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MANPRINT: AVOIDING DISASTER

Gretchen Eberhard

On July 3, 1988, the Navy cruiser *USS Vincennes* and frigate *USS Elmer Montgomery* had spent most of the day engaged in a battle with several small, fast, Iranian gunboats. Suddenly, the *Vincennes'* high-tech Aegis radar system detected an airplane departing from a nearby military/civilian airfield in Iran. The crew of the Combat Information Center, located in a windowless control room in the *Vincennes*, identified the aircraft as an Iranian F-14 fighter plane. The watchstanders tried repeatedly to contact the aircraft, but received no response. As the plane approached, the crew warned the *Vincennes'* Captain that the plane had assumed a descending attack profile and was bearing straight toward the ship. Based on the information provided, the Captain gave the order to fire. The aircraft was hit directly and Iran Air Flight 655, a civilian carrier, exploded over the Persian Gulf killing all 290 passengers. A subsequent investigation of the event revealed that the ship's electronic displays had indeed shown an unidentified aircraft, though not a descending F-14 but an unknown ascending aircraft. Human error was blamed for the incident. Difficulty in decoding the electronic data, coupled with the backdrop of a hostile environment, led operators in the control room to misinterpret the situation.

As technology advances and systems grow larger, more complex, and more costly, the importance and complexity of human/machine interaction increases. Nowhere is this more evident and critical than with the high-risk technologies used in warfare. The *Vincennes* incident is just one example pointing to a fundamental problem where high technology systems are designed with greater emphasis on the equipment than on the user. Many accidents, from Three Mile Island to the space shuttle Challenger, have been attributed to people and organizations unable to adequately interpret and control technology.

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Program History

Recognizing this problem, the U.S. Army sought a distinctively new approach to ensure human-system integration in new weapon systems. The Army's objective was to effectively integrate people, organizations and technology to obtain more cost-efficient, reliable, maintainable, safe, and effective user-oriented weapons. From this objective, the Manpower and Personnel Integration (MANPRINT) program emerged. Initially, MANPRINT was envisioned as a technical and management program designed to increase total system performance of all equipment acquired into the Army's inventory. As MANPRINT gained acceptance, the program was integrated into the standard acquisition structure with the publication of Army Regulation 602-2, titled "Manpower and Personnel Integration (MANPRINT) in the Materiel Acquisition Process."

In 1987, the Army officially acknowledged the merits of MANPRINT and formally established policies, procedures, documentation requirements, and the assignment of responsibilities for the MANPRINT program within the Department of the Army. With MANPRINT as an established requirement for all major Army acquisition programs, the philosophy began to be accepted and included in other military regulatory documents at the Office of the Secretary of Defense (OSD) level. For example, Department of Defense Directive (DODD) 5000.53, "Manpower, Personnel, Training, and Safety (MPTS) in the Defense Acquisition Process" was published in 1988, formally requiring DOD components to establish a means to conduct MPTS analyses along with other system design criteria. Subsequent documents (DODD 5000.1, "Major and Non-Major Defense Acquisition Program", and DOD Instruction 5000.2, "Defense Acquisition Program Procedures") incorporated human system integration taskings, as well.

The Deputy Chief of Staff for Personnel (DCSPER), MANPRINT Directorate, chartered in the 1980s, has been assigned the responsibility for exercising Department of Army (DA) staff level management for the MANPRINT program. This responsibility currently includes the development, coordination, and dissemination of MANPRINT program policy and guidance to all Army commands and agencies. Additionally, the MANPRINT Directorate has been tasked to review and monitor materiel objectives, requirements documents, and other pertinent acquisition related documents to ensure that MANPRINT is addressed early, adequately, and continuously throughout all programs.

Throughout its development, the MANPRINT program has progressively gained acceptance and expanded its influence far beyond the Army. Several U.S. Government agencies and many international organizations have begun to apply MANPRINT principles to the procurement of new, technologically advanced systems. Within the U.S. Government, for example, the Federal Aviation Administration (FAA) has used MANPRINT for new system acquisitions as well as for daily planning and management activities. The FAA has focused on three program areas: a strong human factors program, a National Airspace Integrated Logistics Support System (commonly referred to as NAILS) program, and a manpower, personnel, and training oriented National Airspace System Human Resource Management program.

