, system levels, mission areas, and acquisition phases. Most (84%) listed technologies were complete and ready for use. Of the 405 computer-based technologies, 175 (43%) were available for use on IBM PC-compatible computers, 104 for engineering workstations, but only 29 for Macintosh systems. We made special efforts to identify Mac-based tools, but only increased these kinds of survey returns from 9 to 29. Therefore, if you are aware of other Mac-based HSI technologies, please let us know. One of the most significant survey findings and areas for HSI technology improvement was that of the 500 technologies listed, 400

Liveware Survey Participation
By Service/Industry (As of April 1993)

Liveware Domain	United States						Total By Domain
	Air Force	Army	Navy Marines	Other Govt	Industry	Universities	
Manpower	54	44	15	25	103	7	248
Personnel	43	11	12	25	99	6	231
Training	68	52	37	33	126	8	324
Safety	27	16	8	15	87	6	155
Health Hazards	21	15	7	15	71	4	137
Human Factors Engineering	46	42	11	30	112	11	254
Integration	38	23	15	23	79	8	06
Number of Technologies in Database	115	85	52	60	174	13	500

Note: Each Technology can impact more than one domain.

(80%) reported no validation studies (see Figure 1).

Over 254 technologies support Human Factors Engineering analyses. Examining the Human Factors Engineering subdomains, we found the highest participation was in the area of performance and workload (177 technologies). Human-machine interface had 139 technologies; mission, function, and task analysis had 136; information transfer, 88; work-space/anthropometry, 86; and life support/environment had 78 technologies providing support. (In case you noticed that the sum of these subdomains is larger than the total number in human factors engineering, remember that any tool can support multiple domains and/or sub-domains).

A detailed report of the survey findings is being prepared for the NATO Research Group (RSG.21), that commissioned the study. Also, a catalog of these tools is being developed for publication during CY 1994.

Future of the Liveware Survey & Database

The Liveware database was originally scheduled to be hosted by the Defense Training and Performance Data Center (TPDC). Since TPDC was disestablished as part of downsizing, MATRIS has offered to place the Liveware database on-line for its users. MATRIS has begun the process of converting the PC Focus database to a BASISPlus document database management system on their VAX/OpenVMS system. MATRIS will store the primary Liveware database, with updates to be added as owners/users/developers furnish new information. The shift in responsibility occurred during the Fall of 1993. MATRIS plans to have the database available on-line by March 1994.

To obtain a survey or establish a DTIC/MATRIS account for the on-line Liveware database, contact Ms. Byars Vicino at the MATRIS Office (DTIC-AM), San Diego, CA 92152-7213, or phone (619) 553-7000, DSN: 553-7000.

Or for information concerning the Liveware survey analysis, contact Frank C. Gentner at AL/CFH/CSERIAC, 2255 H Street, Bldg. 248, Wright-Patterson AFB, OH 45433-6573, (513) 255-4842, DSN: 785-4842, FAX: (513) 255-4823, E-mail: FGentner@FALCON.AAMRL.AF.MIL.

Continued from page 4

increase in system reliability with 50 percent fewer maintainers. The materiel developer is using artificial intelligence and microelectronics, advanced diagnostics and prognostics to develop modern ground and aviation equipment. Fault tolerant systems will be developed to maximize operational availability and to minimize maintenance manpower requirements. The tremendous operating and support (O&S) cost burden of corrosion will be minimized through the development of anti-corrosive paints, coatings, and structural materials using biotechnology and advanced materials.

(5) Mobility. Concerns for strategic (inter- and intra-theater) and tactical (battlefield) mobility have increased as the Army moves toward a highly mobile, dispersed warfighting doctrine. The Army is using advanced materials and aeronautical design technology to develop systems that provide an enhanced capability for high-speed (over 250 knots) and low-altitude (500 feet and below) airborne deployment. It is being developed for both cargo and personnel. It will greatly improve our vertical insertion capabilities for airborne and special operations. Automation technology is being employed to develop expert systems for locating optimal LOTS equipment (e.g., causeways, lighterage, etc.), based on the commanders' needs. Lightweight bridging is being developed using composite materials for bridge panels and beams. Enhancements, such as better interfaces between Army and Air Force cargo aircraft and materials handling systems, are being added to the Palletized Loading System (PLS). The Army needs continued research into technologies that enhance mobility across all terrain and surfaces. This will reduce our dependency on road networks and reduce Main Supply Route signature. Enhancements, such as Forward Looking Infrared Radar (FLIR) or other technological tools, could create an all weather, day/night rapid movement capability that does not exist now.

