MANPRINT BULLETIN

Vol. II No. 2 "Remember the Soldier" August 1987

The MANPRINT Index: An Industry Perspective

by
Dave Wickman, Sikorsky Aircraft

One of the many initiatives of the MANPRINT program is to develop an active Army-industry partnership. This partnership is composed of many elements including open lines of communication, data exchange, assessing requirements, and achieving unified goals for system performance. This last goal, to obtain maximum performance of the system, is expressed as a function of equipment performance, human performance, and environmental considerations. The equation is typically expressed in this way:

$$P_s = \int (P_e) (P_h) (E)$$

where,

P_s = performance of the system

P_e = performance of the equipment

P_h = performance of the human

E = environments (including operational, social, physical)

Many of you working in the MANPRINT arena have probably seen this expression before. What you may not have considered is how far-reaching its implications can be to the Army-industry partnership in MANPRINT.

Let's examine, from an industry perspective, the equation of system performance for a new item of equipment that needs to be introduced into the Army inventory. This new item may fill a deficiency or replace one or several existing items. The industry contribution to system performance can be shown by modifying the expression in this way:

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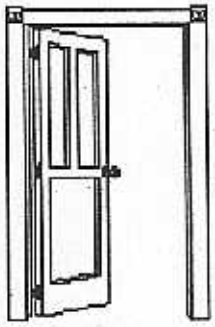

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$$P_s = \int_{\text{Product (a)}}^{\text{Product series } (a_1 \ldots a_n)} (P_e)\,(P_h)\,(E)$$

where:

Product (a) = one item of equipment that industry has delivered to the government.

Product series $(a_1 \ldots a_n)$ = All items of equipment of one particular type that have been delivered to fulfill production contracts.

The expression can be expanded in this way:

$$P_s = \sum (P_e a_1)\,(P_h a_1)\,(E a_1) + (P_e a_2)\,(P_h a_2)\,(E a_2) \ldots + (P_e a_n)\,(P_h a_n)\,(E a_n)$$

The weapon system is understood here to be the total collection of delivered items at any moment, with whatever personnel are assigned to them, in their current state of readiness, in whatever environments we find them. This is a somewhat unusual definition but leads to some useful observations.

During initial deliveries to the government, system performance is influenced a great deal by industry. This is because there is emphasis on meeting design requirements, and industry is involved in maintaining the first items and training the first operators. Given the way that performance is measured and the conditions of measurement at early stages of delivery, industry can control and possibly guarantee that performance contraints are met. Industry's effort here is referred to as design assurance.

As the system starts to enter the field, additional factors such as funding, interaction with existing systems, and soldier morale impact system performance. Industry has no control over these factors which often fall into the environmental or human terms of the performance equation. Therefore, as the number of items delivered increases, P_s becomes more of a responsibility of the Army and less of industry.

Figure 1 describes the performance of two imaginary items of equipment over the interval in which items are delivered by industry to the government. Item X is traced through three optional paths. Assume that X_1 is a well-engineered version, X_2 is a mediocre version, and X_3 is an existing version in the Army inventory that the others can be

