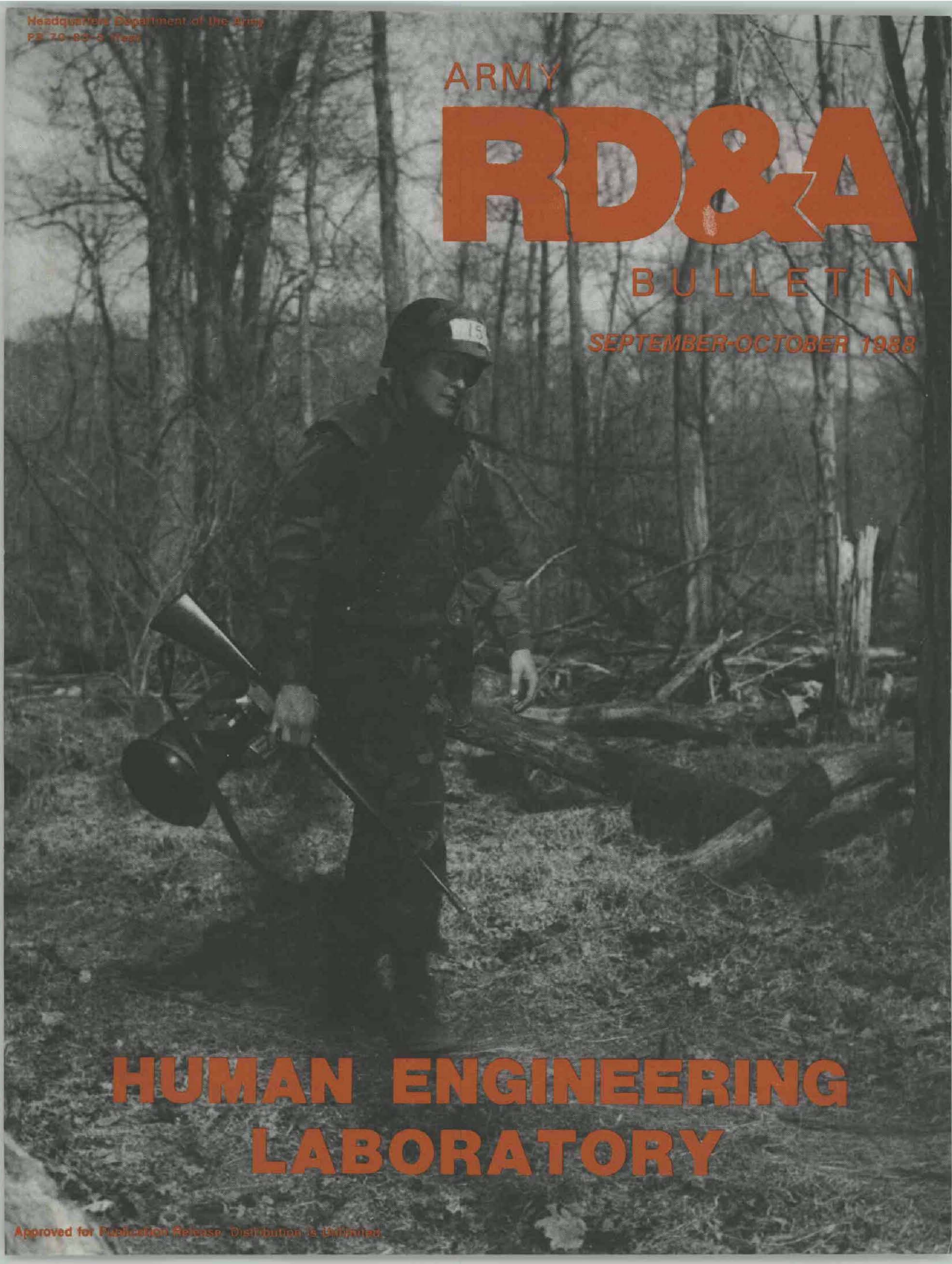
Headquarters Department of the Army
PB 70-88-5 (Test)



ARMY RD&A BULLETIN

SEPTEMBER-OCTOBER 1988

HUMAN ENGINEERING LABORATORY

Research
Development
Acquisition

RD&A

PB 70-88-5

SEPTEMBER-OCTOBER 1988

PROFESSIONAL BULLETIN OF THE RDA COMMUNITY

This medium is approved for the official dissemination of material designed to keep individuals within the Army knowledgeable of current and emerging developments within their areas of expertise for the purpose of enhancing their professional development.

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Distribution: Special

FEATURES

U.S. Army Human Engineering Laboratory — LTC Thomas L. Frezell 1
Yuma Proving Ground: The Army's Desert Test Center — Ben Duffy 5
Interview With ASA (RD&A) Dr. J. R. Sculley 8
Army Announces R&D Achievement Award Recipients 11
New RAMifications — Daniel J. Peddicord 16
Human Factors Challenges in Armored Vehicle Design — CPT R. Mark Brown 18
Belvoir Developing Countermine Technologies — Gayle Peterson 20
Soviet and Chinese Materiel 22
Helicopter Engine Fuel Controls: 25 Years of Evolution — Roger L. Furguson 24
Role of Reserves in R&D — LTC Thomas J. Gleason (USAR) 27
Army Ammunition Center Provides Expertise — Paul Levesque 30
TACOM Getting Robotic Command Center — George Taylor 33
Conferees Discuss MANPRINT/Safety Issues — Roscille W. Nelson 35
Task Force Updates AR 70-1 — Jim O'Brien 37

DEPARTMENTS

Career Development Update 38
RD&A News Briefs 39
Historical Highlights 44

ABOUT THE COVER

Shown on the front cover is a soldier carrying an antiarmor system on a 3.8 kilometer cross-country course during evaluations conducted by the Army's Human Engineering Laboratory. The back cover shows some of the rough terrain that Army equipment is exposed to during testing at the Army's desert test center, Yuma Proving Ground AZ.

Army RD&A Bulletin (ISSN 0892-8657) is published bimonthly by HQ, U.S. Army Materiel Command. Articles reflect views of the authors and should not be interpreted as official opinion of the Department of the Army or any branch, command, or agency of the Army. The purpose is to instruct members of the RD&A community relative to RD&A processes, procedures, techniques and management philosophy and to disseminate other information pertinent to the professional development of the RD&A community. Private subscriptions and rates are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 or (202) 783-3238. Second class official postage paid at Alexandria, VA and additional mailing offices. POSTMASTER: Send address changes to Editor, Army RD&A Bulletin, 5001 Eisenhower Avenue, Alexandria, VA 22333-0001. Inquiries: (202) 274-8977 or AV 284-8977. Articles may be reprinted if credit is given to Army RD&A Bulletin and the author except where copyright is indicated. Unless otherwise indicated, all photographs are from U.S. Army sources. Approved for public release; Distribution is unlimited.

By LTC Thomas L. Frezell

U.S. ARMY HUMAN ENGINEERING LABORATORY

Considering the soldier in the design and performance of weapons and equipment

Introduction

The U.S. Army Human Engineering Laboratory (HEL), located at Aberdeen Proving Ground (APG), MD, is the Army's lead laboratory for research and development (R&D) in the area of soldier-machine interface. It is one of seven laboratories under the aegis of the U.S. Army Laboratory Command (LABCOM).

Since its establishment in 1951, the HEL has gained worldwide recognition as a leading organization in the field of human factors engineering. The main focus of this research is twofold: to ensure equipment is designed for the soldier and to ensure the tasks soldiers are required to perform on the battlefield are within their physical and mental abilities.

Though soldier's basic capabilities have not changed, the technologies of today, as well as those in development, provide a tremendous number of options in the ways soldiers can interface with materiel. In addition, options in tactics, precipitated by the threat, have placed various demands on soldiers. Therefore, data regarding these options are required if soldier performance (sensing, integrating, and reacting) is to be optimized.

Human factors engineering in the Army is the science of considering the soldier (the operator and maintainer) early in the design phase (as well as later during the modification phases) of weapons and equipment and their proposed use in the operational environment. This man-in-the-loop design process simplifies the operation and maintenance of equipment, reduces time and error, reduces training time for soldiers, reduces the labor required to perform the task, and increases warfighting capability.

Laboratory and Field Work

The human factors engineering R&D takes place both in the laboratory and in the field. Researchers either bring soldiers to APG or travel to other military installations to conduct human factors research in a variety of areas. This knowledge base is then provided to the Army's combat and materiel developers for incorporation in the initial design of military hardware in order to achieve the optimal level of soldier-machine integration. Materiel in and of itself will not win a war. Soldiers using materiel can win wars and for materiel to be most effectively used by soldiers, it must be designed for soldiers.

The highly skilled scientists associated with HEL conduct basic and applied research on human performance (both mental and physical) and apply the results of these efforts to U.S. Army materiel designs. The application of this data base is done primarily through HEL detachments and field offices located at the major Army Materiel Command (AMC) subordinate commands and major Training and Doctrine Command (TRADOC) Centers and Schools (Figure 1).

These detachments and field offices work directly with combat developers, materiel developers, contractors, and others involved in the materiel acquisition process. These HEL personnel are also actively involved with the Manpower and Personnel Integration (MANPRINT) programs being implemented throughout the materiel acquisition community.

The laboratory also maintains close ties with the other services and NATO representatives in the human factors engineering field through the chairing of, or membership on, working committees and panels.

Because the laboratory's product line is predominantly soldier performance information, and because it has an application support arm which exists to ensure the transfer of this information to both the materiel and combat developers, HEL is unique as a laboratory within the LABCOM family.

With the Army's increased emphasis on MANPRINT, the organization has received an increased workload for human factors engineering support that far exceeds its present capability. However, various methods are being explored to augment the present workforce to meet these increased workload requirements.

Programs

There are numerous research programs underway at HEL and most are focused on the cutting edge of technology. For example, the laboratory continues to play an important role in the Army's efforts to improve its medium antiarmor weapon systems. These systems are currently being developed and evaluated as possible improvements or replacements for the Dragon antiarmor system.

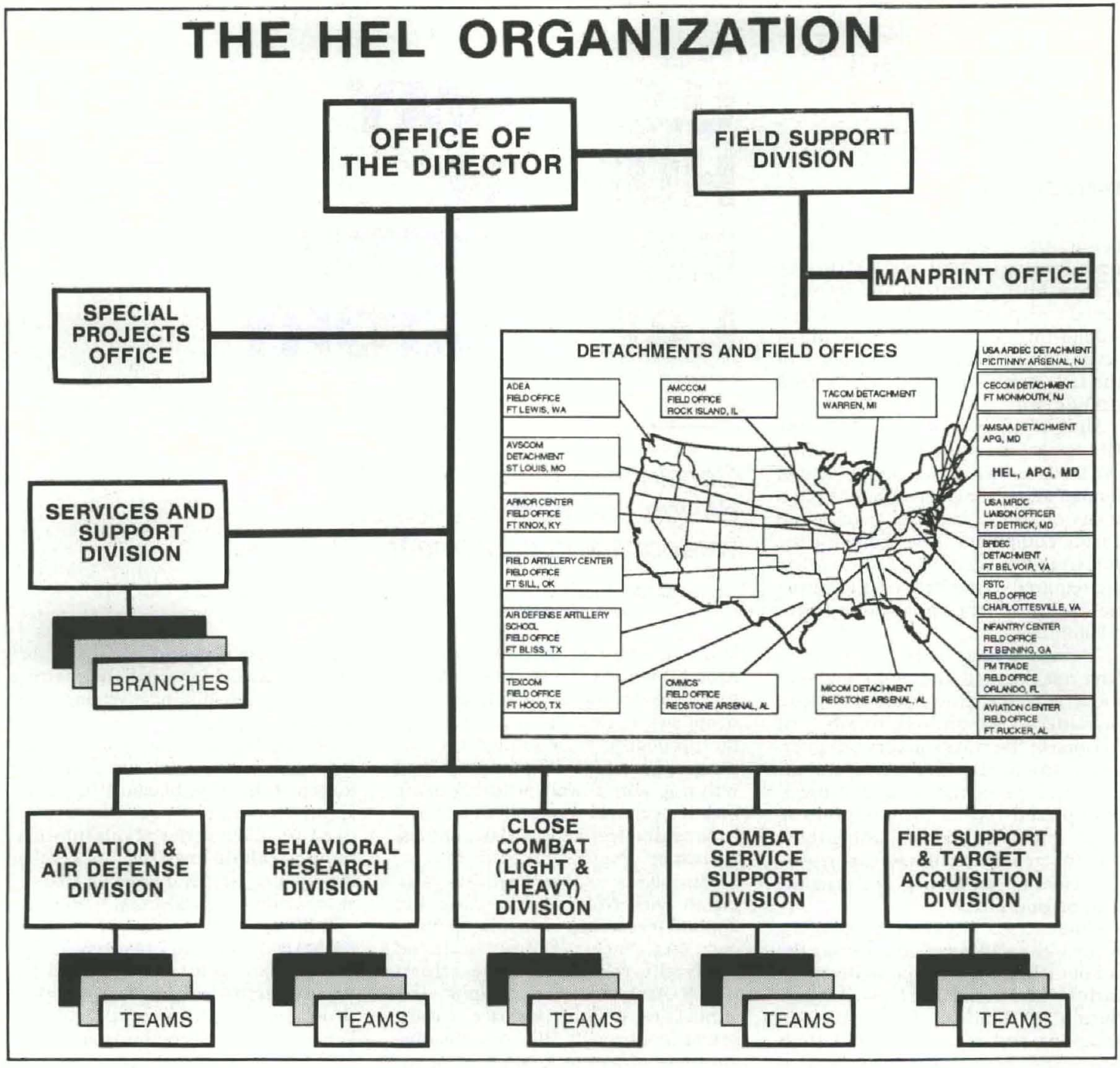


Figure 1.

Three separate Army programs are presently underway to either improve or replace the Dragon. The first program is a two-phase product improvement program (PIP) that will improve the performance of the Dragon. In this regard, the HEL has developed a lightweight viscous damped mount to improve the tracking ability of Dragon gunners to hit moving targets.

The second program is designed to evaluate off-the-shelf foreign systems that are used or are under development by U.S. allies. The third program involves the development of new candidate systems being developed by three defense contractors.

The ability of a soldier to quickly engage an enemy target and to carry and negotiate obstacles while under battlefield-like conditions are some of the critical issues in the evaluation process.

The HEL has recently conducted target tracking accuracy experiments and three portability evaluations of candidate systems within a fully instrumented obstacle course and a 3.8 km cross-country course. Figure 2 shows a soldier negotiating various obstacles.

During these studies, important objective and subjective data were collected that will provide decision makers with information regarding the relative operability effectiveness of the various systems. Secondarily, reliable human engineering infor-

mation was collected and design changes recommended to improve the battlefield effectiveness of the candidate systems.

More recently, researchers have begun to more accurately collect physiological data related to the physical cost of individual soldier load bearing through mobility/portability evaluations. The physical costs associated with carrying various weapon systems may be a more important variable than time. This physical cost evaluation may help resolve some critical human factors questions with respect to individual soldiers, their load bearing capabilities, and their combat effectiveness.

Figure 2.
The ability to negotiate various obstacles is a critical factor.

Stress

Another major area of interest involves the effects of combat-like stress on soldier performance. One program that addressed this issue looked at the effects of stress with respect to accuracy in weapons firing. A more recent study was salvo stress and is providing human factors data crucial to a number of Army programs, including the Advanced Combat Rifle (ACR) development effort.

HEL's purposes were to develop standard procedures for producing stress responses in test participants while meeting human use guidelines. These procedures then allow the testing of man-machine systems under conditions that closely approximate combat.

This evaluation was conducted to also assess a three-round burst mode in a weapon as opposed to the single-round mode. The weapons were modified M16A2 rifles and were equipped with Naval Weapon Systems Center (Crane, Inc.) #1 muzzle devices, which yield a burst dispersion of less than 16 mils, compared to the M16A2 flash suppressors, which yield a burst dispersion greater than 22 mils. Both the semiautomatic and burst modes were compared by examining the shooting of soldiers in rapidly paced day defense scenarios with and without direct competition.

This experiment was conducted over a three-week period. Sixty-seven volunteer infantrymen from the 82nd Airborne Division and the 101st Airborne Division (Air Assault) served as subjects. Each week, new groups of soldiers arrived at APG and entered the study. On record fire day, each soldier shot two 72-target scenarios. One was fired in semiautomatic mode, the other was fired in burst mode. Data were collected on each soldier's shooting performance, psychological reactions to the situation, and blood chemistry.