International government organizations have also affirmed their support of the MANPRINT concept. The British Ministry of Defence (MOD), for example, has created a program, also called MANPRINT, which was based on the original U.S. Army program. The French military has also adopted a form of MANPRINT. Additionally, the NATO countries of Canada, Germany, France, the Netherlands, the United Kingdom, and the United States have formed a study group to develop NATO-wide policies, similar to MANPRINT, as a means to ensure effective development/modification of defense acquisition programs.

With the adoption of MANPRINT--in whole or in part--by so many government organizations, an increased awareness and interest by industry has resulted. The U.S. defense industry is facing a more competitive global market as other nations have significantly increased sales of military hardware. To remain globally competitive, many U.S.

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manufacturers have implemented a quality management philosophy. Because of MANPRINT's top-down approach and the requirement that trade-off techniques be performed early in the design phase, innovative designs have resulted in better utilization of skills. MANPRINT regulations have compelled industry to become visionary in their approach to product design. For industries seeking business with the U.S. Army, contracts have and will continue to be won or lost on the basis of MANPRINT evaluation criteria. More importantly, industry has found that by embracing MANPRINT, they have improved their product and, as a result, have become more commercially competitive.

The MANPRINT Program

The MANPRINT program is a comprehensive management and technical initiative intended to enhance total system performance by integrating human performance, reliability, and survivability during weapons system and equipment design, development, production, and modification. The goal of MANPRINT is to successfully integrate technology and people to meet mission objectives under numerous environmental conditions at the lowest possible life-cycle cost. MANPRINT promotes an increased emphasis on front-end planning to control the impact of the new system on the human by requiring consideration of issues related to six domains: manpower, personnel, training, human factors engineering, system safety, and health hazard assessment.

The *manpower* domain addresses the affordability of fielding a new materiel system in terms of the Army's human resources (all military and civilian men and women who are required and available to operate and maintain Army equipment). Consideration of the net effect of new materiel systems on overall Army human resource requirements and authorizations is critical to ensure the affordability of a proposed system. This consideration includes an analysis of the number and capabilities of people needed to operate, maintain, and support the proposed system (based on predecessor system data); a determination of changes generated by the introduction of the system into the inventory; and an assessment of the impact that the changes will have on the Army's total manpower limits across all operational and maintenance levels affected by the system.

Similar to manpower, the *personnel* domain refers to the aptitudes, abilities, and other human characteristics of military and civilian personnel. These are the attributes necessary to operate, maintain, and support a new materiel system and achieve optimal system performance in peace and wartime. Detailed analyses of personnel requirements for predecessor systems, based on system components, are necessary to project personnel requirements for the new system. The new system is designed based on the personnel projected to be available throughout the life-cycle of the system. Personnel analysis data must be included in the system life-cycle cost estimates and are needed in time to allow for appropriate recruitment, training, and assignment of personnel in conjunction with system fielding.

The *training* domain refers to the requisite knowledge, skills, and abilities (KSAs) required by the available personnel to operate and maintain systems under peace and wartime conditions. Training considers the time and cost to provide necessary skills and knowledge through entry-level and sustainment training to qualify Army personnel for support of the new system. Consideration of training needs requires the formulation and selection of engineering design alternatives which are supportable from a training perspective. It also includes the identification of resource requirements, the formulation of training strategies, the availability of training resources (to include qualified instructors and proper equipment), and the time needed for training to be completed. These efforts ensure that adequate numbers of qualified personnel will be available for assignment to the new system.

Human factors engineering (HFE) is the comprehensive integration of design criteria, psychological principles and human capabilities into system design, development, test, and evaluation, and is used to optimize the performance of human-machine combinations. HFE's goal is to maximize the ability of the operator to perform at required levels by eliminating design-induced error. HFE considerations in system design

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The Nay Sayers Aren't Always the Problem

MAJ L. Taylor Jones III
MANPRINT Acquisition Division
Directorate for MANPRINT, ODCSPER

If you get a bunch of MANPRINTers together (and a bunch is hard to find these days), the topic of conversation eventually turns to those PMs or TSMs who say their system can't be MANPRINTed. The excuses are numerous. It's NDI, or it's too expensive, or it constrains technology, or it's too early, or ultimately, it's too late. *Don't you just hate a whiner*? Well, don't! The Developer or any other nay sayer who is willing to argue with you about MANPRINT is at least thinking about it.