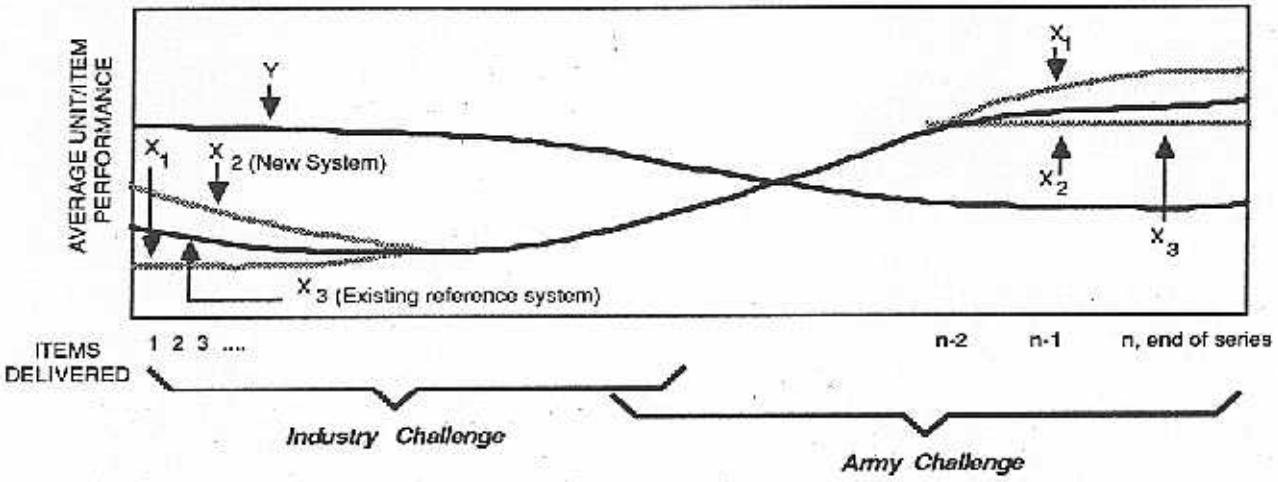

Figure 1. The MANPRINT Index

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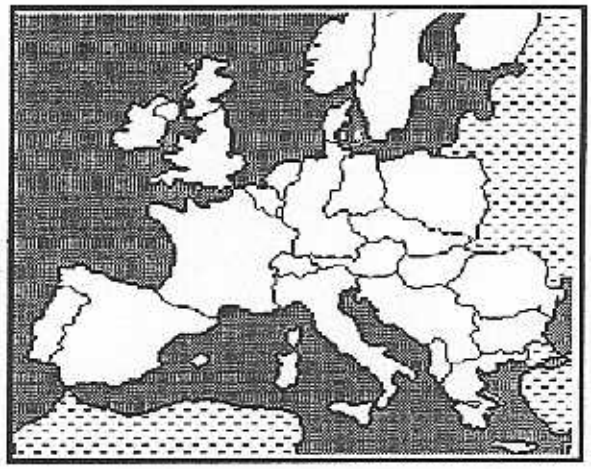
compared to. The initial part of the curve is low for each option, depicting typical start up problems. This may be caused by many factors such as parts shortages, infant mortality, and other learning curve problems. At the conclusion of the curve item, X_2 has a value of P_s that will require greater Army support than anticipated in order to match the performance of the reference system. Assuming adequate support, the well-engineered item X_1 exceeds the P_s values of the reference system.

As the number of items delivered increases, the performance of each Army unit that uses the equipment is factored into the average for all items in the product series. In the case of the X family of items, the Army learned to improve average performance and appeared to be reaching a limit in performance for that particular design. The limiting factor could be any term or combination of terms in the performance equation. The shape of this curve is typical for technologies introduced in industrial settings.

Item Y tells a different story. Y started out strongly but fell in performance. The drop in performance could have been caused by the Army electing to change training, support, or maintenance concepts at the same time that the item was fielded. Y may also have been used in an environment or application that was not anticipated when the design specifications were written. The performance can only go down in these cases.

Thus, industry and the Army , both, contribute to system performance but at different times and in different ways. Industry builds the item of equipment with design assurance, thereby fulfilling initial performance objectives as stated in contracts. The Army forms fighting units by staffing, funding, and supporting the item of equipment and thereby achieves total system performance in the field. Clearly, there are common areas of responsibility where both parties team to develop the equipment, the fighting unit, and the complete series of fielded items.

For additional information, contact Dave Wickman, Sikorsky Aircraft, North Main Street, Stratford CT 06601. (203) 386-3816. ●



HUMAN FACTORS IN FOREIGN ARMIES

The Soldier Technologies Branch of the U.S. Army Foreign Science and Technology Center (FSTC) in Charlottesville, Virginia provides evaluations and information on a variety of MANPRINT related topics concerning the armies of foreign countries. The Human Factors Section at FSTC is staffed with a biologist, a psychologist,and a biomedical engineer. FSTC staff also have military experience. The following subject areas are studied in depth by this group:

- Ergonomics/Human Engineering
- Personnel Psychophysiological Selection
- Human Performance Enhancement and Degradation
- Preliminary Training and Education of Youth
- Simulators and Training Devices
- Combat Stress
- Biocybernetics
- Operator Modeling
- Soldier Support Systems and Equipment

While this list is not all inclusive, it is representative of ongoing research topics. U.S. Government organizations wishing data or analysis on other human factors areas or published works, briefings, or copies of studies and reports should contact the center at Comm 804-296-5171, ext. 433; AV 274-7433; Washington, D.C. area 464-1860, ext. 433; or write:

Commander, U.S. Army Foreign Science
and Technology Center
ATTN: AIFRTD
220 Seventh Street, NE
Charlottesville, VA 22901-5396

DEFEWS Offers Foxhole Experience to Civilians

by Karen Spear

If you are a civilian scientist or engineer in the U.S. Army Materiel Command, you can spend two to four weeks in an Active Army unit of the U.S. Army Forces Command. The Design Engineering Field Experience with Soldiers (DEFEWS) Program provides design engineers, scientists, and technicians with foxhole-level experience and experience in handling individual and crew equipment. Civilian scientists and engineers live, eat, and work alongside soldiers in an Active Army unit. Such experience will help research and development engineers design equipment and field items that are more reliable and more easily used and maintained by soldiers and that better meet the Army's combat performance requirements. The program has been in effect since 1981, and so far 51 engineers have taken advantage of the opportunity it offers.