The various biochemical levels in the blood samples are now being analyzed and will provide a measure of physiological stress. Shooting performance will serve to indicate a soldier's ability to operate a weapon under stressful conditions. Analysis of the data collected is in progress.

Although both units' teams performed well on the demanding scenarios, the 82nd Airborne Division soldiers proved to be superior marksmen during competition weeks. Many soldiers commented that the training received and the chance to help the Army in its materiel development efforts made participation in this experiment an interesting and valuable experience.

Aviation

Human engineering issues with respect to aviation are another major research area within HEL. One recent study was oriented toward the evaluation of two display technologies specifically involving touch and bezel keys during various helicopter vibration levels.

The workload of Army helicopter aircrewmen is extremely demanding. Current aircraft require the use of both hands and feet in order to maintain control. Additional demands are then placed upon the aircrew through tasks such as navigation, communication, and target acquisition. How can the aircrewmen interact with the subsystems efficiently and effectively, while maintaining control of the aircraft? The research conducted at HEL by the Aviation and Air Defense Division is geared to answer such issues.

Through a joint research effort with McDonnell Douglas Helicopter Corp., a recent study was conducted evaluating the effects of various helicopter flight maneuvers and associated vibration levels on an operator's ability to actuate touch and bezel keys. Bezel keys are one of the current methods by which crew members interact with multifunction displays.

The test was performed in a JUH-1H helicopter. Test participants were seated in the rear passenger seats, with the test hardware mounted directly in front of them. The flight crew flew through a series of 13 standardized flight maneuvers, with each maneuver associated with a different vibration level. Active duty Army aviators and researchers from HEL participated in the evaluation.

During each maneuver, 24 prompts were presented to actuate a key. Subjects responded to those prompts by selecting the appropriate key. In order to evaluate performance, response time, input time, and errors were recorded for each key strike. The vibration levels experienced by the subjects and displays were also collected.

Data from this evaluation are being analyzed. Results will help guide the future application of touch panels in helicopter cockpits.

The Fire Support and Target Acquisition Division (FSTAD) of HEL is currently investigating future fire support

Figure 3.

A modified M109 has proven to be an excellent command post vehicle in the artillery community.

systems, associated doctrine, field rules, and potential applications for decision aids to enhance soldier capability to function on the future battlefield.

The Field Artillery Survey Knowledge Acquisition Program (FASKAP) is a multiyear effort to compile a comprehensive base of fire support expertise. The goals of the program are to develop a methodology for understanding complex battlefield decision processes and to evolve a decision-aid application to assist soldiers in the execution of their mission on the battlefield.

FASKAP is currently investigating three fire support functions: allocation of firing units, positioning of firing units, and distribution of fires. FSTAD is trying to identify rules used by decision makers in the execution of their duties. Doctrine and tactics manuals and other publications have been reviewed yielding some rules.

An open-ended field survey was mailed to senior artillerymen (E7-E9 and 03-06). Over 600 responses were returned to HEL. The majority of the responders had 10 to 15 years of artillery experience. Initial findings indicate that some field rules coincide with doctrine and others conflict. The U.S. Army Field Artillery School (USAFAS) is being kept informed and the survey results are being used as indicators for doctrinal investigation and operational effectiveness, as well as rule-based decision-aid applications.

Testbeds

HEL also uses testbeds of various kinds to determine the effects that advanced technologies have on crew size and soldier/crew performance in various battlefield environments. One such testbed has been used to study command and control functions in artillery. Studies revealed that given the "right technologies," these functions could be executed for continuous periods exceeding 72 hours. Like much of the research at HEL, this was a combined effort of many organizations such as the Natick RDE Center, Natick, MA; the Chemical RDE Center at APG; the Field Artillery School at Fort Sill, OK; and the U.S. Army Medical R&D Command at Fort Detrick, MD. Figure 3 shows a modified M109 which has proven to be an excellent command post vehicle in the artillery community.

Robotics

HEL, as the LABCOM lead laboratory for R&D in field robotics within AMC, is involved in robotics and its applications to Army needs. Robotics applied on the battlefield has the potential to reduce risk to soldiers, extend capabilities of existing forces, and increase efficiency. As part of this effort, HEL played a key role in drafting the Army R&D robotics plan now being staffed within the Army.

HEL has several technology base efforts in this area that are addressing soldier-robot interface issues: stereovision versus monovision, color versus black and white, high resolution versus low resolution, wide field of view versus narrow field of view, and various control configurations. Information on these interface issues is absolutely essential for effective robot management and control. Activities helping the Army and HEL in this area are many and include the national laboratories, other Services, academia, and industry.

Conclusion

Today's challenges of threat and advances in technology demand that the HEL not only produce soldier performance data regarding interaction effectiveness with new technology and tactics, but also be proactive in its application to the development process. HEL's mission is to ensure that these technologies are designed and applied so that they can be effectively used and maintained by soldiers. To continue to achieve this, the soldier performance data base must continue to be updated and integrated early in the development process.

LTC THOMAS L. FREZELL, MSC, is the deputy director/commander of the U.S. Army Human Engineering Laboratory. He also serves as the chief of the laboratory's Behavioral Research Division. He holds a master's degree in psychology from the University of Alabama.

YUMA PROVING GROUND: THE ARMY'S DESERT TEST CENTER

Introduction

Monday, August 31. A thin blue haze hangs over the mountains 20 miles to the east, and the desert is eerily quiet. It's 10 a.m., and the temperature hovers near 100 degrees Fahrenheit. A hot, dry wind from the south carries with it a fine grit of wind blown sand, and the smell of dust, alkali, and creosote. By 3 p.m. the temperature in the non-existent shade is 114 degrees. The sun hangs overhead like a fist and rising heat waves shimmer on the horizon like some distant sea. In the distance a lowering dust cloud raised by a HELLFIRE missile test creeps to the north 15 minutes later.

At the Army's Yuma Proving Ground near Yuma, AZ, Army equipment is tested and evaluated to determine if it can withstand the extreme conditions encountered in desert warfare. Yuma Proving Ground is the Army's only combined general purpose proving ground and environmental test center. Very few other Department of Defense proving grounds have the ability to match the diversity of testing done at Yuma.

High temperatures, low humidity, knife-sharp rocks, sand and windblown dust are all features common to the Sonoran desert. All, or any one of them, can defeat an Army as completely and decisively as any enemy force by rendering vital equipment useless.

Located in southwestern Arizona on the lower Colorado River 40 miles from the Mexican border, Yuma Proving Ground is on the northern reaches of Mexico's great Sonoran desert. Air temperatures routinely reach into the 100 degree range daily from May through September. In July, August, and September daily temperatures can exceed 110 degrees Fahrenheit. Highs of 118 degrees have been recorded on the proving ground's ranges.

By Ben Duffy

Known within government and industry RDT&E communities as YPG, Yuma Proving Ground covers nearly 1,400 square miles of low desert. Environmentally, it is a close match to many of the great deserts of the world. In many respects it resembles conditions found in the deserts of North Africa, the Mid East, and Central Asia. Surface areas can also be used at YPG to represent the colder Gobi and Kara Kum deserts of China and Central Asia.

The proving ground's soils range from pea sized pebbles polished smooth by centuries of wind blown grit, to fine grained sand with the consistency of talcum powder. Low desert scrub, desert plants, rock mountains, gravel hills, and sandy plains contribute to the extreme conditions found at Yuma.

History

Testing began at the present site of the Yuma Proving Ground in the early years of World War II. In 1943, the U.S. Corps of Engineers opened the Yuma Test Branch. Located on the Colorado River,

Volcano anti-tank mines are loaded aboard an air delivery platform. Volcano has been successfully air deployed during testing at YPG.

Apache helicopter fires 2.75mm rockets at YPG's Cibola Range. Yuma Proving Ground's air-to-ground aircraft armament test range with electronic and optical real-time instrumentation is unique.

the Yuma Test Branch (YTB) tested new bridges, tools, amphibious vehicles, and well drilling equipment for American and Allied troops. Much of the work done at YTB was carried out by a labor battalion of Italian prisoners of war. A stone "castle" built by Italian stone masons to store paint and tools can still be seen today, a historic monument to the artisans' skill.

The Test Branch closed in 1950, but in 1951 it was reactivated as the Yuma Test Station. YTS was principally a staging center for desert testing by safari teams from the various technical services. By 1956, several of the teams were at YTS year 'round. In 1962 YTS and most of its personnel were reassigned to the U.S. Army Materiel Command, under the operational control of the U.S. Army Test and Evaluation Command.

In 1963, Yuma Test Station became the Yuma Proving Ground, and in 1973 it was redesignated as the U.S. Army Yuma Proving Ground. In June 1974, YPG was named a Department of Defense Major Range and Test Facility, one of only 26 DOD ranges and test facilities to be so designated.

YPG covers nearly 840,000 acres of low desert. Roughly U-shaped, it extends 58 miles north to south and 52 miles east to west. Land within the "U" is the Kofa National Wildlife Refuge. Kofa is named after the old King of Arizona gold mine, located within what is now the national wildlife refuge.

Yuma Proving Ground has not neglected its initial role as an Army desert environment test center. A massive data base of environmental data has grown over the years. Specialized facilities have been developed to continue to challenge weapons and equipment with one of the most hostile environments to men and machines on earth. These facilities in turn are supported by the shops and labs which support the test ranges. Large desert areas are preserved in their natural state to provide test models to determine mobility and durability in the world's deserts.

YPG's clean air, low humidity, and low rainfall (about three inches a year), as well as almost 350 clear and sunny days a year add up to almost perfect conditions for testing a wide range of materiel for America's Armed Forces. Unlike other test facilities, no tests are delayed or postponed because of snow. The adjacent Colorado River with its dams and reservoirs provide Yuma Proving Ground with amphibious test capabilities not normally associated with desert testing.

Capabilities

The proving ground's commitment to quality and thoroughness is fully supported by an experienced core of professionals with extensive knowledge of desert conditions. Fully instrumented ranges and courses provide testers with a wide variety of critical test information, under conditions matching those in the world's major desert areas.

Yuma also operates the Army's only air-to-ground aircraft armament test range with electronic and optical real-time instrumentation. Precision satellite and laser assisted aircraft tracking systems make Yuma a world leader in this critical test area.

Sophisticated instrumentation delivers critical information instantaneously by electronically recording, transmitting, and interpreting test data into measurable real-time results. Each test is scrutinized to squeeze every useful bit of information available from it. Countless videotaped test replays, high-speed test films, and decades of accumulated testing experience are used to study and analyze each system thoroughly. Optical, electromagnetic, mechanical and remote sensors measure performance, and telemetry transmits the data to high-speed computers to give testers an overall performance picture. Frequently, all this is accomplished as it happens and gives engineers immediate feed-back to correct errors and determine the success or failure of a test.

Currently, a new instrumentation system using tracking outputs to point optical and electronic sensor platforms to pinpoint height of burst and functioning characteristics of projectiles is being developed at YPG. Low altitude tracking, improved ballistic test capability and real-time video tracking telescopes give YPG a test capability found nowhere else.

Three state-of-the-art laser tracking systems also give YPG a testing edge. Among other applications, these systems are used for calibration tests of the Air Force Global Positioning System (GPS) navigation satellites. GPS can accurately locate a vessel, aircraft, or vehicle's position by latitude, longitude, and height above the earth's surface to within one meter. Work is underway to further increase the system's accuracy, as well as to incorporate GPS technology into YPG's range measurement system.

Air delivery and personal parachute testing is part of YPG's mission. Here sling loading for water training is tested.

Environmental Matters

Responsibility for thoroughness and quality extends to environmental matters as well. At the Yuma Proving Ground, protecting the fragile desert environment is a top priority. In a climate where 50-year-old tin cans and wagon wheel tracks more than 100 years old can still be found relatively unaffected by weather, environmental protection is a must. Environmental integrity is an inseparable part of the testing done a YPG. All planned testing is studied and evaluated, environmental documentation prepared, and mitigation measures implemented to reduce adverse environmental impact.

Preservation, wildlife conservation, and protection of historical and archaeological sites and artifacts are the concerns of not only YPG's environmental engineers, but everyone at Yuma Proving Ground. Formal environmental programs protect and ensure the continued survival of the desert and the wild plant and animal life under our care.

YPG's environmental engineers are stewards of 11 surveyed archaeological sites on the proving ground, several of which have significant historical and cultural worth. Remains of early American Indian sleeping circles, camp fires, pot-shards, and stone implements have been found on the proving ground, some of which date back almost 10,000 years, showing the area was in continuous use by early American Indians as hunting grounds and a main travel route to the Colorado River.

Yuma Proving Ground is no longer just a remote oasis in the desert from which teams of soldiers and civilians set out to challenge new weapons and equipment in one of the most hostile environments the Army will face. Highly instrumented ranges tied together by extensive data handling and processing networks cover two-thirds of the installation.

Not only is Yuma Proving Ground the premier facility for testing both ground and aerial weapon systems, it leads in artillery ammunition and air delivery system testing as well. YPG is also capable and ready to support testing overflow from other TECOM activities in the automotive and electronics areas.

Because of YPG's varied and sophisticated ranges and instrumentation, the proving ground is a leader in developing facilities to exploit testing programs which will come about from breakthroughs in the Strategic Defense Initiatives, including directed energy and hypervelocity weapons.

Summary

Since its beginning as a sleepy desert environmental test center, YPG has seen its mission as a dynamic general purpose proving ground grow to encompass almost every aspect of defense testing for the Army, other sister services, and some allied governments as well.

Yuma Proving Ground's numerous sophisticated and highly instrumented facilities and test mission capabilities have greatly expanded since 1943. These facilities and unique capabilities, together with a skilled and dedicated civilian and military work force of highly qualified professional men and women with special abilities, talents, experience and knowledge, ensure that the U.S. Army Yuma Proving Ground will play a leading role in the Army's test and evaluation program well into the 21st century.

BEN DUFFY is public affairs officer for the U.S. Army Yuma Proving Ground. He received his B.A. in journalism and internal relations from the University of Southern California.

INTERVIEW WITH DR. J. R. SCULLEY

Assistant Secretary of the Army for RD&A and Deputy Army Acquisition Executive

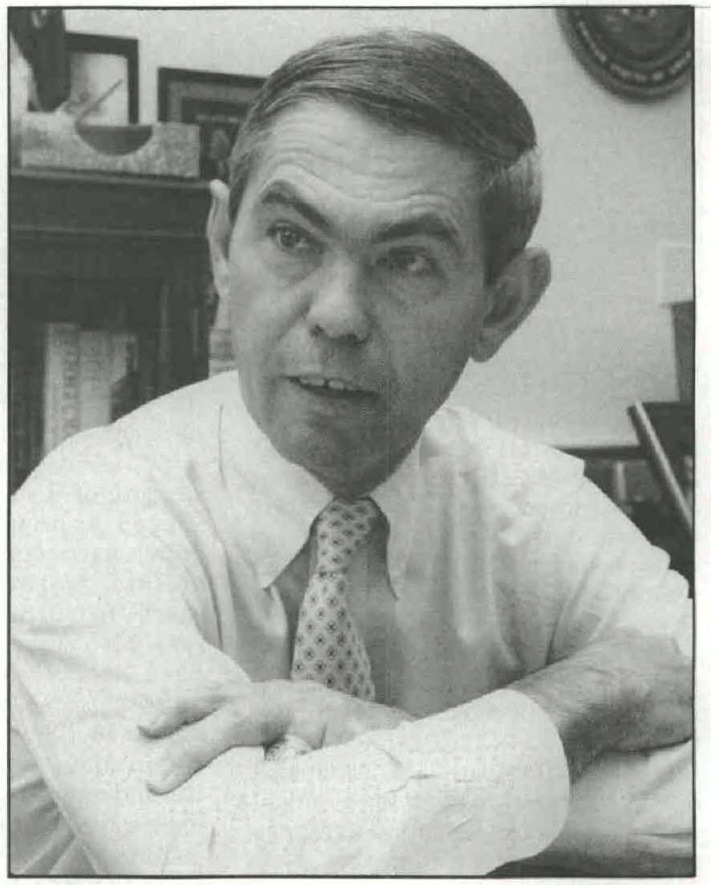
Q. You have served as the ASA (RD&A) for about seven years. What are some of the major improvements in the Army's acquisition process that have occurred during this period that you are especially proud of?

A. I certainly think that one of the major accomplishments is, after about a 20-year absence, the re-establishment of the contracting function — first on the Army staff and then under Goldwater-Nichols in the secretariat. Other major accomplishments are the reorganization that took place under Goldwater-Nichols and the reduction in the size of the Department of Army Headquarters in acquisition by about 50 percent.