What about all those systems out there that you haven't heard from? The calls that aren't returned. The program without a point of contact. You've seen the system in magazines or at a symposium, but don't know the MANPRINTer dedicated to the effort. And what about those special access programs that you can't ask about? Are they exempt from human systems integration? If you know MANPRINT, then you know the answer--NO!

Now let's ask ourselves a few more questions a little closer to home. Have you looked beyond the systems which you are working to see what's out there? Oh sure, you're understaffed. But have you considered getting your bosses to at least sponsor a little command awareness of MANPRINT? Is there a way that you can get a hook in those "closet" programs to let them know that you know they are out there? Are you proactive?

Now those special access programs are another question. If a "black program" were to contact your office for assistance, could you respond? If you don't have the necessary clearances, do you know someone who does? A new special access project manager doesn't have six months to spare while you get the necessary credentials. Are you prepared?

In a business where we ensure total system performance, are we ready to be an efficient mechanism in that business? If not, then we aren't user friendly. And if that's the case, then we're due for a MANPRINT Assessment of ourselves.

So here's the bottom line - the next time that nay sayer argues the need for human systems integration with you, congratulate him/her and yourself. Contemplation of the need is the basis for any acquisition process. But the next time you see a "closet" system drive by, ask yourself who the MANPRINTer was. If you don't know, then you may be the one missing from the loop!

Soldier Survivability & Fratricide

MAJ James Vaas
Deputy Chief of Staff for Personnel Integration Total Army
Personnel Command

In the deluge of information on lessons learned from Operation Desert Storm one of the most heart-breaking discoveries was the need to better identify our own combat vehicles. The *60 Minutes* presentation of a video tape showing a Bradley being destroyed by "friendly fire" reinforced that need. With increased lethality of weapons and dramatic leaps in ranges of vehicle acquisition and targeting, a more effective means of identification friend or foe (Iff) than the human *eyeball* is needed.

Currently, Defense Acquisition Management Policies and Procedures, DOD 5000.2 deals primarily in "survivability." The subject of survivability is almost totally focused on the Threat as opposed to "friendly fire." Additionally, Army Regulations 70-1, 70-60, 70-71, and 602-2 do not adequately address the Soldier Survivability and Fratricide issue. Since no programmatic process is in place to address this concern the only current method for ensuring that Soldier Survivability and Fratricide is addressed is to have the Proponent of the system make it a clear issue. This approach to considering the soldier begs our attention.

As part of the MANPRINT Concept (See Figure 1.) Soldier Survivability and Fratricide can easily be seen in the area overlapped by all the elements considered for optimum system performance. A method of addressing Soldier Survivability and Fratricide would be to add a seventh domain to the MANPRINT program. Soldier Survivability and Fratricide would then have a visible, documented program track to ensure consideration/ inclusion in the materiel acquisition process.

Early in Phase 0 (Concept Exploration and Definition) the MANPRINT Joint Working Group (MJWG) would give Soldier Survivability and Fratricide special attention when developing the System MANPRINT Management Plan (SMMP). The SMMP would then be used as the vehicle during the front-end analysis to recommend any special training or design/technical features to ensure consideration of this domain in the MANPRINT process. The follow-up to this would then be to make sure all concerns are addressed in the production of program and requirement documents.

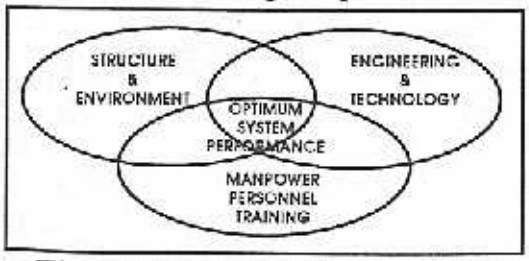

Figure 1. MANPRINT Concept

MANPRINT Domains	
1. Manpower	4. Human Factors
2. Training	5. Safety
3. Personnel	6. Health Hazards
? 7. Soldier Survivability & Fratricide ?	