The 1993 Manpower and Personnel Integration (MANPRINT) Training Steering Committee Meeting

by Diana Lueker, Chief, Operations Branch, DCSPLANS, PERSCOM

On 19-20 October 1993, the Deputy Chief of Staff for Plans, Force Integration, and Analysis (DCSPLANS), U.S. Total Army Personnel Command (PERSCOM), proponent for MANPRINT Training, hosted the annual MANPRINT Training Steering Committee Meeting. Committee members include representatives from the Office of the Army Deputy Chief of Staff for Personnel (ODCSPER), the U.S. Army Training and Doctrine Command (TRADOC), the Director of Information Systems for Command, Control, Communications, and Computers (DISC4), the Office of the Surgeon General (OTSG), the U.S. Army Materiel Command (AMC), the U.S. Army Operational Test and Evaluation Command (OPTEC), the U.S. Army Safety Center, the U.S. Army Research Laboratory (ARL), the U.S. Army Logistics Management College (ALMC), and PERSCOM.

PERSCOM uses this forum to review the past year's MANPRINT training program; analyze current and future training needs; and propose new initiatives to meet the changing requirements for MANPRINT training. Members represent each of the seven MANPRINT domains and their subject matter expertise provides the input necessary to enhance the training program and maximize its effectiveness. Members have an opportunity to provide domain updates and assist in planning and developing the course of future MANPRINT training.

Key discussion topics at this year's session focused on the need to develop formal automated information systems (AIS) MANPRINT training; the increasing demand to tailor traditional MANPRINT training to meet customer needs; and the incorporation of MANPRINT's seventh and newest domain, Soldier Survivability, into the current program of instruction.

ALMC's June 1993 presentation of a pilot course designed specifically for the AIS community was the initial effort to expand the scope of MANPRINT training. The course was well received and the Steering Committee agreed that AIS MANPRINT training needs to be part of program. The AIS version of the MANPRINT for Action Officers course will be offered again this year. Tentative sites for this training are Washington, DC and Fort Benjamin Harrison, Indiana.

Tailoring current MANPRINT training courses to meet the needs of the acquisition community is becoming a virtual necessity. Early MANPRINT action officer training was four weeks long. Through the years, it has shrunk to nine days. Now, there is a demand to reduce training even further. Although there are many reasons, both limited resources and Army downsizing contribute to today's need for shorter and more concise training. With fewer people at installations, in some cases one deep at a position, managers cannot afford to have people "out of the net" for any extended periods of time. The Steering Committee recognized this need and plans to work with ALMC to find an acceptable solution. Fort Bragg, North Carolina and Fort Rucker, Alabama have already requested this tailored training.

Soldier Survivability is an entirely new MANPRINT focus. Growing out of concerns surfaced during Desert Storm, the inclusion of this domain in MANPRINT is both timely and pertinent. The Army Research Laboratory is the lead agency in exploring this concern. MAJ(P) Mitchell Howell and Mr. Richard Zigler gave a joint presentation on this topic and its MANPRINT impact. Soldier Survivability will be included in this year's training.

The MANPRINT Training Steering Committee plans to reconvene in the March/April timeframe. With the changing Army today and the training changes proposed, PERSCOM is recommending the committee meet semi-annually as opposed to annually for the near term. As proponent for this vital program, PERSCOM's MANPRINT training focus is always on timely, quality training that will meet the needs of the Army community and ensure MANPRINT is an integral part of tomorrow's Army systems.

FY 94 MANPRINT Training Schedule

MANPRINT Action Officer Courses

Class	Dates	Location
703	3 JAN - 13 JAN 94	Natick, MA
704	7 FEB - 17 FEB 94	Ft. Belvoir, VA
705	7 MAR - 17 MAR 94	QM School, Ft. Lee, VA
706	11 APR - 21 APR 94	FA School, Ft. Sill, OK
710	16 MAY - 26 MAY 94	CECOM, Ft. Monmouth, NJ
707	20 JUN - 30 JUN 94	CTIES, Ft. Eustis, VA
708	25 JUL - 4 AUG 94	Ft. Leonard Wood, MO
709	15 AUG - 25 AUG 94	TACOM, Warren, MI
711	19 SEP - 29 SEP 94	ADA School, Ft. Bliss, TX

MANPRINT for Managers Courses

Class	Dates	Location
703	13 JAN - 14 JAN 94	Natick, MA
704	17 FEB - 18 FEB 94	Ft. Belvoir, VA
705	17 MAR - 18 MAR 94	QM School, Ft. Lee, VA
706	21 APR - 22 APR 94	FA School, Ft. Sill, OK
707	30 JUN - 1 JUL 94	ADA School, Ft. Bliss, TX
708	4 AUG - 5 AUG 94	*Open*
709	25 AUG - 26 AUG 94	TACOM, Warren, MI

MANPRINT for Senior Leaders Seminar

MANPRINT for Senior Leaders Seminar is a two hour seminar designed to give General Officers and Senior Executive Service personnel an overview of MANPRINT. The Senior Leaders Seminar will be available upon request.