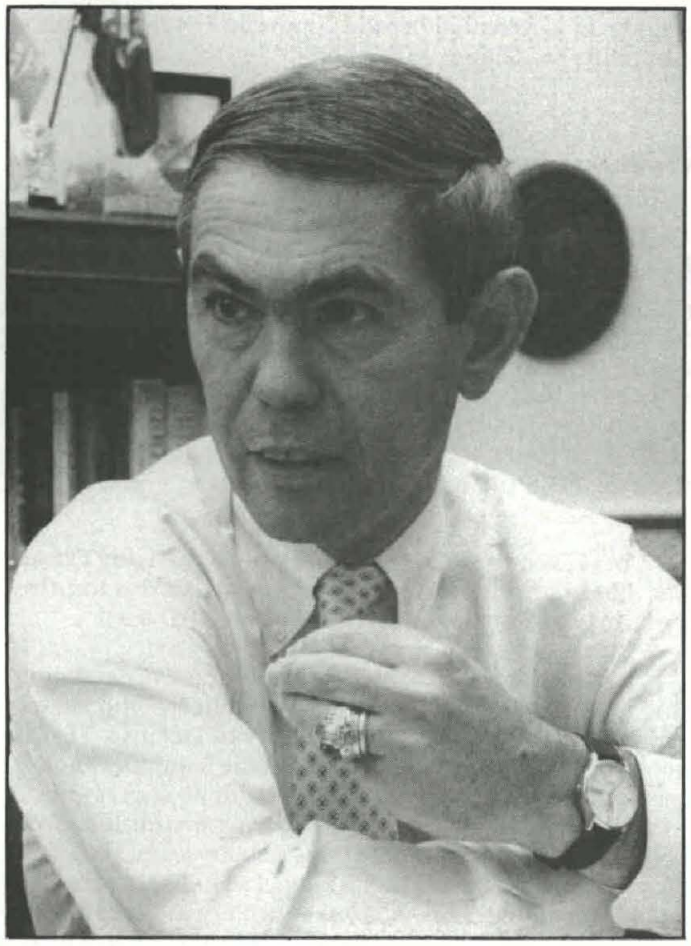
Q. The recent reorganization of the Army's acquisition structure resulted, among other things, in creation of an Army Acquisition Executive. In what ways do you believe this will help the Army's acquisition process?

A. One way that it has helped me — in my role as the Deputy and during the interim as the Army Acquisition Executive between Jim Ambrose and Mike Stone — is by giving me visibility into Army programs that I felt I had never had in the past. This was achieved through PEOs that were fully involved with program managers and not burdened with the housekeeping responsibilities that commodity command commanders have with being the judge, the city manager, the mayor, and proponents for investigations, etc. They are working programs full-time.

Q. Another result of the reorganization was the establishment of Program Executive Officers to whom most PMs now report rather than to the Army Materiel Command. Some people contend that this



"AMC is as important as it ever was and so are the hundred and some thousand plus people in AMC who serve the Army."



arrangement tends to diminish the importance of AMC. What is your response?

A. AMC is as important as it ever was and so are the hundred and some thousand plus people in AMC who serve the Army. Let's make no mistake about it, I view AMC as the organization that does the research, development, acquisition, and logistics support that keeps the Army going. I have often used the analogy that the Acquisition Executive is the programmatic chief and the Materiel Command commanding general is the functional chief and together they serve the Army — one in the programmatic sense and one in the functional sense. I view this as an excellent partnership with AMC and would just emphasize that their importance has been enhanced and not diminished.

Q. To what extent does your office interface with the new Office of the Under Secretary of Defense for Acquisition?

A. We interface to a great extent, particularly in the areas of defense research and engineering, research and advanced technology, tactical warfare, and strategic programs. There is almost a daily interaction with Dr. Costello's staff and on many days with Dr. Costello himself. To his credit, it has been an excellent working relationship. He is personable, technically competent, and is a vigorous person who has enhanced the relationship between the Services and the Office of the Secretary of Defense.

"The AIM Program will work toward a real long term lasting workload reduction for the people in the Army's acquisition community."

Q. Some critics of the Army's acquisition process claim that far too many systems are falling under the PEO reporting concept, ultimately negating the original intent of the PM approach to management. Is this a fair criticism?

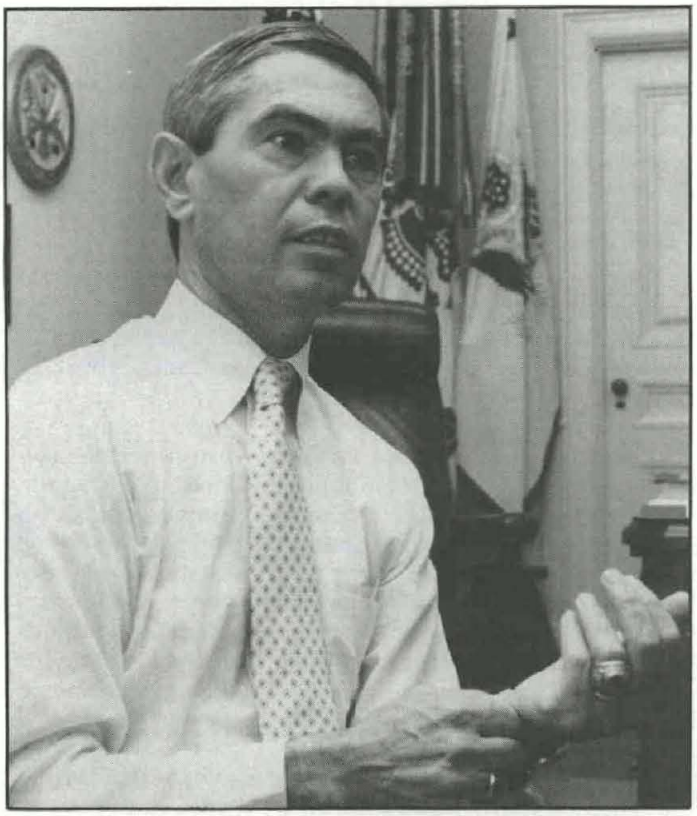
A. In my view, it is not a fair criticism. In my own management style, the focus should appropriately be on the Program Executive Officer, not on the Service Acquisition Executive. The Program Executive Officers then surface problems that they feel cannot be resolved at the commodity command/PEO level. This management by exception has worked well. There are many programs that come under PEOs that I know very little about because the PEO and his partner — the commodity commander — have been able to manage those programs and resolve the issues.

Q. When implemented, the new Acquisition Information Management Program is expected to provide a responsive information network to support the Army's acquisition mission. Will this network lead to another reporting system for those who now complain that there are already too many required reports?

A. The people who complain that there are too many required reports are right. Even worse, however, is that each of them has to be generated from scratch, and separately submitted. I think that the problem is less related to how many reports are generated, and more related to the basic redundancy of the data in the reports. The AIM Program is seeking to improve the efficiency and effectiveness of the reporting function by separating the data collection process from the data packaging and information production process. By sharing timely, accurate data, there is less need to regenerate the data in individualized specialized reports.

The AIM Program will not lead to a new reporting system but is intended to merge, over time, the current reporting system into a more effective, integrated and coordinated process. Unfortunately, lasting reduction in required reports is difficult. If the requirement for information hasn't changed, and no enduring method established to gather the information, then an old report will probably emerge with a new name. But in the long run, there will be no reduction in workload. The AIM Program will work toward a real long term lasting workload reduction for the people in the Army's acquisition community.

As an example of the AIM Program's initiative toward reducing reporting requirements, the AIM PM is working on development of a PEO/PM Management Information System (PMIS). The idea is that the PM office will provide data periodically to a local computer. The one data input will then be used to generate the reports required by OSD (Defense Acquisition Executive Summary); by Congress (Selected



"We have a much better Army today than we did some seven years ago, both in the quality of the people and in the quality of the materiel we have provided."

Acquisition Report or Budget Procurement forms); for ASA (FM) (Official Baseline Cost Estimate); and many other mandatory reports. From the PM's view there will be less work inputting data and more consistent and accurate output. The PM can't refuse to submit the reports, but by an aggressive data and information management program, we can reduce PM workload; share data between reports; and improve consistency, accuracy and timelines of data. You can see from the example of PMIS that the goal is not another reporting system, but to simplify and make the ones we have more efficient.

Q. Prior to your present service with the Department of the Army, you also had distinguished careers in both academia and private industry. What advice would you offer those who are just entering government service if they are to be successful?

A. The first advice would be to take the time to learn the system and then take the time to evaluate the people who surround you and advise you and have full confidence in their abilities. Once you have that confidence in those people then rely on them. I would emphasize, certainly in today's environment, to never forget the principles of integrity, ethics, and morality in your dealings, and especially at this level — to remember the importance of the elements of humility in dealing with people.

Q. I guess you wouldn't agree with today's critics that there is something seriously wrong with the system that needs to be fixed.

A. There is very little wrong with today's system. Any system can be tweaked and refined, but fundamentally, it's sound. Those attributes of integrity, ethics and morality can't be legislated nor governed by regulation or policy. If they are remembered in all dealings, not just to be legally sufficient or sufficient from an integrity, ethical or morality view, then you won't have those problems. Unfortunately, elements of greed have crept in with a few individuals and detracted from the whole system.

Q. What are some of the short range and long range goals you would like to accomplish during the remainder of your tenure as the ASA (RD&A)?

A. Certainly, I would like to see more attractive packaging of Army programs so that we better compete for resources in the Office of the Secretary of Defense. That is literally taking place at the moment in the Summer Defense Resources Board cycle and I think it will be successful.

I would also like to leave a system that is institutionalized for the future Army that would bring stability to our programs during difficult times with the budget deficits that we face and during better times, not unlike what was experienced during the early years of the administration. That type of system would allow us to acquire materiel on a more stable, less volatile basis.

Q. Do you foresee some tough times ahead?

A. Yes, I don't see any indications that cause me to be optimistic from a resource point of view. I think we face budget deficits and defense will be asked to pay for more than its fair share at a time when we know current force structure and current materiel acquisition programs are inadequate to meet the national security goals.

Q. Do you have any additional comments regarding the Army's acquisition process in general?

A. I have been impressed with the quality of the force, both civilian and military. I have not been associated with a group of professionals that I hold in higher esteem and I want to really thank them for their work and support. I think history will judge the last seven years kindly and as the most significant modernization period in peacetime that the Army has been through. When I look back at what has been developed and fielded during this period, I feel there are significant accomplishments. We have a much better Army today than we did some seven years ago, both in the quality of the people and in the quality of the materiel we have provided. This has come from a lot of dedication and hard work by the people responsible.

ARMY ANNOUNCES ARMY R&D ACHIEVEMENT AWARD RECIPIENTS

One hundred fourteen Army in-house scientists and engineers have been selected to receive Department of the Army R&D Achievement Awards. These awards are presented in recognition of outstanding achievements that have improved capabilities of the U.S. Army and contributed to the national welfare during 1987.

The achievement awards, which will be presented this year in the form of a wall plaque, will honor 73 personnel employed at activities of the U.S. Army Materiel Command, 27 assigned to the U.S. Army Corps of Engineers, and 14 employees from the U.S. Army Medical Research and Development Command.

U.S. Army Materiel Command

• U.S. Army Armament, Munitions and Chemical Command:

Armament Research, Development and Engineering Center (ARDEC)

Two employees with ARDEC will be recognized for their work in advancing the state-of-the-art of explosive production capabilities in terms of safety and economics. Dr. Jack Alster and Seymour Portnoy of ARDEC conducted developmental research on a new and unique process for producing HMX — which has proven to be the most powerful of conventional high explosives used by the military. This effort upgrades the Army's program for improved explosive manufacturing technology.

Dr. Suryanarayana Bulusu will be commended for clarifying the first significant molecular steps of the chemical processes of detonation of presently-used military explosives. Dr. Bulusu performed laboratory kinetic experiments and then designed experiments to measure the shock sensitivity and detonation velocity in bulk explosives to confirm his laboratory findings. This

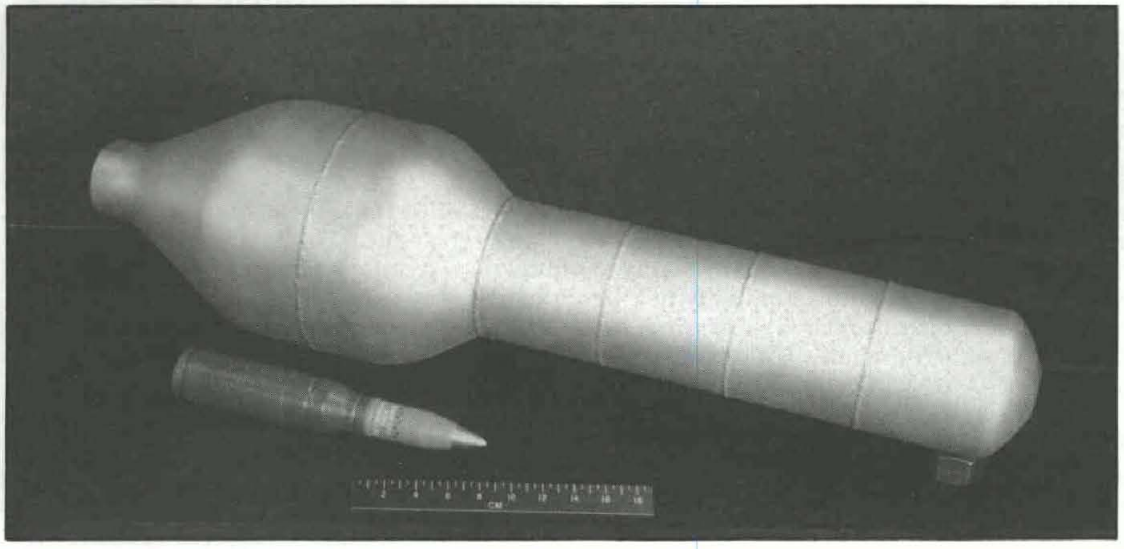


Figure 1.
Final design of a fieldable prototype muffler developed at the Ballistic Research Laboratory.

achievement will have a major impact on the Army's efforts to find high output, low sensitivity explosives required for the protection of personnel on the Bradley Fighting Vehicle, tanks, self-propelled Howitzers, and other military vehicles on future battlefields.

Dr. Chang S. Choi and Dr. Henry J. Prask will be cited for using neutron diffraction as a probe for residual stress in armament components. Residual stress plays a major role in fatigue failure, fracture, and stress-corrosion cracking; and in performance and storage life of certain hardware. Their work has potential for cost-savings by reducing trial-and-error approaches, and by improving performance and storage life of certain armament components.

A team composed of Russell F. Fiscella, Ralph P. Mischitelli, James T. Feldmaier, Richard Carroll, Kenneth G. Lucas, Donald F. Bushey, Stephen M. Van Dyke-Restifo, and James G. Bendick will receive the award for the development of the 155mm cannon for the Howitzer Improvement Program (HIP). This cannon consists of the XM284 product-improved M185 Cannon, and the new and advanced XM283 and XM282 cannons, which will be part of a block modification program planned for early 1990. The design team's effort improves the Army's technical capability in cannon design, and will soon contribute materially to our nation's defense when fielding of the HIP Modified Armament System is accomplished.

• Ballistic Research Laboratory:

Aivars Ozolins will be recognized for his development of a stochastic vulnerability/lethality assessment model, SQUASH. The SQUASH model is the first such model in the DOD and allows the Army, for the first time, to rationally analyze the results of live-fire tests. This model will also form the basis for more accurate vulnerability/lethality predictions, that will lead to improved materiel acquisition decisions and improved operations planning.

Dr. Kevin S. Fansler and David H. Lyon will be commended for developing an effective lightweight muffler for the 25mm cannon mounted on the Bradley Fighting Vehicle (BFV). (See Figure 1.) The successful deployment of the muffler will play a major role in obtaining permission to begin construction and expansion of Bradley ranges. These ranges are critical because the increasing number of BFVs entering service in Europe cannot possibly be accommodated by the present facilities. Alternative solutions to the gun muffler are restrictive and expensive.

A team of researchers consisting of Dr. Arpad A. Juhasz, Dr. Kevin J. White, William F. Oberle, Robert E. Tompkins, Gloria P. Wren and Charles D. Bullock will be recognized for the demonstration of the traveling charge concept. The experimental and theoretical proof of the traveling charge principle is a unique first, forming the basis of a rational examination of this chemical option for new hypervelocity anti-armor and anti-missile guns. The team's findings have potential impact on the Army's future hypervelocity gun systems.