What is important at this point is that we do not continue with business-as-usual. MANPRINT managers should immediately emphasize with proponents that specific requirements for Soldier Survivability and Fratricide must be included in requirement documents (MNS and ORD) and the Request for Proposals. Even if Soldier Survivability and Fratricide do not enter MANPRINT as a separate domain, the penalty of ignoring these concerns is evident.

In the long term a more formalized, programmatic approach is needed. Current thought and documentation requirements have only adequately covered material survivability and not Soldier Survivability and Fratricide. The consolidation of survivability and IFF into a clear, concise, documented requirement would provide proponents and materiel developers with a vehicle to articulate issues and concerns and a forum for expressing criteria compliance. At that point Army Regulations could be changed to make it mandatory to include such issues in appropriate documents.

Refer to page 9 for a note from LTC Albert Sciarretta on ODCSPER's studies on survivability.

Task Data Accounting Process Issues

CPT Brian Prosser, Analysis Div.,
MANPRINT Div., DCSPI, PERSCOM

The accounting process for solider performance tasks in the DoD Standardization Program is currently a topic of discussion. Two issues related to this process are important to note. First, disagreement exists concerning the correct definition of *task* and *critical task*. The definitions of *task* found in the Army Dictionary of Terms (AR 310-25), Logistic Support Analysis (MIL-STD 1388-1A) and the Army Training Glossary (TRADOC PAM 25-33) are in conflict. Similarly, the definitions for *critical task* provided in MIL-H-1478 (Task Performance Analysis) and TRADOC PAM 25-33 do not match.

A second issue involves the use of inconsistent task inventories. DCSPI derives the list of resource intensive tasks from TRADOC task inventories. However, these TRADOC task inventories do not match the LSAR task inventory descriptions contained in MIL-STD-1388-2B.

While these issues present real problems, potential solutions do exist. TRADOC REG XXX-XX (Individual Task Management System), when published, will standardize the task numbering system, while a proposal to standardize task descriptions is currently under review. Regarding task inventories, new automated systems will help to mitigate many of the problems. For example, when the Automated System Approach to Training (ASAT) comes on-line it will link dozens of data bases and data repositories. Using ASAT, TRADOC task inventories, and LSAR task inventories will have the ability to rapidly and thoroughly cross-reference one another.

TRADOC is also working with the tri-service Automated-Training, Evaluation, Acquisition, and Management (A-TEAM) to automate the Instructional System Design/Logistic Support Record Decision Support System (ISD/LSAR DSS). The ISD/LSAR DSS can automatically track LSAR tasks for use in formulating a consolidated training task. When fully implemented, this auto-

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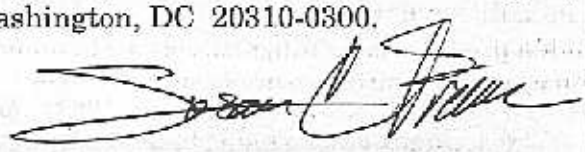
A Note from the Editor

I want to take a moment to welcome you to the new **MANPRINT Quarterly**. We have tried to incorporate your many suggestions and comments into the bulletin. We look forward to starting the new year with our "new look." But that doesn't mean we don't want to hear from you anymore! There is more space on the Reader's Response page for your comments and, with enough input, a Reader's Column will fill this space in future issues. We welcome contributions of any size: lead articles, meeting announcements, commentaries, humor! Feel free to consider the **MANPRINT Quarterly** your forum to reach your fellow MANPRINTers -- as Ms. Eberhard points out in her article (*MANPRINT: Avoiding Disaster*, page 1, this issue), MANPRINT philosophies are not just limited to the Army. Any comments or suggestions can be sent by fax to (703)695-3195, or by mail: MANPRINT Quarterly, HQDA (DAPE-MR), The Pentagon, Washington, DC 20310-0300.



Susan Culkin Freeman
Editor

Correction

Due to an error in production, the following sentence from the article **Training Effectiveness User Evaluation (TEUE), New Training Helicopter (NTH)** (MANPRINT Bulletin, Vol. VI, No. 8; November/December 1992; page 6) was partly deleted. The sentence should have read:

> To provide data regarding the training effectiveness of candidate aircraft to perform Initial Entry Rotary Wing (initial flight training) core training mission, safety, operational fuel **consumption and demonstrated maintainability.**

ensure that a system operator is able to visually identify and physically reach all console components. In addition, HFE considerations makes certain that placement of those components is arranged such that the soldier can manipulate them without causing work overload. This domain also examines the thought processes and cognitive aptitude of operators and maintainers to sustain acceptable workload levels, particularly under stressful conditions such as found in combat situations.