In the cover story of the January issue of *AMC NEWS* (Vol. 15, No. 3), Pat Snow describes his experience as a DEFEWS volunteer. Snow is a civilian chemical engineer at the Natick Research, Development, and Engineering Center in Natick, MA. He designs clothing and equipment to be used by soldiers in the field to better protect themselves. Snow became interested in the DEFEWS Program as a means of better understanding the soldiers' real needs by working and living as a soldier in the field with other soldiers.

Before being accepted into the program, Snow had to fulfill some basic requirements. An interview with the DEFEWS point of contact at Natick revealed his background, work habits, and motives for program participation. Snowden was also required to pass a physical examination and a fitness test. DEFEWS volunteers must also possess a secret or higher level security clearance.

During his DEFEWS experience, Snow had the opportunity to handle various weapons including the M16, the M302 grenade launchers, the light antitank weapon (LAW), the M60, and .50 caliber machine guns. As a result, he became familiar with their use and their roles in the overall scheme of things. This experience also gave Snow insight into problems inherent in specific weapons. For example, he noted the awkwardness of the positioning of the M16 when it is worn over the chest or shoulders while handling a casualty or performing some other task. The soldiers with whom he was training suggested that the strap be modified so that the gun hangs right side up. Other comments focused on the quality of combat boots and on problems in heating up rations developed by Natick.

Snow's article descibes how the DEFEWS Program can provide a valuable experience for Army research and development engineers to gain insight into the needs of soldiers in the field with regard to reliability and maintainability of weapons and equipment. The Army Materiel Command has under consideration the feasibility of opening the program to engineers from industry. Information on the DEFEWS Program can be obtained in AMCCOMR 350-2 or by calling CPT Dobinson, U.S. Army Armament Research Development and Engineering Center, AV 880-7843 or COMM (201) 724-7843. ●

Book Review

Human Productivity Enhancement

by Kent Myers, Ph.D.

Zeidner, Joseph, ed. *Human Productivity Enhancement: Organizations, Personnel, and Decision Making*, Volume Two, New York: Praeger, 1987.

Volume One, Dealing with Training and Human Factors, was reviewed in the February 1987 *Bulletin*. Volume Two contains some compelling yet lesser-known approaches to productivity that are

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Human Productivity Enhancement
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excellent threoretical foundations for MANPRINT. Kenyon DeGreene reviews sociotechnical systems, an approach that fuses the design of social and technical systems and presents the approach as a remedy for the failures and blind spots of both Taylor's scientific management and the human relations school. DeGreene isolates some key factors in work design: "the need for control over one's self, one's immediate environment, and one's destiny and the perception that this control exists." The restriction of this control in modern work settings can result in "depression, lack of confidence, defensive and evasive behaviors, and reduced health—all leading to lowered productivity." Labor productivity has hit a standstill in the United States despite the steady addition of machinery. Sociotechnical design has shown promise in breaking this barrier, for instance by increasing productivity in Volvo plants by 20-percent. The design principles are discussed in relation to the latest automated settings and the possibilities drawn for appropriately matching the remaining workers to the technology , such as by designing monitoring tasks that do not atrophy the worker's skills that are needed during emergencies. DeGreene writes that "The major challenge will be management of complexity, and complexity is best managed by seeing the system as a whole."

Gordon Pask and Dik Gregory outline a striking alternative to most approaches in artificial intelligence. They do not attempt to represent knowledge in a static hierarchy that is intended to produce answers. That approach, which has been convenient for programming, is not matched to accounts of how people think and deal with problems and contains many questionable philosophical assumptions. An alternative, "conversation theory," is introduced and shown as a basis for a unique intelligent support system called "Thoughtsticker." This is a training authoring system that, among other things, continuously uses and updates a model of the trainee (such as whether he has a serialist or holist learning style) and allows the trainee to choose his own pathway through a topic. The program can incorporate new associations between content topics without program reconstruction. A "teachback" facility has the trainee manipulate a model creatively as a demonstration of his mastery in contrast to taking multiple choice tests that are only indirect measures of learning. This opens a completely different approach to computer-based training that could avoid much of the rigidity, expense, and other ineffective features of standard approaches.