• Chemical Research, Development and Engineering Center:

John A. Scavnicky and Malcolm E. Little will be cited for their efforts in developing and type classifying a new protective mask for the U.S. Army Advanced Attack Helicopter (AH-64). Their success in developing the M43 protective mask lies in the use of new technologies, and the incorporation of radically new design approaches. This achievement has significantly extended the operational capability of the aviator in a nuclear, chemical and biological environment.

CPT Everett O. Lewis will be honored for his contributions in the design and development of low toxicity decontamination simulants. These simulants have enabled workers to safely conduct degradation studies, which were then directly related to the properties of the toxic agents. Following decontamination, the simulants designed by CPT Lewis show an observable change, which can be easily analyzed to provide information on the speed and effectiveness of toxic agent degradation.

Joel M. Klein will be awarded for his contributions toward understanding the hazards of chemical warfare agents on man-made surfaces. Under his direction, a research team of government and industrial scientists and technicians conducted investigations to advance the knowledge of the hazards associated with surfaces previously contaminated with liquid chemical warfare agents. As a result of his efforts, the chemical defense capability of the United States has been significantly enhanced.

Dr. Paul D. Fedele will be cited for developing and validating models for air flow distribution and transport of vapor and aerosols through permeable clothing systems. His work enabled the design and construction of an experimental apparatus for testing the wind-driven penetration of aerosol through the fabric of protective clothing. Through his efforts, Dr. Fedele made significant contributions to the survivability of the American soldier on the chemical battlefield.

Dr. Joseph J. DeFrank will be honored for his biotechnology research contributions in discovering novel methods for decontaminating chemical and biological agents. His work on catalytic enzymes will provide urgently needed alternatives to currently fielded caustic, toxic decontaminant formulations. Products are envisioned for use on soldiers equipment, electronic circuitry, vehicle interiors, aircraft cockpits, aboard ships, and perhaps even on contaminated wounds. His work also resulted in agent-detoxifying enzymes which are stable at wide ranges of temperature and salt concentration.

• Communications-Electronics Command:

Center for Signals Warfare

Thomas E. Robertson, Thomas W. Mills Jr., and Melanie J. Smith will be recognized for their contributions to a scientific technological breakthrough that would provide the U.S. soldier a capability that has never been achieved in the tactical world. This achievement gives the U.S. Army, through intelligence, the decisive edge both in peacetime and in war.

Center for Night Vision and Electro-optics

David R. Kaplan will be honored for his expert independent evaluations of infrared detector arrays. In addition, he has performed measurements and com-

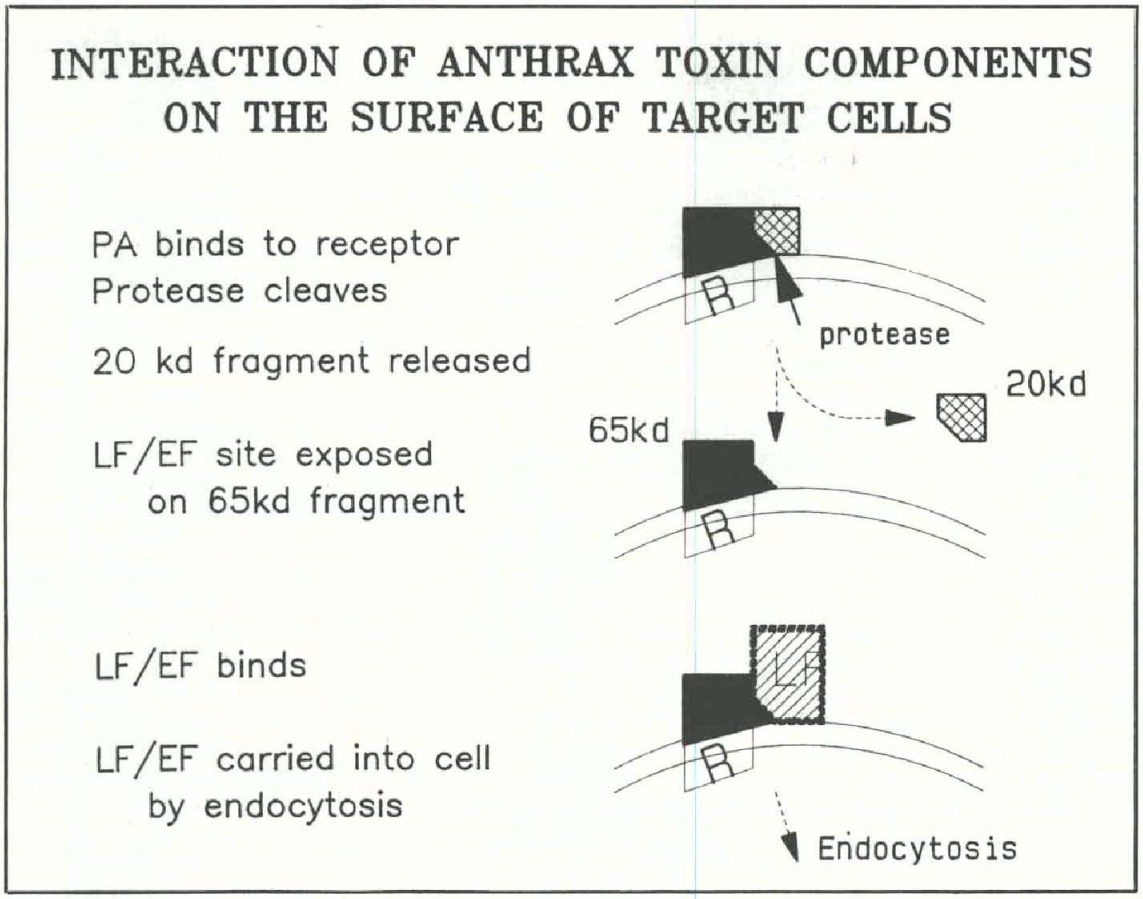


Figure 2.
Interaction of anthrax toxin components as researched at the Medical Research Institute of Infectious Diseases.

pleted comprehensive data analyses on various unique detector arrays.

• Laboratory Command:

Electronics Technology and Devices Laboratory

Dr. Herbert A. Leupold and Dr. Ernest Potenziani II will be awarded for the invention and prototype construction of a permanent magnet twister structure for helical free electron lasers. By eliminating bulky, massive electric coils and power supplies of present free electron laser wave sources (FELs), the permanent magnet structures they invented and constructed afford extended application of FELs from fixed station or very large vehicles to airborne, ballistic and space applications.

A team comprised of Edward J. Plichta, Steven M. Slane, Dr. Michelle C. Uchiyama, and Dr. Mark Salomon will be recognized for developing a low cost, high power and high energy density rechargeable lithium battery chemistry for both stationary and man-portable electronic equipment. These new battery formulations utilize oxidation resistant solvents and high energy cathode materials which significantly reduce costs while increasing cell performance over formulations previously used in the lithium battery industry.

A team consisting of Dr. Maurice Weiner, Lawrence J. Bovino, Anderson Kim, Robert J. Youmans, Terence Burke, Robert A. Pastore Jr., and Jeffry S. DuBois will be cited for their contributions to the state-of-the-art of microwave and laser technologies. Their efforts have resulted in improved high energy pulsers and microwave sources, which will advance the capabilities of future directed energy and jammer systems.

Philip J. Caplan, Dr. Arthur H. Edwards, Milton Harmatz, and Dr. Edward H. Poindexter will be honored for their contributions to the analysis and control of atomic scaled defects in high performance metal-oxide-silicone integrated circuits. Their work in defining the electronic role of individual atoms is a basis for the design, production, and operation of the emerging ultra-submicron integrated circuits used in advanced signal and data processing applications.

• Army Missile Command:

A team composed of Michael C. Schexnayder, Donald E. Lovelace, C. Stephen Cornelius, Scott D. Hill, Robert R. Mitchell, George A. Sanders III, and Larry J. Lawson will be commended for demonstrating a new anti-tank missile concept. The design incorporated three new technologies; heavy tandem warheads, wraparound flex wings, and an optical/magnetic standoff sensor in a direct-fire anti-tank missile. The team developed innovative solutions to problems presented by the integration of these technologies into current and future anti-armor missile systems. Their efforts provide the capability for direct fire anti-tank missiles to defeat present and future frontal threat tank armors while utilizing the Army's current inventory of TOW launch platforms and systems.

A team composed of William R. Phillips, Thomas L. Killough, William J. Lyons, Michael A. Schrenk, and Jerry W. Adams will be awarded for their efforts in conceiving, developing, fabricating, managing, testing, and conducting the Army Missile Command's Precision Deep Attack Missile System Technology Demonstration Program.

The results of the program have shown that a bi-directional integrated, radio frequency/fiber optics data link can be used effectively in the deep battle role, and that inexpensive and reliable strapdown imaging seekers can be used in such a system. Their efforts have established the basis for significant improvements in tactical corps support missile systems.

• Test and Evaluation Command

Richard G. Reitz will be recognized for developing a concept for comprehensively testing smart munitions such as the Sense and Destroy Armor (SADARM). After gathering data requirements from Army developers, evaluators and operational testers, Reitz compared these requirements with current capabilities to obtain the required data. From this research, Reitz developed an innovative concept for an "Army Smart Munitions Test Suite" which will provide for all currently required test data.

A team consisting of Roger E. Joinson and Saif J. Musalli from the Armament Research, Development and Engineering Center; Dr. Bruce P. Burns, Dr. William H. Drysdale, Dennis L. Henry, and Richard D. Kirkendall from the Ballistic Research Laboratory; T. T. Chiao, Dr. Richard M. Christensen, Frank H. Magness, and Richard L. Moore from the Department of Energy's Lawrence Livermore National Laboratory; and Michael E. Danesi from the Production Base Modernization Activity, will be cited for reducing the mass of sabot for kinetic energy projectiles.

U.S. Corps of Engineers

• Construction Engineering Research Laboratory:

Vincent F. Hock will be recognized for developing an anti-scale/corrosion coating system for potable water heat exchangers. This system greatly reduces operating and maintenance costs by eliminating the need for acid-cleaning of scaled tube bundles. Also, the coating system eliminates feedwater softening devices, which can induce pipe corrosion, and significantly increases service life of the tube bundle. This achievement, which provides a technology that can be used in new construction or to coat previously scaled or corroded tube bundles, has been approved by the surgeon general for use on potable hot water heat exchangers.

Paul H. Nielsen will be commended for developing a surface wire grounding system for electrical grounding of U.S. Army tactical equipment. The advantages of this system over conventional technology include: considerably easier installation and retrieval, increased safety, and improved equipment operation. The system, which has high potential for significant cost savings, has been included in the current procurement inventory for the Standardized Integrated Command Post by the Army Troop Support Command.

A team composed of Dr. Stephen W. Maloney, Dr. Edgar Smith, Dr. Temkar M. Prakash, and Richard J. Scholze Jr. will be recognized for developing a carbon dioxide water treatment system which will allow for increased capacity and flow in previously scaled pipes. This process is safe to building occupants and will minimize heat loss, pumping and energy consumption, producing savings to the Army that could amount to millions of dollars per year.

Dr. Aaron J. Averbuch and Dr. Paul D. Schomer will be honored for their efforts in developing a noise warning system which allows Army installations to measure and monitor noise emissions while conducting day-to-day operations. Activities on base can be delayed should blast noise problems become imminent as signaled by the system. This achievement allows reduction of noise problems with communities bordering Army installations.

Ronald D. Webster, William D. Goran, Michael Shapiro and James D. Westervelt will be cited for developing a computerized landscape management system called the Geographic Resource Analysis Support System. With this system, environmental and training planners can select locations for new land use activities, identify land use conflicts, simulate training scenarios, monitor changing landscape conditions, and model erosion losses.

Cold Regions Research and Engineering Laboratory

Edwin J. Chamberlain Jr., Dr. Iskandar K. Iskandar and Dr. C. James Martel will be awarded for developing techniques using freezing to achieve effective processing of sewage sludge, dredged material and sediments, and for decontamination of hazardous waste sites. This freezing concept permits a much more rapid and less environmentally intrusive way to concentrate waste sludges, resulting in easier removal and treatment.

George L. Blaisdell will be commended for his research in snow mechanics, with emphasis on wheeled vehicles operating in snow. His research efforts have resulted in a better capability to forecast vehicle mobility in various snow conditions and to evaluate new concepts for improving winter mobility. This technique has been incorporated in the NATO mobility model and the condensed Army mobility model.

David S. Deck will be recognized for developing a technique using cooling pond water from a power generation plant to prevent formation of ice jams on rivers. His method, which was demonstrated on the Kankakee River in Wilmington, IL, used warm water from an adjacent nuclear power plant cooling pond to melt the accumulated ice; therefore, preventing ice jamming problems from occurring.

Frederick C. Gernhard and Charles J. Korhonen will be honored for developing a device which provides a rapid, inexpensive method to repair blisters that develop on built-up roof membranes. The device is an easily installed, inexpensive, miniature pressure relief valve that prevents the build-up of pressure beneath the roof membrane during the heat of the day. The device has been deemed patentable by the U.S. Patent Office and has been selected for commercialization by the private sector.

Engineer Topographic Laboratories

Dr. William W. Seemuller will be cited for his research in automated drainage delineation. He developed techniques to extract the drainage network and for displaying the derived drainage superimposed on a stereographic image of the terrain. His efforts provide the Army with a quick response capability for producing drainage overlay products.

Waterways Experiment Station

Henry T. Thornton and Alton M. Alexander will be recognized for their research on and development of a unique nondestructive testing system for the evaluation of concrete structures. Their efforts have resulted in providing a means to determine the condition of a concrete structure when only one surface of the structure is accessible. An ultrasonic wave is induced at that surface and reflections, or echoes, of that wave are received at the same surface. Analysis of the echoes shows the locations of cracks, voids, or inferior concrete within the structure, and can show the presence or absence of reinforcing steel.

Charles A. Miller, John H. Ballard and Charles R. Malone will be awarded for the development and application of a technique for conducting site characterization procedures for measuring and analyzing data at operational security sites for the successful deployment of high technology electronic security sensor systems. Their efforts have resulted in significantly advancing the state-of-the-art for evaluating the performance of these sensor systems prior to their actual installation.

Victor A. McFarland and Joan U. Clarke will be cited for their invention and successful application of the Flow-through Aquatic Toxicology Exposure System (FATES). Research using FATES has guided the development of new technologies for evaluating the toxicity and bioaccumulation potential of sediment contaminants. Their efforts have resulted in improving the Corps of Engineers ability to discriminate among contaminated dredged materials and to select cost-effective, environmentally-sound disposal alternatives.

U.S. Army Medical Research and Development Command

• Walter Reed Army Institute of Research:

LTC Yancy Y. Phillips, MAJ Gary R. Ripple, CPT Thomas G. Mundie and Dr. Kenneth T. Dodd will be commended for their evaluation of medical effects in the Bradley Fighting Vehicle Live Fire Test. Their work resulted in new testing methods and injury criteria for nonfragment medical effects behind defeated armor to include blast overpressure, toxic gases, burns and acceleration. This team's achievement has significantly enhanced the knowledge of health hazards behind defeated armor and has influenced doctrine changes which will improve soldier safety in training and combat.

A team composed of SSG Lucia Gerena, CPT Dennis E. Kyle, MAJ Samuel K. Martin, MAJ(P) Wilbur K. Milhous and A. M. J. Oduola will be recognized for their research and studies on malaria parasites. They discovered that drug resistance in malaria parasites is analogous to a mechanism in cancer cells where an enhanced outward drug transport mechanism may confer resistance to drugs even of different chemical classes. These studies have led to a new clinical rationale for the development of drugs targeted specifically toward reversing drug resistance. As a result, the Walter Reed Army Institute of Research is actively pursuing the design of drugs which will selectively inhibit the parasite's drug transport mechanism without significant toxicity to the patient. This team's achievement has provided valuable new leads for the development of anti-malarial drugs.

CPT Joseph B. Long will be honored for designing and implementing a series of creative experiments that have characterized many of the pathophysiological processes involved in central nervous system injury and ischemia, that is, localized tissue anemia due to obstruction of the inflow of arterial blood. Injury to the central nervous system accounts for a significant proportion of battlefield casualties. This research has directly resulted in the development of creative therapeutic strategies that may ultimately prevent death and/or paralysis following central nervous system injury in battlefield environments.

MAJ Edward W. Bernton will be commended for his research accomplishments defining direct interactions between the endocrine and immune systems. His description of these reciprocal relationships between the endocrine and immune systems has revolutionized concepts about the mechanisms by which stress, through altered endocrine function, can directly influence host defenses. This effort has already made an enormous impact on future strategies for treating stress, critical illnesses and infection in the civilian and military populations.