System safety refers to the system's ability to be operated and maintained without accidental injury to personnel or to the system. System safety involves the application of both engineering and management principles and techniques to design and develop a system which optimizes safety within the established operational, cost, and time parameters. Safety data is collected through lessons learned on a predecessor system and mishap data, as well as through the use of design trade-off data. A summary of the collected data provides a risk assessment, a potential hazard classification for the item, and a list of recommended procedures or other corrective actions to reduce these hazards to an acceptable level.

Health hazards involves the identification and elimination of biomedical hazards associated with the system. A health hazard is defined as an existing or likely condition, inherent to the operation or use of materiel, that can cause death, injury, acute or chronic illness, disability, and/or reduced job performance. These conditions can result from either long-term or short-term exposure to shock, recoil, vibration, noise, toxic fumes, radiation, heat and cold, and/or pathogenic microorganisms. Similar to system safety, the health hazards domain seeks to improve total system performance while controlling health risks to the personnel who test, use, or service Army systems.

A Common Sense Approach

While each domain focuses on separate issues and concerns, it is MANPRINT's unique integration aspect that provides the greatest benefit and demonstrates the practicality of the program. MANPRINT's approach is mindful of the capabilities and limitations of the people who operate, maintain, and support Army equipment. MANPRINT seeks to include the human as an integral element with other acquisition factors such as cost, system requirements, schedule, reliability, vulnerability, and lethality. Trade-offs and compromises performed among these factors, achieve a new level of integration in system design decisions. System decisions are more accurately made because of supporting data supplied by MANPRINT-related, front-end analyses. These analyses include tools and methodologies available in various forms such as analytical modeling methods, software systems, and databases. Other analyses are performed throughout the acquisition process, contributing up-to-date information for contribution to the MANPRINT influenced design process.

The six MANPRINT domains integrate to form a dynamic organizational and management approach to the procurement of today's complex military systems. Incidents such as the *Vincennes* will likely be reduced as greater attention is paid to the integration of people, organizations, and technology. Continual adaptation and refinement of the MANPRINT concept will additionally result in lower cost, both in human and financial terms, while concurrently enhancing capabilities. MANPRINT's attention given to early system design and development can ensure that the most critical element--the human--is an optimal part of total system performance.

Note: For further information on MANPRINT see: Booher, Harold R., ed. *Manpower and Personnel Integration (MANPRINT): An Approach to Systems Integration.* (NY: Van Nostrand Reinhold, 1990).

About the Author

Gretchen Eberhard is a management consultant with Fu Associates, Ltd. in Arlington, VA. She specializes in human resource management and planning, and is currently providing support for the DCSPER, MANPRINT Directorate and the Federal Aviation Administration (FAA). Ms. Eberhard holds a B.A. degree in psychology from St. Mary's College of Maryland.

Borrowed Military Manpower-- How the Job Gets Done *Is There A Better Way?*

Darril Imbs, Information Systems Branch
MANPRINT Division, DCSPI, PERSCOM

In the Army today, a seldom acknowledged fact is that some systems rely heavily on *Borrowed Military Manpower* (BMM) to perform their mission. The use of BMM occurs when military manpower from a *Modified Table of Organization and Equipment* (MTOE) unit performs duties within a *Table of Distribution and Allowances* (TDA) activity where a MACOM approved manpower requirement exists, but for which no manpower space has been authorized. Using BMM does not accurately reflect manpower needs and it often means soldiers are not performing tasks in their primary *Military Occupational Specialty* (MOS). New systems under development whose predecessors relied heavily on the use of BMM to accomplish their missions present challenges for MANPRINT.

When a system is approved for development, one of the first MANPRINT goals is to identify who will operate, maintain, and repair the system. A list of these individuals is contained in the *Target Audience Description* (TAD) as part of the *System MANPRINT Management Plan* (SMMP).