Other chapters of special interest include T.O. Jacobs' and Elliott Jacques' on leadership. These authors use system concepts to identify strata in organizations and to differentiate roles at each level. The higher-level leadership role is to reduce uncertainty, balance short- and long-term interests, and apply resources to adaptation needs. Leadership at this level depends on having cognitive maps to accurately represent relevant external reality.

Newell Eaton, Laurence Hauser, and Joyce Shields review the design and preliminary findings of Project A, the Army Research Institute's massive longitudinal study of selection and classification issues. Project A's main aim is to isolate factors that will predict job performance and this has involved extensive re-examination of job performance measures for many military specialties.

Other chapters review psychological studies of productivity, cognitive assessment methods, expert systems, decision support systems, and person-job matching systems. ●

MANPRINT TOLL-FREE HOTLINE TO BE DISCONTINUED SEPTEMBER 30, 1987

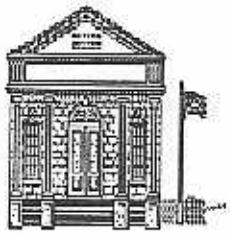
The MANPRINT toll-free hotline was activated in September 1986 to serve as a temporary information processing center during the early stages of the MANPRINT Program implementation.

Beginning October 1, 1987, the services previously provided by the hotline will be provided by the following:

Policy- MANPRINT Policy Office, HQDA (DAPE-ZAM), Washington, DC 20310-0300. AV 225-9213 COMM (202) 695-9213.

Training- Soldier Support Center-National Capitol Region, ATTN: ATNC-NM, Alexandria, VA 22332-0400, AV 221-3707 COMM (703) 325-3707.

General Information (MANPRINT Bulletin, Points of Contact List, etc.) - Automation Research Systems, Ltd., Attn: MANPRINT PM, 4480 King Street, Alexandria, VA 22302. (703) 820-9000.



Schedule of MANPRINT Courses for FY88

MANPRINT Staff Officer Courses*

19 Oct - 6 Nov 87	2 - 20 May 88
30 Nov - 18 Dec 87	6 - 24 Jun 88
25 Jan - 12 Feb 88	11 - 29 Jul 88
7 - 25 Mar 88	8 - 26 Aug 88
4 - 22 Apr 88	12 - 30 Sep 88

Schedule of one-week MANPRINT Managers courses and one-day GO/SES seminars will be announced later.

*All courses will be held at the Casey Building, Humphrey's Engineer Support Activity Complex, Ft. Belvoir, VA.

Meetings of Interest

22 - 24 September
Automatic Test Equipment International Conference. Wiesbaden, Germany. Sponsored by the National Security Industrial Association. Contact: National Security Industrial Association, 1015 15th Street, N.W., Suite 901, Washington, D.C. 20005. Telephone: (202) 393-3620.

12 -14 October
Association United States Army Meeting. Washington, D.C.

19 -23 October
Human Factors Society Annual Meeting. New York City, NY. Contact: Human Factors Society, P.O. Box 1369, Santa Monica, CA 90406. Telephone: (213) 394-1811.

30 November - 2 December
9th Interservice/Industry Training Systems Conference (I/ITSC). Washington, D.C. Sponsored by the American Defense Preparedness Association. Contact: American Defense Preparedness Association, Rosslyn Center, Suite 900, 1700 N. Moore Street, Arlington, VA 22209-1942, Attn: TMAS. Telephone (703) 522-1820.

NOTE CHANGE!

Responsibility for MANPRINT training officially transfers from HQDA ODCSPER to TRADOC on 1 October 1987. All communication regarding FY88 MANPRINT training is to be directed to the TRADOC executive agent for MANPRINT, the Soldier Support Center-National Capital Region.

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The MANPRINT Bulletin 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 six domains of manpower, personnel, training, human factors engineering, system safety, and health hazard assessment. 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 published monthly under contract by Automation Research Systems, Ltd., 4480 King Street, Suite 500, Alexandria , Virginia 22302, for the Office of the Special Assistant to the Deputy Chief of Staff for Personnel (MANPRINT) under the provisions of AR 310-2 as a functional bulletin. Proposed articles, comments, or suggestions should be mailed to MANPRINT Bulletin, Attn: HQDA (DAPE-ZAM), Washington, DC 20310-0300. Telephone: Commercial (202) 695-9213 or Autovon: 225-9213.