• Medical Research Institute of Infectious Diseases:

Dr. John L. Middlebrook will be cited for his contribution to immunopharmacology and toxinology through his identification of distinct serological groups of military-important toxins. His findings will enable a much simplified approach to the development of detection and diagnostic systems for these toxins. Also, Dr. Middlebrook has shown that it is possible to protect animals against more than one toxin with only one anti-serum. This observation should lead to the development of a single vaccine capable of providing protection from several toxins.

COL Arthur M. Friedlander Jr. and Dr. Stephen H. Leppla will be honored for their contributions to the understanding of the mechanisms of action of the three toxin components in *Bacillus anthracis*, the causative agent of anthrax. Their research showed that the protective antigen (PA) has two binding sites — one for binding to the surface of animal cells, and a second that binds either of the two other toxin components. The latter site becomes exposed only after PA is proteolytically cleaved by a target cell enzyme. (See Figure 2.) Removal or alteration of the cleavage site is expected to make PA inactive and increase the safety of future anthrax vaccines.

NEW *RAM* IFICATIONS

By Daniel J. Peddicord

Using Reliability Engineers More Wisely

A reliability earthquake is rolling through the Army Training and Doctrine Command (TRADOC) and the Army Materiel Command (AMC), and the shock waves are being felt Army wide. Kicking off the activity was LTG William G. T. Tuttle Jr., commander, U.S. Army Logistics Center, at the TRADOC Reliability, Availability, and Maintainability (RAM) Conference, held at Fort Lee VA, March 29, 1988. The theme of the conference was "Interservice RAM Initiatives — A User Perspective" and the speaker list looked liked a who's who catalog of DOD, including Walter Hollis, deputy under secretary of the Army, operations research.

The purpose here is to provide a few suggestions on how we may better utilize this wealth of new found support to the best advantage. The intent is not to review the message of the conference. However, two presentations are of special interest.

Catapulted to the groups attention at the outset, was LTG Tuttle's information on the Family of Medium Tactical Wheeled Vehicles (FMTV). He presented slides showing a reliability payoff savings equivalent to the cost of 7,300 trucks, 12,000 mechanics, and an annual repair parts savings of $45 million!

On a more gloomy note, he squarely pointed out that better methods had to surface to enable us to retain reliability engineers. Reliability engineers are making career moves to industry and other agencies at an alarming rate. And at the same time we have been unable to retain RAM interns. He stated that only nine out of 44 interns from the class of 1980 are still working in TRADOC. Forty-three percent went to industry, 49 percent to other Army agencies and 8.6 percent to other services.

The only consolation we can take from this ego deflating news, is that the problem is now being addressed. A reorganization of RAM elements within TRADOC and the Logistics Center has been approved by LTG Tuttle and forwarded to GEN Maxwell R. Thurman, commander, TRADOC. This restructuring would position a large share of the RAM personnel in TRADOC directly under the Logistics Center, providing greater career progression and higher grade levels.

Previously we had management support. Today, it seems we have management participation. This has been the desire of the RAM community for many years but now we must increase management's knowledge on how to use us more effectively.

We may have to tell some organizations where and why they need reliability engineers. In some cases, just telling folks they need a reliability engineer, would be analogous to telling a cave man that he needed a computer. Neither understands the capabilities, how to use one, nor how to select one. Managers sometimes need to be educated and motivated too. Optimistically, this instrument will provide additional insight.

Substitution of operations research personnel and statisticians for RAM engineers appears to be a prevailing management policy. Operations research and reliability engineering are as distinctly different as mathematics and engineering. Yet we often find, in some organizations, that the "RAM engineer" is an operations research analyst in RAM's clothing. Statistics is, of course, a branch of mathematics. And operations research is a discipline that uses statistics to study and analyze problems, and to make probabilistic statements about them.

A reliability engineer combines his engineering tools with operations research techniques, and focuses his problem solving and probabilistic determinations on complex electro/mechanical systems. We must somehow get this idea across to management.

Users are quick to point out that systems, which are unreliable and/or exorbitant to maintain, do not respond to their needs. The life cycle costs become unreasonable and the systems become an ineffective burden on integrated logistic support. We like to think that "someone" is taking care of these things. But experience has shown that more often than not, incurable reliability problems surface during operational testing, which could easily have been cured early on. Thus, we face two alternatives; live with a lower reliability and face inordinate support costs, or return to the drawing board. Urgency of need usually wins out.

Reliability cannot be tested into a system. The combat developer must identify the qualitative mission needs as soon as the organizational and operational plan is complete. He must continue the analysis, coordination, and documentation, from then on, in order to develop a meaningful RAM Rational Report. For this we need competent reliability engineers.

The state of the art now allows us to design to a particular reliability. In other words, if we do our homework

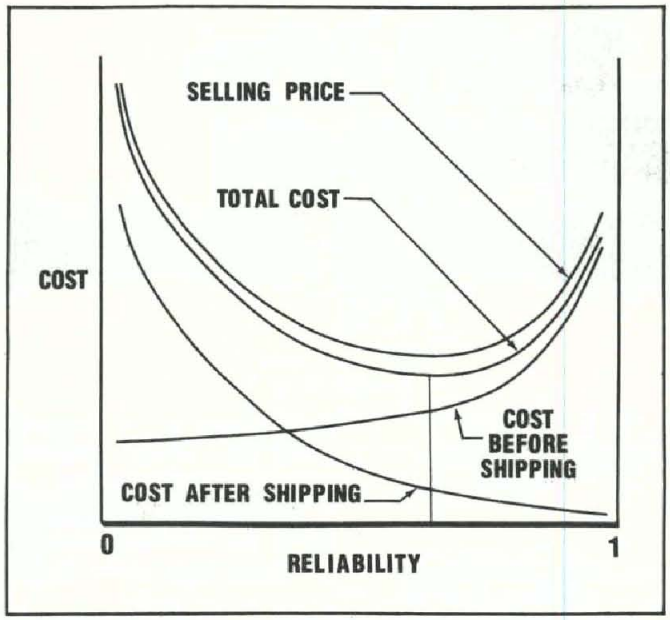


Figure 1.

properly, we can design in the reliability we desire. We can meet our needs without gold plating. As greater reliability is demanded, the initial cost will increase, but support costs will decrease. We must establish realistic and well thought out reliability goals.

Expensive systems, purchased in large quantities, justify a high reliability. Some non-critical and inexpensive device purchased in low quantity may justify a lower reliability. On the other hand, a parachute justifies a high reliability, no matter what it costs, how large the quantity, or who the user is!

Figure 1 illustrates graphically some analytical and subjective factors used by some companies to determine reliability goals.

In Figure 1, consider first the curve illustrating that for greater reliability, the producer cost before shipping continually increases. Also note the curve illustrating that for greater reliability, the producers' cost after shipping continually decreases. The latter is due to the lower support costs, such as warranties, technical assistance, and just plain good will. Finally, examination of the producer's total cost and selling price reveals that the lowest selling price will not occur at the lowest reliability.

All this assumes that the producer does indeed incur follow-on costs. But what if he's not bound by follow-on agreements? The October 1987 Reliability Analysis Center newsletter contained an interesting article. In it was the assertion, that they still receive students in their Reliability Design Training Course each year who point out that their management has no incentive to improve reliability because "maintenance is a big money-maker for the company." This certainly calls into question something fundamental about the scruples of such a company and one would hope that this is not generally the case. Nevertheless, the old adage, "Let the buyer beware" still holds true.

Mean Time Between Essential Maintenance Actions (MTBEMA) is a big manipulator of support costs. A low MTBEMA means low support costs. We must have a reliability engineer included in the acquisition process, to verify that specifications are properly stated, and to maintain a watchful eye as the design progresses.

Environmental characteristics, part counts, stress level, submodule repair rates, . . . etc., can be determined at the very early stages of design and, coupled with the proper growth models, enable the reliability engineer to predict problems before they occur. Reliability engineers must be used more wisely!

Another leading regulator of support costs is Mean Time To Repair (MTTR). Given the availability of past data, the ability to simulate repair tasks and prior experience, proper use of a reliability engineer would provide a most powerful tool for maintainability prediction. Unfortunately, our reliability engineers are rarely given this opportunity.

An important question that no one ever thinks to ask of their reliability engineer is, "What is the optimum number of each type of line replaceable unit, to meet a desired level of confidence that the proper LRU will be available when needed?" The mix of LRUs and cost of the spares kit will vary according to how certain we want to be that a spare will be available.

The methodology to produce curves for various kits versus cost and confidence level is not new. And it's right smack-dab down the alley of a reliability engineers expertise. At present we simply require the contractor to develop a system support package and if we don't have many problems we're happy. But how cost effective is this?

Along this same line, is the question of optimum preventive maintenance times. Reliability can be substantially increased by performing scheduled maintenance to forestall failures during missions. Again, we generally accept the contractor's recommendation. How many man-hours are we wasting due to too many unnecessary PMs and how many failures are we suffering due to too few? Reliability engineers have the answers to such questions, but no one ever asks!

In summary, we have a lot of work to do and the lion's share will be in educating management as to what we're good for. Dollars may not be the only reason we are losing reliability engineers, it just may be "use or lose."

DANIEL J. PEDDICORD is chief of the Reliability, Availability and Maintainability Branch, U. S. Army Intelligence and Security Board, Fort Huachuca, AZ. He holds a B.S. degree in electronic engineering from the State University of Iowa and an M.S. degree in reliability engineering from the University of Arizona.

HUMAN FACTORS CHALLENGES IN ARMORED VEHICLE DESIGN

By CPT R. Mark Brown

Countless examples of human factors engineering problems, or challenges, exist in the world today. In a systemic sense, any time a human is in the loop, in any way, there are human factors concerns. These concerns range from the simple to the complex depending on the system itself. This is particularly true for military systems.

This article addresses three human factors challenges facing the U.S. Army in the design evolution of armored vehicles. The tank, like the fighter aircraft and the capital ship for air warfare and sea warfare respectively, is the major challenge facing the engineers who design U.S. Army land warfare equipment.

The first problem is weight versus armor protection (or survivability). The design parameters for the tank, as in all military systems, are threat driven. Restated, we design our systems to survive or defend against and defeat what the enemy can do. In terms of tank technology, the lethality of kinetic energy (KE) projectiles that travel in excess of one mile per second velocity has caused the armor protection requirement to become increasingly heavy to provide the same levels of survivability for the crew.

Aside from the survivability issue should a KE round impact, which is a human factors concern in it's own right, a more interesting human factors issue has risen. Tank crews have traditionally contained four to five crewmen. Yet, to retain the same weight, size, and protection levels, the armor has demanded a greater space and weight claim in the design of the tank.

The Army is now faced with an interesting dilemma. That is, "Do we go to an ever larger tank in terms of size and weight (with the attendant logistical problems) (see Figure 1) to maintain a four-man crew, or do we anthropometrically select our armored vehicle crewmen, or even reduce the number of crewmen from four to three or two and use technology to allocate man-machine functions more on the side of the machine?"

The answer is, the jury is still out. Interesting arguments for each case are being put forth. The Soviets have anthropometrically selected tankers for some time to keep the size and weight of their tanks down. This has occurred at the expense of some combat effectiveness. It seems as if they have now also opted to reduce the number of the crew from three, which is already smaller than their NATO counterparts, to two on their Future Soviet Tank I (FST I).

The U.S. Army Armor Center, the responsible agency for establishing Army armor requirements, is arguing against anthropometric selection or crew reduction, and not without good reason. First, they argue that the U.S. population is anthropometrically larger in physical stature and to take this tack would reduce the available crewmen from an already shrinking manpower pool. Second, they argue that to reduce the number of crew would adversely effect human endurance and combat effectiveness of the crew; which must fight under conditions known as "continuous operations" or 24 hours a day seven days a week until the war is over.

The argument is that duties such as crew maintenance, security, communications, vehicle operations, and rest, which are now split between four crewmen, would still have to be accomplished with three or two crewmen, no matter how many functions were allocated to the machine. Sadly, both arguments are correct. The ultimate determinant is, can the tank be fought effectively under combat conditions (see Figure 2).

This leads only to the conclusion that there are no easy answers short of breakthrough technologies for the actual armor plate.

The second human factors problem, or challenge, that I have chosen also relates to armored warfare. Many current U.S. contingencies call for the Army to fight in extreme or desert environments. Additionally, the Army is also expected to fight on a "dirty battlefield" or a battlefield contaminated with toxic chemicals or radioactive fallout if those types of weapons are ever used.

Unlike the United States, the Soviets have not renounced first use of these types of weapons so this is not an unthinkable scenario. One only has to look to the current conflicts in the Persian Gulf and Afghanistan to see the possibilities.

The inside of a tank in hot weather is like a furnace. Temperatures that range up to 120 degrees Fahrenheit inside the tank are not uncommon. In fact, they are encountered every day of the summer at many Army posts in the western and southwestern United States. Tough physical training and conditioning can enable the soldier to cope with these temperatures, until the battlefield becomes "dirty." The soldier must then wear his chemical protective suit to survive. The suit is thick, hot and seals the body from toxic chemicals.

The suit adversely affects human endurance, effectiveness in operating system displays and controls, and in the extreme temperatures mentioned above, survivability. The survivability issue stems from both the enemy, because of the soldier's reduced combat effectiveness, and from the elements.

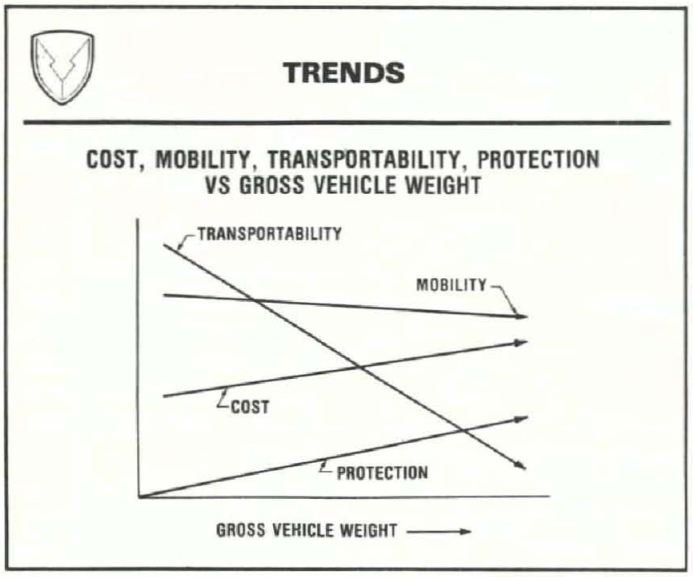


Figure 1.

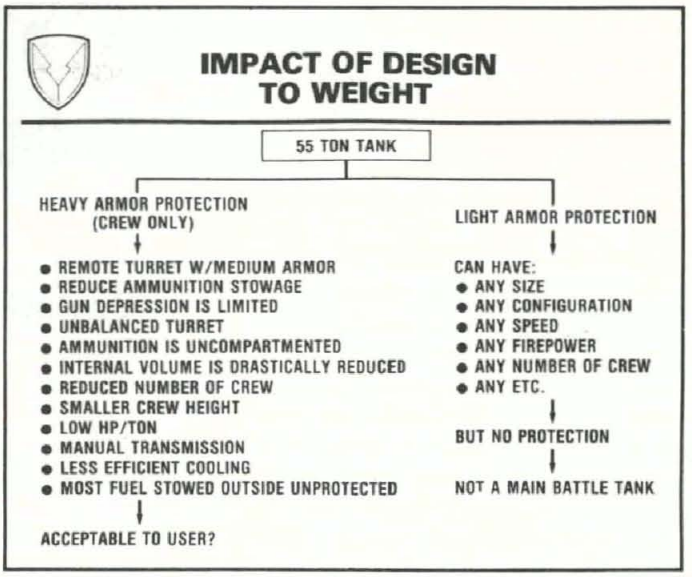


Figure 2.

Having worn these suits in the mentioned environments, I can personally attest that the human can only be effective for an hour at most and probably much less time under actual combat engagement conditions. The Army has many studies to corroborate this statement.

Again, there are no easy solutions to the problem. The Army is investigating suits and protective masks made of different, more hospitable materials that still protect the soldier from toxicants. In addition, the Army is investigating air conditioning for the tanks or suits, and overpressure systems on the tanks that keep the pressure differential inside the tank higher than 14.7 psi so the contaminants can't enter.