As systems are initially developed, *Manpower, Personnel, and Training* (MPT) requirements are reviewed. Part of this process is to ensure system constraints are met, such as no additional manpower, no new MOS, or civilian job series. In this period of declining resources, these appear as reasonable goals and constraints.

The issue of BMM gives rise to many MANPRINT questions. For example, should BMM be identified as an issue in the SMMP? If you identify BMM in the TAD, is it by total numbers, by MOS, or both? It is an important issue. A manpower constraint that no new requirements be created means just that--no added requirements. Can a new system meet that objective if the current system (predecessor) relies heavily on BMM to operate? If it is projected that the new system will reduce the use of BMM, shouldn't it be identified as part of th MANPRINT effort?

Often a new system, once it is fielded, may only reduce the level of BMM, but not eliminate it. If the new system will have the same need to rely heavily on BMM, this should be included as a major manpower issue in the SMMP. Defining the problem early through the MANPRINT effort may help system designers reduce system requirements. Defining the problem early may also allow time to program assets necessary to adequately support the system.

Additional manpower problems can occur when two or more systems are under development that rely on the same MOS to perform tasks and each also relies on BMM. It is crucial that the product managers and functional proponents communicate requirements to each other. When a new system is fielded that relies on BMM, there are training issues that must be addressed. Some examples are:

a. Does the system require formal training (institutional)? If so, how will the soldiers who are performing outside their PMOS be trained?

b. Will their PMOS skills degrade if they are utilized outside their specialty for extended periods of time?

c. What impact will this have on their career?

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Kudos to MAJ Richard Ward, Chief of Training Management Section, All Source Analysis System PMO, for proactive application of MANPRINT to a multi-block hardware and software system.

Note on ODCSPER's Survivability Study

The Deputy Chief of Staff for Personnel MANPRINT Directorate is studying how soldier survivability will fit into the MANPRINT program. A study is being generated which will: (1) define soldier survivability for mounted, as well as dismounted, soldiers; (2) determine how to assess soldier survivability; (3) determine the assessment criteria; (4) define how it will fit into the MANPRINT program and Milestone Decision Reviews; and (5) include anti-fratricide. This study will involve the numerous agencies and studies currently involved with soldier survivability. The end results should not generate redundant efforts nor develop unnecessary requirements. The bottom line is to enhance soldier survivability in all systems -- including the soldier system -- as well as addressing fratricide problems.

-- LTC Albert A. Sciarretta, ODCSPER

Borrowed Military Manpower, continued

As the Army continues to downsize, the issue of BMM becomes even more significant. MANPRINT provides a tool to help resolve issues like the reliance on BMM. When documented in the SMMP as part of the MANPRINT effort, these concerns become visible to system designers and to decision makers alike. The pool of soldiers that was once available will continue to shrink. It is essential that product managers and functional proponents identify BMM usage and work together to reduce reliance on this type of manning. This may mean trade-offs such as performing only essential tasks in a system or providing only information required by policy or regulation rather than providing all the "nice to have" data.

When it comes to the continued reliance on BMM, there are three losers: the Army, the system that relies on BMM, and most importantly, the soldiers.

Meetings

Keep your calendar open for the Practitioner's conference in June '93 in Washington, DC. More information will be coming your way. Look for details in the Spring '93 MANPRINT Quarterly issue.

16-18 February 1993
Ammo Executive Summit. Tysons Corner, VA. Contact: ADPA (703) 522-1820 or Fax (703) 522-1885.

15-18 March 1993
Statistical Process Control (SPC). San Diego, CA. Contact: ADPA (703) 522-1820 or Fax (703) 522-1885.

22-25 March 1993
19th Environmental. Albuquerque, NM. Contact: ADPA (703) 522-1820 or Fax (703) 522-1885.

26-29 April 1993
Logistics. Dayton, OH. Contact: ADPA (703) 522-1820 or Fax (703) 522-1885.

Tasks, continued

mated tracking system will greatly benefit FOOTPRINT users. Using task data from ASOP, DCSPI will input the resource intensive task into FOOTPRINT. Users can then save money and time in the performance of a system front-end or post-field analysis, such as Early Comparability Analysis.

TRADOC is committed to finding solutions to the problems surrounding the accounting process for soldier performance tasks. Initial efforts at improving the process have been promising, yet challanges remain. Only through constant attention to these problems can success be ensured.