Once again, the old space trade-off bugaboo surfaces for the last two solutions. Those type subsystems are both large and heavy. Therefore, they add to the first human factors problem I addressed—size and weight of the tank. Much work is being done on this problem at the U.S. Army Human Engineering Lab at Aberdeen Proving Ground, MD, and at the U.S. Army Natick RDE Center in Massachusetts. Again, success has been evolutionary rather than revolutionary.

Finally, armor crewmen are starting to experience information overload problems much as fighter aircraft pilots have for years. As my unit fielded our new M-1 tanks and Bradley Fighting Vehicles in 1981, my battalion commander was fond of saying, "You must train your men in switchology!" He was referring to the proliferation of displays, gauges, and switches that are increasing on our vehicles. As a qualified helicopter pilot he knew that repetitious training would make performance reaction rather than depending on thought. Well, the situation is getting more complex. New information systems are being added to the vehicles for capabilities such as night fighting, command and control, built-in test, and built-in training, to name but a few.

Can the human in the loop perceive and code this information and still fight the tank? The challenge is not new to those involved with aircraft design. As motivated and excellent as today's young soldiers, are, it is still an enormous task to make the machine work for and with the man as a synergistic unit. This can only occur when our human factors engineers and MANPRINT (Manpower and Personnel Integration) specialists are included from the earliest stages of system design.

In summary, human factors concerns play a major role in the design of armored vehicle systems. The aforementioned problems are not the only problems facing those responsible for the design and production of the next generation of armored vehicles. For example, how does the soldier with glasses use the sophisticated optics now available to maximum advantage? How does the tank crew, moving at rapid ground speeds while fighting the vehicle under conditions of impaired visibility, maintain orientation? This is extremely important because the crew has to engage and kill the enemy and not engage and kill his own fellow soldiers (fratricide).

The list is endless and confronts the designer at every level and phase of the design process. Only when the design of the system is approached with a focus on the human—the key element of the system—can acceptable tradeoffs and solutions be reached.

CPT R. MARK BROWN is assigned to the Armored Family of Vehicles Integration Group at HQ, U.S. Army Materiel Command. He has completed the Army's Training With Industry Program and has served in numerous field assignments with armor units. A 1977 graduate of the U.S. Military Academy, he is studying for his master's degree in systems engineering at Virginia Tech.

BELVOIR DEVELOPING COUNTERMINE TECHNOLOGIES

By Gayle Peterson

A tank is one of the most impressive and powerful weapons on the modern battlefield — 60 tons of steel, speed and firepower. Yet it can be stopped dead in its tracks by the blast of a single mine. During the Vietnam War the most feared weapon wasn't enemy rifles or air strikes — it was the anti-personal mine.

Recent events in the Persian Gulf have only reconfirmed the devastating power of mines in all types of conflict. Yet, in spite of all the overwhelming evidence of the effectiveness of mines, they were often overlooked in peacetime.

Things are changing. In recent years, the U.S. Army Belvoir Research, Development and Engineering Center's countermine program has become one of its most important development efforts.

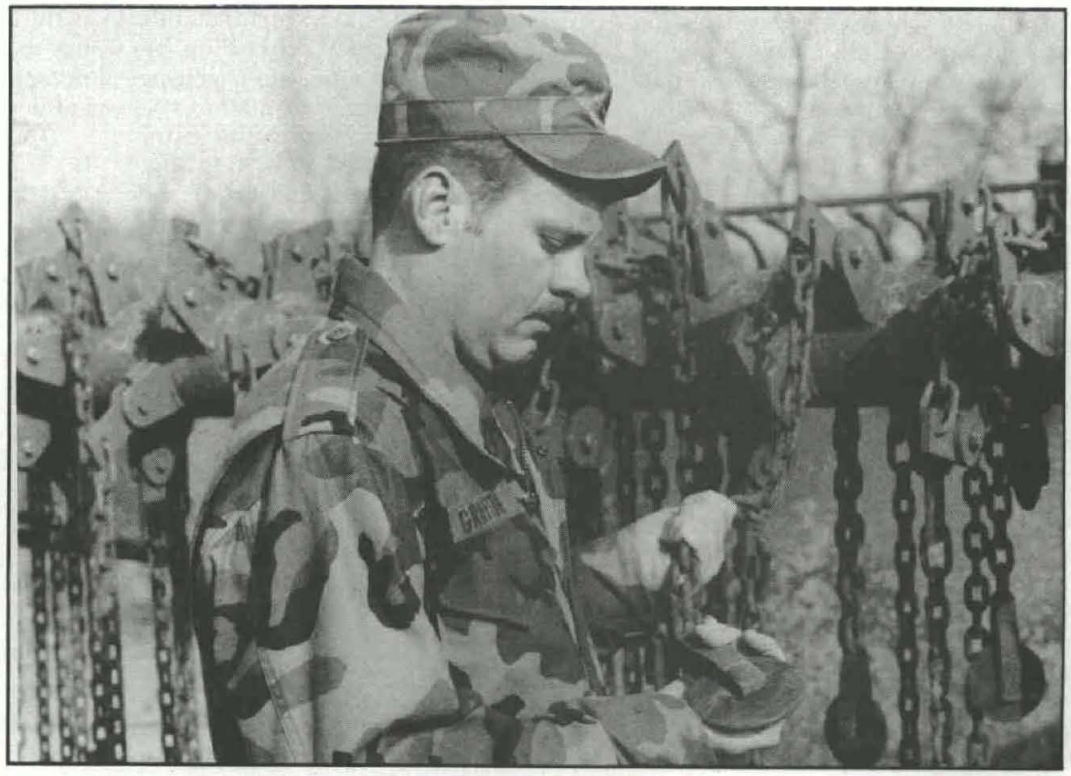
The countermine programs use many different types of technology, ranging from hand-held and airborne detection to locate mines, to the development of plows, rollers, flails and explosives used to neutralize them.

The first thing that comes to mind when someone thinks of mine detectors is the familiar hand-held version that has been around since World War II. A famous cartoon of the period shows a soldier with one of these detectors, as tanks, trucks and other vehicles line up behind him. These detectors still play their role in the total countermine effort, but today's thinking is to use them in a low-intensity conflict situation.

Center engineers have improved the performance of these detectors by updating their electronics to give them more reliable performance in all types of soils. These new models were recently evaluated in the Middle East and Central America.

Vehicle-mounted systems will be important for unit mobility. The Minefield Reconnaissance and Detector System (MIRADOR), currently under development, will use a variety of sensors to detect metallic and non-metallic mines both on and off roads. It can be employed as either a self-propelled system that is remotely operated from a parent vehicle or mounted on a remotely operated tactical vehicle.

During offensive operations, MIRADOR will be used to search known or suspected areas for enemy mines. For counterattacks, it can be



Soldier examining weights on flail.

Mine-Clearing plow.

used to detect hasty minefields laid by enemy mine-scattering artillery for flank protection. Our forces can use this information to select alternate routes or take other actions to keep moving.

Other systems under development include an airborne reconnaissance system to locate minefields and techniques for using radar to detect scatterable mines as they are dispersed. Along with its minefield detection efforts, the center is developing a variety of technologies to neutralize mines once they are located.

One of the most unusual techniques uses a magnetic signature to explode mines ahead of a vehicle. The system, called VEMASID for Vehicle Magnetic Signature Duplicator, works by projecting an electromagnetic signal that explodes magnetically-fused mines before the vehicle reaches them. The system is currently in engineering development for use with the Army and Marine Corps armored vehicles.

One more-conventional mine-clearing technique is the Counterobstacle Vehicle (COV). The COV is a multifunctional combat engineer vehicle which uses a full-width blade to clear a 4.5 meters wide by 15 inches deep path through the minefield. The unique capability of the COV is that besides breaching mines it can also clear other integrated obstacles such as wire, ditches and logs. The COV is currently being deployed at the National Training Center, Fort Irwin, CA, where it replicates Soviet combat engineer capabilities.

Other mine-clearing techniques include rollers and plows. The center's mine-clearing roller system consists of two five-wheel assemblies which are mounted in front of the tracks of an armored vehicle to clear pressure-fuzed mines. A weight drag on a chain between the two assemblies — called a "dog bone," because of its resemblance to one — is used to clear tilt rod mines. An adaptor kit will enable soldiers to mount the roller on M1 or M60 tanks in the field. After clearing a safe path through the minefield, the driver can use a quick-disconnect mechanism to release the roller and continue the mission.

In addition to the mine-clearing roller, the center is developing a track-width mine-clearing plow to dig up buried mines. This system is also equipped with a weight and chain assembly to clear tilt rod mines.

One of the most recent countermine efforts is the evaluation of a new version of an old concept, a mine-clearing flail. The first mine-flail tank was developed for use in North African deserts during World War II. It used rows of weighted chains to beat the ground, to dig up or explode mines. Although the flail could clear a safer path than other methods, it was so heavy and powerful that the areas it cleared were impassable for many vehicles.

The new design being evaluated by the center solves many of these problems. It weighs less, requires less power and provides a better beat pattern. Less power is used even though the new design uses nine chains for every foot of rotor compared to five in the old version. The tip weight has also been matched with the flailing speed to produce an optimum pattern of contact with the ground. During trials, one flail cleared charges of up to 3.6 Kg of explosive with virtually no damage.

Other systems developed by the center rely on explosive charges to clear mines, either by detonation from the pressure wave, or by damaging or displacing mines by shock. One such system will provide the Army with its first all-weather standoff minefield-breaching capability. Called SLUFAE, the Surface Launched Unit, Fuel Air Explosive fires rockets loaded with explosive that can detonate mines while its transport remains in a protected position.

Another standoff system called Mine Clearing Line Charge has been mounted on a trailer and towed by armored vehicles or trucks. A rocket pulls the explosive line charge over the minefield and the charge is remotely detonated. This system allows our forces to clear mines in stride from within the towing vehicle.

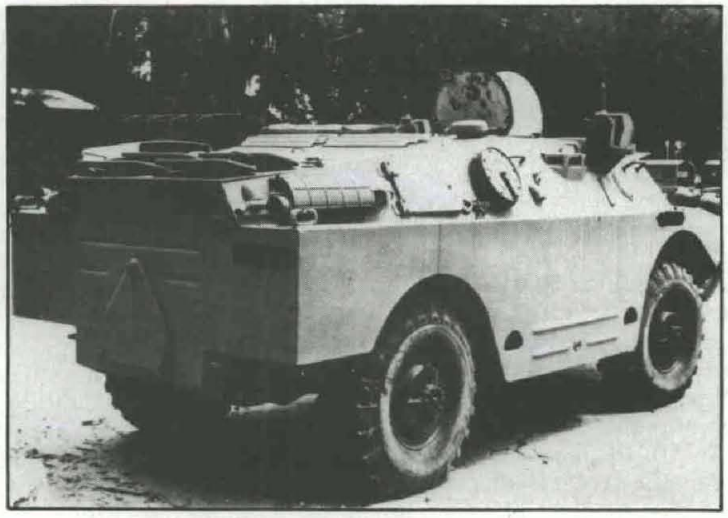
Finally, once a safe path has been cleared through a minefield, the center has developed a system to mark the cleared lane. The Cleared Lane Marking System is mounted on the rear of the minefield-breaching vehicle to dispense markers fitted with colored flags easily seen during the day. Chemiluminescent sticks can be used to guide night operations.

Mines will play a decisive role in offensive and defensive operations on future battlefields. The ability to detect and breach them quickly will be critical to the success of our battle plans.

The center's countermine program will provide effective methods to meet the minefield threat now and in the future. To that end, the Army's deputy project manager for mines, countermine and demolitions has been situated at the center for several years. And, recently, the Countermine Systems Directorate (Provisional) was established at the center.

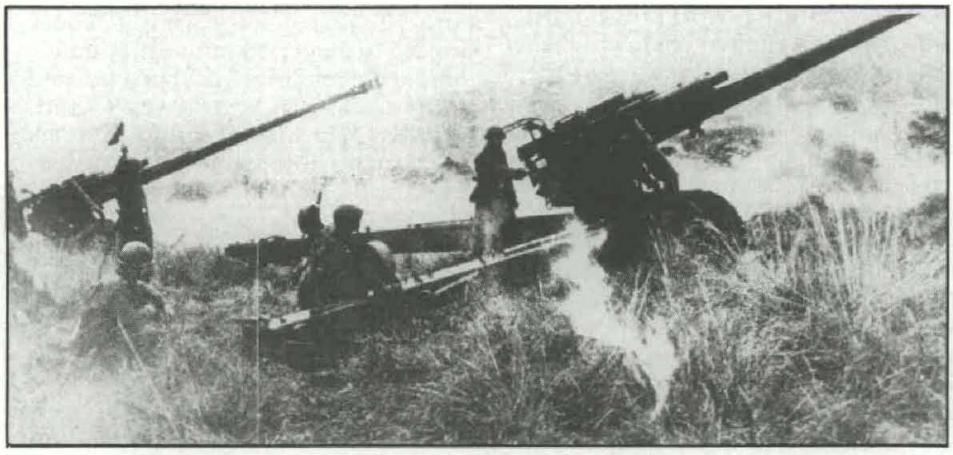
GAYLE PETERSON is a public affairs specialist at the Belvoir Research, Development and Engineering Center. She holds a bachelor's degree in journalism from the University of Missouri.

SOVIET AND CHINESE MATERIEL



BRDM-2U Armored Control Vehicle (ACV)

This ACV is a modified version of the BRDM-2 armored scout car, with the turret and armament removed. The ACV serves as the communication link between the ATGM platoon and the ATGM battery commander.

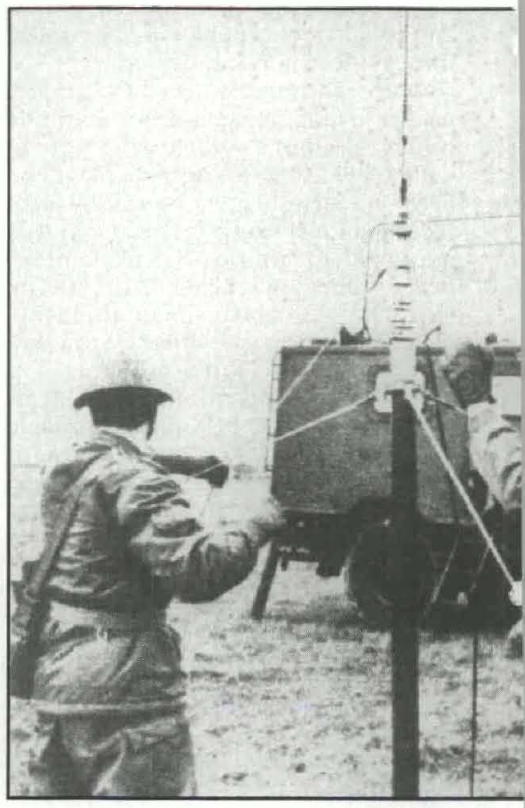


152mm Towed Gun/Howitzer M1987

The M1987 is a recently deployed weapon which will provide Soviet general support artillery formations with a long range fire capability into the 21st century.

Improved

These tanks have stand-off armor added to their turre top of the guns. The lead tank has a mine plow attac protection from infantry fired anti-tank weapons.



R-142 Rad

The R-142 is a new generation high frequency radio st and units from front to division.

-62 Tanks
n addition, they have laser rangefinders strapped on
d to its glacis. The added armor provides additional

n Station
ion. This radio station can be found with all echelons

Chinese Main Battle Tank Type 69-II
This main battle tank has better fire power, armor protection and mobility than that found on the Type 69-I.

R-142 Radio Station (Airborne)
This vehicle is found with airborne type units.

Photos courtesy of the U.S. Army Foreign Science and Technology Center, Charlottesville, VA.

Helicopter Engine Fuel Controls . . .

25 YEARS OF EVOLUTION

By Roger L. Furgurson

The advent of the turboshaft engine marked the real coming-of-age of the helicopter. Reciprocating engines were heavy, noisy, difficult to cool, and prone to sudden stoppage. However, along with the attributes of the turbine engine, came a whole new set of problems relative to control of the power and speed of the engine.

In order to provide maximum flexibility of operation and ease in starting, essentially all turbine engines in helicopter applications are of the "free turbine" type. That is, the turbine which drives the helicopter rotor(s) is not mechanically connected to the remainder of the engine. The gas producer portion of the engine (the compressor, combustor, and gas producer turbine) varies its speed and temperature as required to keep the free or load turbine at a constant speed.

Since the power demand on the helicopter rotors varies rapidly during many phases of operation, the gas producer portion of the engine has a great deal of difficulty "keeping up" to the degree required to maintain the rotors at a nearly constant speed. It is the job of the engine fuel control to meter the proper amount of fuel at the proper time to ensure that the power produced is equal to the power demanded.

Early turboshaft engine fuel controls, and to some extent those developed as late as the mid 1970s, drew heavily upon technology employed for many years in steam turbines. Through a series of links, levers, cams and rotating flyweights, the speed of the shaft to be controlled was sensed and compared with some reference (usually a spring). The fuel metering valve then opened or closed based on the difference between spring force and the force created by the rotating flyweights to govern the output shaft at something approximating a constant speed.

Unfortunately, the amount of fuel which can be supplied to a turbine engine at any given instant is limited. Too much fuel will cause over temperature of the turbine or aerodynamic stall of the compressor. Too little could cause lean blowout of the combustor. These maximum and minimum limits vary with gas producer speed, ambient air temperature and altitude — a complex control problem.

> Change and innovation are generally slow to come in the aircraft engine business.

In order to properly limit the metered fuel in these mechanical systems, functions of ambient temperature and pressure were introduced through an expanding bellows or fluid filled probe. The proper relationship between these three variables was then established by the use of a three-dimensional cam followed by as mechanical multiplication device. These systems were in fact sophisticated, compact, mechanical, computers. Although this description of these controls is in the past tense, fully 95 percent of all helicopters in operation today use systems designed prior to 1970, similar to those described above.

Change and innovation are generally slow to come in the aircraft engine business. "If it works, don't fix it" is a familiar axiom to those engineers contemplating their company's next design. Existing systems have gone through exhaustive test programs and qualification procedures.

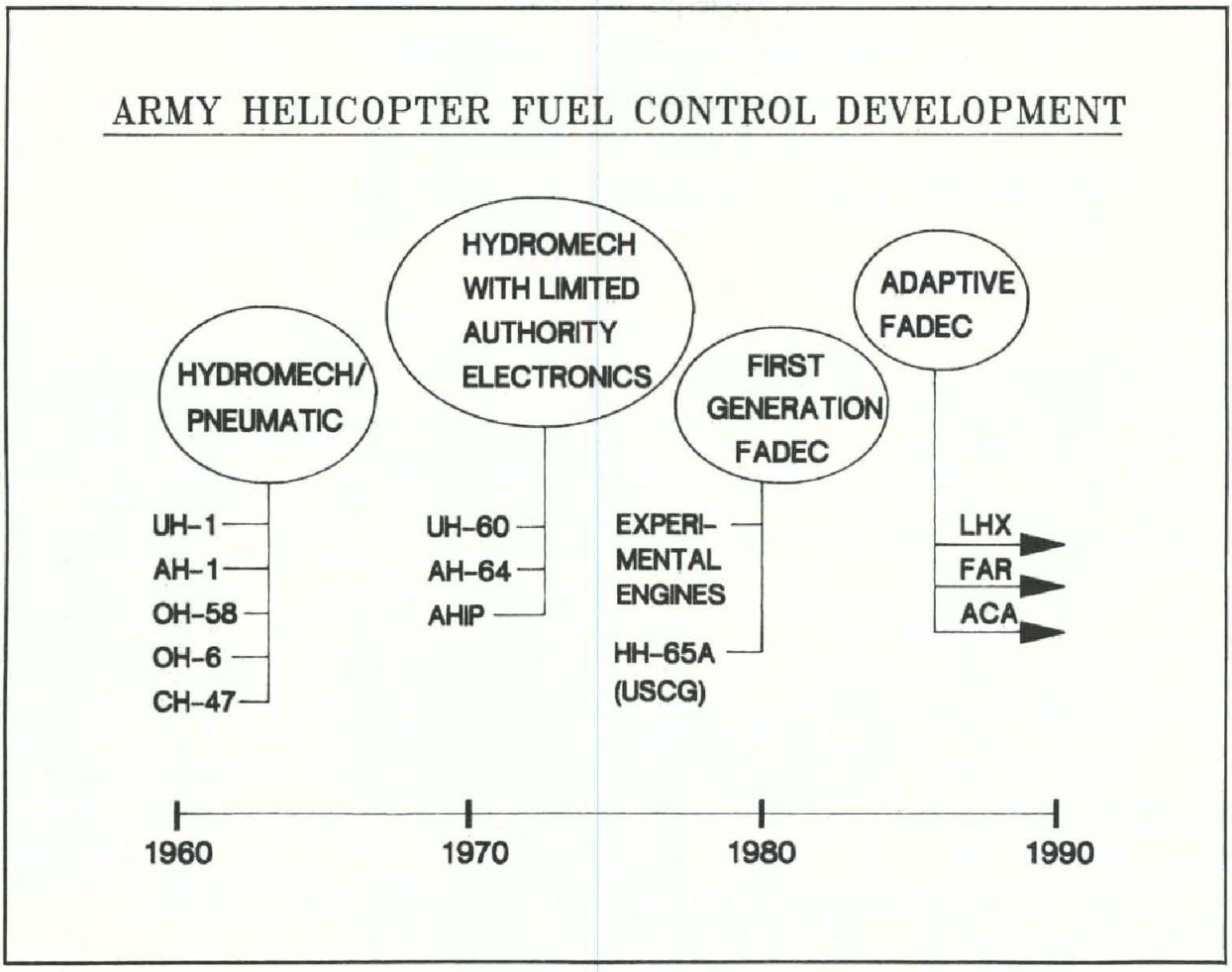
Field experience has taught many lessons and the shortcomings of a particular design have been corrected. At some point, however, new technologies offer so much promise that very serious consideration must be given to its incorporation into new product lines.

During the late 1960's, an advanced development demonstrator engine program was initiated by the Army Aviation Applied Technology Directorate (AATD) at Fort Eustis, VA. This 1500 Horsepower Demonstrator Engine program explored new levels of performance for engines in this category, from the standpoint of engine weight and fuel consumption, as well as factors affecting maintainability, survivability, and compatibility with different aircraft. The T700 engine evolved from this competitive process. It now powers the Black Hawk and Apache aircraft within the Army and is in operation in several commercial aircraft.

The control system for the T700 incorporated what was thought to be the best of the old technology with some of the new. If any bright young engineer was given the basic problem of control of a gas turbine engine today they would almost certainly choose electronics as the primary medium of sensing and computation.

Currently available microprocessors can handle the computational problem with ease. The necessary sensors are highly developed and circuit fabrication and packaging techniques have solved most of the environmental problems inherent with earlier systems. Most new cars today have a considerable amount of under-hood electronics which has proven to be very reliable.

However, the microprocessor was in its infancy at that time and although electronic systems were entirely feasible, there was reluctance to put all the eggs in this one basket. Previous



all-electronic controls (the Rolls-Royce Gnome engine for one) were analog systems and did little more than mimic the functions of hydromechanical units.

The T700 engine control retained the tried and proven hydromechanical technology for the gas producer unit, providing starting and acceleration/deceleration control, coupled with electronics for free turbine governing, temperature limiting, and torque matching.

The very compact, lightweight mechanical portion was designed for installation and removal within minutes, requiring no rigging or adjustments. It incorporated the lessons learned from many years of field experience with this type of control. It also provided a "fly home" capability in the event of failure of the electronic system.

The electronics was designed for isochronous control of free turbine speed and made temperature limiting and automatic torque matching an easy task. Another reason for choosing electronics for free turbine governing was the flexibility it provided during development and early flight testing. Changes in gain or lead and lag could be made rapidly with fairly certain results as compared to a mechanical system.

History has proved that the choices made for the T700 design were good ones for its time. The control system as well as the entire engine has compiled an unprecedented record for safety and reliability in over one and a half million hours of service.

While development of the T700 engine was underway, exploratory development of other engine control strategies and technologies continued. In 1977, AATD initiated its Advanced Technology Demonstrator Engine (ATDE) program with the objective of validating advanced technology concepts in the 800 horsepower class of engines. The controls for the engines in this competitive program were based on the successes and failures of previous work.

The ATDE controls were full authority digital electronic (FADEC) systems. Breadboard and brassboard versions of these controls provided a high degree of flexibility during early engine testing, allowing rapid changes to be made in engine fuel schedules and limits. In fact, these controls had so much capability that some of the engineers began thinking about how this excess capacity could be used.

It didn't take long to realize that existing controls really didn't do what

The process is an evolutionary one with new technologies and approaches being carefully evaluated prior to commitment to a production design.

you would like for them to do in many situations. For example, during a number of maneuvers conducted by combat helicopters (autorotation recovery, quick stop, and steep turns), the main rotor overspeeds due to the aerodynamic unloading. The free turbine of the engine, being governed by the fuel control at a fixed operational value, is then uncoupled from the helicopter transmission by the overrunning clutch. When the maneuver is completed and load is applied to the uncoupled rotor, its speed decreases very fast.

The fuel control, unaware that it needs to do anything in advance, waits until the rotor speed drops sufficiently to re-engage the clutch and reduce the free turbine speed below the original governing point before an increase in fuel flow is called for. By the time the engine responds and produces the power required, a significant underspeed of the rotor often occurs, reducing lift capability and causing a great increase in pilot workload.

The FADEC system can be programed to "see" that the main rotor and free turbine are uncoupled and "know" that the rotor is decreasing rapidly and raise the free turbine set point or otherwise schedule fuel flow early such that rotor speed is kept from drooping past optimum values.

The term "adaptive" has been used to describe controls that have the capability of sensing the state of the variables being controlled and taking action based on what the engine and the aircraft need rather than simply controlling around a fixed value.

This concept of adaptive controls has been pursued through simulation studies, bench and engine testing, and limited flight testing. In order to be successful, these approaches require a thorough knowledge of the aircraft rotor dynamics and engine characteristics.

The control logic and software has to be developed with close involvement of aircraft, engine and control disciplines from start to finish. By the time this article is published, full flight test evaluation will have been completed on two separate adaptive control designs in two types of helicopters.

In 1985, development was started on the T800 engine. Designated to be the engine for the LHX aircraft, the T800 is being developed by two competitive teams. Both engine designs are based to some extent on the ATDE designs. The control systems for these engines can also trace their genealogy to the ATDE controls, both are FADECs and they have a number of detailed features based on the ATDE. But there are many differences. The T800 controls are designed to the latest military requirements. The computer language is Ada, the common language for all new systems as directed by DOD. They meet all the tough environmental requirements and they have many redundant features for system reliability.

The powerful microprocessors have been put to work. These systems will not only control the engine in the usual manner, they will have many of the adaptive features developed in previous programs. They will provide much of the information required by an airframe mounted, engine monitoring system and they have the capability of indicating critical engine health or performance information to the pilot.

These improvements in engine controls have not come easily. The process is an evolutionary one with new technologies and approaches being carefully evaluated prior to commitment to a production design. This has caused some systems to seem outdated by the time they are fielded, particularly because of rapid advances in electronics. But this is the way it has always been in aviation. If the system is a good one it will last for many years.

Hardly a week goes by that I don't see a DC-3 on television in some far away place and occasionally I hear one clawing its way to altitude near my home. The DC-3 first entered service in 1935. Improvements may be made along the way but significant system modernizations are few and far between. Therefore, it is very important that a continuing program be maintained to evaluate new approaches so that when new systems requirements are identified, the technology will be ready for application.

ROGER L. FURGURSON, an aerospace engineer assigned to the Propulsion Technical Area of the U.S. Army Aviation Research and Technology Activity's Aviation Applied Technology Directorate, Fort Eustis, VA, retired March 31 after completing more than 28 years of federal service. He holds a B.S. degree in mechanical engineering from the Virginia Polytechnic Institute.

By LTC Thomas J. Gleason (USAR)

ROLE OF THE RESERVES IN R&D

Offering rapid reinforcement of R&D professionals to the Army.

Introduction

When most people think of the Army Reserve they think of the "weekend warriors" featured in the recruiting advertisements on television — reservists who are members of combat or support units that will be mobilized to reinforce the active Army in time of war or national emergency.

What is not so well known is that the research and development (R&D) community in the Army Materiel Command (AMC) will also receive reinforcements from the Army Reserve if mobilization is ordered. The reinforcements, called Individual Mobilization Augmentees (IMAs), are members of the Selected Reserve who have orders to report as individuals to a variety of mobilization slots within AMC. They are selected and trained to provide personnel who can rapidly augment the capability of key AMC organizations to mobilize the industrial base, cope with increased work load, and, in many cases, help compensate for the loss of active Army military who will be needed for duties in the field after mobilization.

In order to be ready to "hit the ground running" when mobilized, IMAs perform two weeks of active training (AT) each year in their mobilization slots. This on-the-job training allows the IMAs to learn the mission, organization, and functions of the office to which they are assigned. Just as important is the opportunity to get to know the people and operating procedures of their organization. In a mobilization situation no one will have time to lead them around and explain the system — they must be able to settle in and get to work as if they had just been called back from leave to deal with the crisis.

Ideally, an IMA should be a full member of the team, knowledgeable enough to immediately accept responsibilities, and known and accepted by his or her co-workers.

Continued contact throughout the year between the IMA and the mobilization organization is encouraged. For the IMA, such contact helps maintain familiarity with the issues and activities that are current in the organization and allows the IMA to do some homework in preparation for the next active duty tour.

The organization can request the IMA to perform research projects between active duty tours as Inactive Duty Training (IDT), typically preparing a "white paper" or staff study on some subject of interest to the organization, sometimes making use of special libraries or other sources of data available at their home organizations.

The IMA earns reserve participation points for IDT and the organization has a resource on which it can call year round. All formal and informal contact during the year contributes to making the IMA a real part of the team that will work together upon mobilization.

Detachments

During the 50 weeks between active training tours, many IMAs belong to IMA Detachments (IMADs), reporting administratively to regional Army Reserve Commands. Some of these IMADs are specialized to include primarily IMAs with R&D-related assignments. The IMADs meet two or more evenings every month and provide a year-round connection to the Army. IMAD meetings are unpaid drills for which reserve participation points are awarded.

Assignments

There are a total of about 19,000 IMAs in the Army Reserve, of whom about 1,800 are assigned to AMC Headquarters and its subordinate commands. These IMAs fill all manner of military jobs, from chaplains to supply sergeants and from deputy commanders to computer programmers.

It is difficult to draw a clear line between R&D and non-R&D assignments for IMAs. As with the peacetime staff of AMC, many individuals whose job titles are non-technical make critical contributions to the R&D process, and many jobs that require an engineering background are related to life-cycle support rather than R&D.

AMC Headquarters has about 25 percent of its IMAs in R&D slots, and an additional 10 percent in procurement slots that fall within the Materiel Acquisition Management career field.

The IMA is not a visitor, but a member of the team who often has been assigned to a particular organization for many years.

Although there are large variations between organizations, this appears to be a typical ratio for major subordinate command headquarters organizations and research, development and engineering centers. Laboratories naturally tend to be more dedicated to R&D, with 50 to 100 percent of their IMAs in R&D assignments.

Not all IMAs contributing to the R&D process are located within AMC. Some fill slots on the Department of the Army Staff, in combat developer organizations within the Training and Doctrine Command, or in operational or force development testing organizations.

Very often, the qualifications of IMAs to perform their mobilization jobs are enhanced by civilian jobs that are related to their military specialties. This is particularly true of those assigned to slots related to R&D, many of whom are full-time professionals in R&D. These IMAs bring to their assignments a combination of civilian technical and/or R&D management skills and a military background and education.

Typical IMAs

Some of the members of the 162nd IMAD (R&D), from the Washington area, offer examples of typical R&D IMAs. The commanding officer of the detachment, LTC Forrest Agee, is a Military Intelligence officer with an IMA assignment as an R&D coordinator at the Chemical RDE Center, Aberdeen Proving Ground. In civilian life, Dr. Agee is director of the Aurora flash x-ray nuclear simulator at the U.S. Army Harry Diamond Laboratories (HDL).

Another HDL employee in the unit is LTC Tom Mills, an electronics engineer whose civilian job is project leader for design development of test equipment for nuclear fuze programs, and who has held IMA assignments at both TRADOC Headquarters and as a project engineer in tactical communications jammers at the Center for Signals Warfare, Vint Hill Farms.

MAJ Jennings Wong is a contracting officer for the National Oceanic and Atmospheric Administration as a civilian, with an IMA assignment as a procuring contracting officer in the Tactical Radio Branch at the Communications Electronics Command (CECOM), Fort Monmouth.

MAJ James Radosevich is a computer specialist with the National Aeronautics and Space Administration whose IMA assignment is as an ADP operations officer in the Information Resources Branch at AMC Headquarters. Finally, CPT Michael Hamilton is an information management consultant who serves as an IMA nuclear surety officer at Headquarters, Test and Evaluation Command, Aberdeen Proving Ground.

Various Backgrounds

These and other IMAs have a wide range of backgrounds in industry and government R&D that allow them to bring to their IMA assignments a high level of professionalism and often to contribute a fresh viewpoint to the organizations which they serve. One of the unique features of an IMA assignment is that the IMA is both insider and an outsider.

The IMA is not a visitor, but a member of the team who often has been assigned to a particular organization for many years. At the same time the IMA is familiar with how things are being done elsewhere and may see current issues from a fresh perspective. These attributes can be exploited during the active training period or through IDT projects to make the IMA a valuable asset to the organization in peacetime.

Often an IMA has civilian expertise that is immediately useful to the organization to which he is assigned. For instance, LTC Arthur Hartstein of the 162nd IMAD is deputy director of the Office of Oil, Gas, and Shale Technology in the Office of Fossil Energy of the Department of Energy. Each year when he reports for active training at the Belvoir RDE Center he prepares a review of current activities in synthetic fuels programs and changes in conventional fuel quality and availability. This information is presented to technical and management personnel throughout AMC and at the Pentagon.

One of the major benefits of the IMA program is that it allows the Army to identify, in advance, individuals who will be well matched to the mobilization needs of particular organizations and able to make an immediate contribution under mobilization conditions.

Members

In peacetime, in addition to their individual activities, such as active training tours and projects for their mobilization organizations, many IMAs provide support to the Army R&D community through collective activities as members of IMA detachments. Each IMAD is sponsored by an Army organization for which the detachment performs a year-round training mission that may include carrying our special studies and projects for the sponsor.

Since the membership of an IMAD is drawn from a geographical area, while IMA mobilization assignments may be anywhere in the country, there is not necessarily any relationship between the organization that sponsors the IMAD and the organizations to which the members are assigned for mobilization. The IMAD sponsorship

relates to support provided in peacetime, on an IDT (unpaid, part time) basis by the IMAD as a unit.

For example, the 162nd IMAD (R&D) has met at HDL in Adelphi, MD for more than 15 years. The membership of the detachment is drawn from among R&D IMAs that live in the vicinity of HDL and are able to attend the unpaid evening drills there, but have IMA mobilization assignments to a variety of other organizations, both in AMC and in other parts of the Army.

Since 1987, the 162nd IMAD has been sponsored by the Army's Strategic Defense Command (SDC), chartered to provide technical assistance to SDC Headquarters based on the skills and expertise of its members.

Since they are likely to be required to help execute the mobilization plan and carry out the post-mobilization mission of their organization, IMAs can be a highly-motivated choice to review and revise an organization's plan for the U.S. Army Laboratory Command.

Another detachment, the 101st IMAD (Chemical) meets at Aberdeen Proving Ground and is sponsored by the Chemical Research, Development, and Engineering Center (CRDEC). As part of its support to its sponsor, it has prepared mobilization plans and TDAs for two other reserve units that will be mobilized to support CRDEC.

Several years ago, when formation of the Materiel Acquisition Management career field was being considered, the 160th IMAD (R&D), which meets at Fort Belvoir, carried out a comprehensive study of the utilization of specialty code (SC) 97 (procurement) officers in the reserves. This study, performed for the deputy chief of staff of the Army for research, development, and acquisition, involved a nationwide questionnaire to reserve officers and statistical analysis of both reserve and active Army SC-97 educational and service backgrounds.

IMAD drills include training sessions in areas related to mobilization duties, general military professional skills, and areas related to the mission of the IMAD for its sponsoring organization. In addition, they provide an opportunity for dissemination of information of general interest and importance to the members, such as changes in regulations that affect reservists, administrative procedures, and notices of reserve troop-unit vacancies in the geographical area.

The availability of R&D oriented IMAs throughout the country makes possible an active, nationwide program, managed by the Army Research Office, of Army participation in high school science fairs. IMADs organize teams of Army judges, who select winners for special Army awards. The program motivates the young competitors and is a visible indicator of the Army's interest in and sponsorship of research and engineering.

Summary

In summary, the IMA program provides the Army with the services of members of the Army Reserve whose education and experience allow them to make a contribution to R&D, both in peacetime and after mobilization. The program matches their skills on an individual basis to specific jobs within the R&D establishment that will augment the peacetime organization to deal with increased work load and special requirements that are anticipated upon mobilization. It offers the Army, and AMC in particular, a rapid reinforcement of professionally skilled personnel who are already trained in their jobs and ready to go to work at once.

LTC THOMAS J. GLEASON (USAR) is an IMA assigned to the Office of the Deputy Chief of Staff for Development, Engineering, and Acquisition at AMC Headquarters and is operations and training officer of the 162nd IMAD (R&D). He has bachelor's and doctorate degrees in physics from the Johns Hopkins University. In civilian life, he is president of Gleason Research Associates, Inc. in Columbia, MD.

How to Become an IMA

To become a member of the Individual Mobilization Augmentation (IMA), program, a reservist must make an application to the U.S. Army Reserve Personnel Center (ARPERCEN) by using a Department of the Army Form 2976-R. Those who desire an IMA assignment should contact their appropriate personnel management officer or career advisor and request information pertaining to a suitable IMA research, development and acquisition vacancy.

For additional information regarding an IMA assignment contact:

HQ, AMC
ATTN: AMCPE-MT
5001 Eisenhower Ave.
Alexandria, VA, 22333-0001.
Autovon 284-9117 /
Comm: 202-274-9117.

Reservists that wish to join an AMC IMA Detachment should contact the Senior Reserve Advisor's Office, telephone number:

202-274-9689 /
AV: 284-9689.

ARMY AMMUNITION CENTER PROVIDES EXPERTISE

By Paul Levesque

Introduction

Ammunition is the very lifeblood of any fighting unit on the land, sea or air, because no unit can fight without it. In peacetime, ammunition has to be manufactured, stored, maintained and tested in a manner that assures readiness and safety. In combat, high-quality ammo must be shipped to the front and supplied to troops in a sufficient quantity to assure victory. Should any part of this logistical system break down, troops could face battle shorn of their ability to fight back.

But the storage and shipment of ammunition presents problems which are not encountered when supplying weapons, equipment and other commodities to combat troops. Most ammo contains high explosives, and it can cause greater damage to friendly forces than to its intended targets if it blows up before (or after) it's supposed to. Yet, because everybody who fights needs it, ammo must also be relatively easy to handle. And, because it's used on every kind of weapon and in every type of combat mission, ammo has to come in a complex variety of shapes, sizes and explosive powers.

For all these reasons, ammunition is not just very important but also very unique. Thus, the U.S. Department of Defense needs a cadre of highly trained ammo experts, as well as a center where the peculiar hardware and procedures needed to keep the ammunition system going can be studied, analyzed and developed. That is a key mission of the U.S. Army Defense Ammunition Center and School (USADACS), located seven miles north of Savanna IL, along the upper Mississippi Valley.

While it is classified as an Army center and school, USADACS serves all of DOD and, to some degree, allied forces, since the Army is the Pentagon's single manager for conventional ammunition. USADACS is part of the Army's Armament, Munitions and Chemical Command, which directly manages DOD's ammunition program.

The school was established at Savanna in 1950, while the center was established there in 1971. USADACS is located on Savanna Army Depot Activity, an installation that today is mainly used for ammo storage. But Savanna has a long, rich history that dates back to 1917, when it was founded as a weapons proving ground for Rock Island Arsenal, located about 65 miles downriver. The depot has been long noted for its diverse contributions in the ammo field, and is best known for assembling and loading the bombs used during World War II's famous Doolittle Raid on Tokyo.

Savanna was selected as the site for the ammunition center and school because of the variety of ammo maintenance and storage facilities found at the depot. Its remote location in the midst of farms and forests also provides an atmosphere conducive to academics and research.

Though it has some responsibility for virtually ever facet of the ammunition program except procurement, USADACS has a relatively small staff of just over 200 employees. They are divided into seven separate but closely interrelated organizations.

According to USADACS Director John Byrd, the center and school is driven toward excellence by a blend of competitiveness and cooperation.

Program and Control Office

The glue that holds USADACS together is also provided by the Program and Control Office, one of the center and school's seven organizations. Byrd points out that, unlike the rest of USADACS, the office had a low turnover rate and so provided continuity. The Program and Control office performs a variety of administrative tasks for USADACS, and has the key responsibility of managing both money and manpower.

Here's a rundown of the other organizations within USADACS and a brief look at how they help keep the lifeblood of the military flowing.

Ammunition School

The ammunition school at USADACS is probably the best known of the seven organizations. It is the only school in the free world which is solely dedicated to teaching civilian students about ammo and ammo-related subjects.

The school's current curriculum consists of about 70 different courses. The courses, and the school itself, are divided into four different departments dealing with conventional ammunition, ammo logistics, nuclear weapons, and guided missiles and chemical weapons.

These courses are taught by a staff of 52 instructors, most of whom were once students at USADACS themselves. All of the instructors have worked with ammunition in the field, and all of them will eventually return to the field. Typically, USADACS instructors spend just three years of their careers as teachers or school administrators.

Up to 8,000 students a year attend the ammunition school. At any one time, these students might include everyone from E-4s to general officers and wage graders to members of the Senior Executive Service. Some come through the school for short courses on a particular subject or, in the case of high-

As part of the 1987 Service Response Force Exercise, field operations personnel are monitored for simulated external toxic contamination as they are processed through a personnel decontamination control station.

ranked people, for a quick refresher on ammo.

About 50 foreign students attend the school annually, coming from nations ranging from Australia to Zimbabwe. Others come in from private industry, most commonly from the companies that operate the Army's ammo manufacturing plants. But the core of USADACS' student body consists of interns in the various ammo-related career fields.

Ammo interns spend 18 months of their two-year internship at the school. Those who wish to become interns and attend USADACS must first be selected by the school, which recruits and interviews all its students. Students are selected on the basis of their education, experience, or a combination of both, and on their personal qualifications. They are recruited from both inside and outside the government.

Once they are selected, these USADACS students spend the next year and a half in an intense, difficult course of instruction. They learn about the configurations and properties of all types of mines, mortars, missiles, bullets, bombs, chemical agents, etc. They learn about ammunition transportation, storage, maintenance, handling and disposal. They are taught time and again that while failure in the classroom can be disappointing, failure in the field can be fatal.

Once they spend enough time in the classroom, students begin receiving more and more hands-on training. At first, they handle inert items, but they later work with live rounds and perform tasks like setting up demolition charges. They inspect magazines, igloos, rail cars and trucks to assure that ammo in them has been properly stacked and placed.

To assure that this training is as realistic and up-to-date as possible, the school's lesson plans are reviewed and approved by DOD's leading ammunition proponents. Instruction at USADACS is designed to be flexible to meet the needs of the ever-changing ammo world, and more than half of the school's courses are modified in some fashion every year.

USADACS' instructors don't spend all of their time at the school. When needed, they can also take their show on the road and provide training in the field. Such training often takes place when a new ammunition item is scheduled for shipment to combat units.

Finally, the school also arranges and coordinates the annual Service Response Force Exercise. The exercise, which is held every summer at Savanna or at another ammunition storage depot, provides a look at what might happen in the event of an accident involving chemical or nuclear weapons.

Career Programs

After they graduate from the school, the interns go into one of two ammo-related career programs — the ammunition management field, or the quality assurance specialist (ammunition surveillance) field. The career management offices for both the ammo management and the QASAS programs can be found at USADACS.

Ironically, the two career programs are the oldest and the newest in the Army. While QASAS dates back to 1920, the ammo specialist program wasn't formally established until August 1983. For both the old and the new program, the offices at USADACS develop referral lists, maintain registers of who's in the program, evaluate training plans, and perform other functions to maintain a pool of highly skilled ammo technicians.

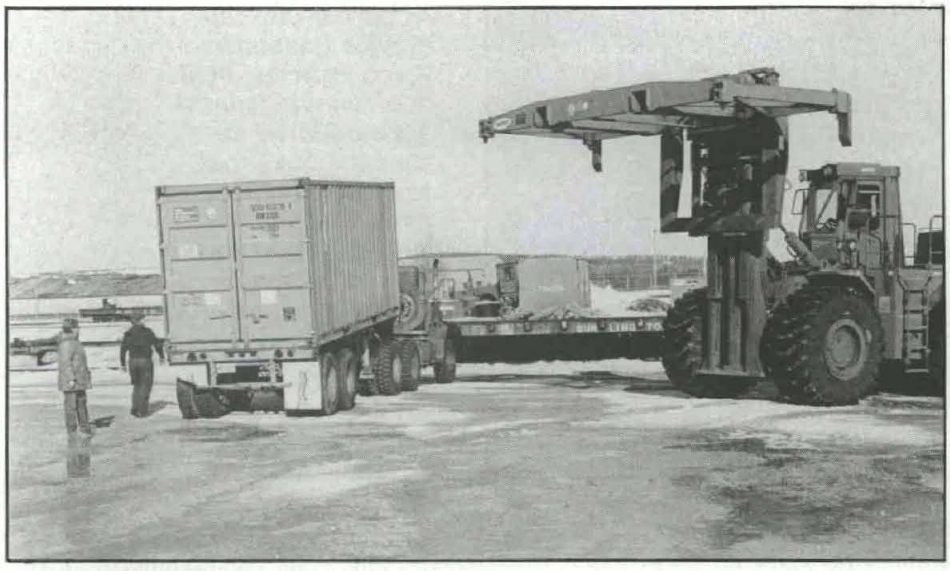
Approximately 700 civilian employees worldwide are now registered in the QASAS program. Before they could get into the program, though, all of these employees had to sign mobility agreements indicating a willingness to move.

Employees in the QASAS program are responsible for assuring the reliability, quality and safety of ammo stockpiles found around the world. They assign various condition codes to the stockpiles, ranging from A downward, that signify whether they are immediately usable or not and indicate what type of maintenance is needed to get the ammo in the stockpile up to code A.

QASAS employees are often assigned to posts near Korea's demilitarized zone, along the border between West and East Germany, or to other potential hot spots around the world.

Like QASAS employees, those in the ammo management career field face mandatory rotation and the possibility of unaccompanied assignments to remote and dangerous areas. Their job is to deal with the logistics of ammunition, including its supply, maintenance and transportation. A total of about 800 employees are currently registered in the ammo management program.

At one time, many of these same ammo managers were scattered among the various other logistical career programs. But they were all brought together in one commodity-oriented program in 1983, under the theory that ammo and its attendant supply, maintenance and transportation were unique. Still, ammo managers are matrixed through the other logistical programs and receive much of the same instruction, with additional technical training on the peculiarities of ammunition.



Preparations are made for container handling/loading for a rail impact transportability test. The container handler is approaching the commercial container for removal from the chassis and placement on a railcar.

Logistics Engineering Office

Since ammunition is unique, the equipment required for its storage, maintenance and transportation is also unique. Such equipment can't be found off the shelf or in any catalogue, but it can be found at USADACS. There, the center and school's Logistics Engineering Office has the mission of developing, building and testing various forms of ammunition peculiar equipment (APE). As its name implies, APE can be used only on ammunition, since it is designed to meet the peculiar requirements of handling ammo.

The Logistics Engineering Office has its own machine shop at Savanna, where maintenance APE can be produced. Engineers and technicians from the office turn out the first production models of equipment needed to perform particular ammo-related tasks.

The APE designed by USADACS is usually needed to perform a particular maintenance task required to assure the safety and readiness of the ammo stockpile. For example, one recent model was made to remove the ogive from the 155mm round. The ogive, a curved metal part at the tip of the round, had deteriorated in storage, and needed to be taken off, repaired, and screwed back on tight enough to prevent future deterioration. This had to be done with enough force to remove and replace the ogive, but delicately enough so the live round wouldn't explode. Such situations are faced and solved constantly by the engineers in the Logistics Engineering Office.

In addition to building machines for ammo maintenance, the Logistics Engineering Office also develops the proper techniques for storing and shipping ammunition. They examine the containers that ammo will be in during storage and shipment, and they come up with ways to configure the ammo in a manner that will assure its stability and safety.

USADACS does this work under a public law that states that the Army must reach agreements on how ammo will be shipped with the private transportation companies that move its ammunition.

After the design engineers in the Logistics Engineering Office come up with a new ammo configuration, the office's test engineers put it through its paces. The testers will take a rail car or truck trailer filled with inert ammo in the new configuration, then simulate severe transport conditions.

Review and Analysis

The "eyes and ears" of the ammo community can be found in another USADACS organization, the Logistics Review and Analysis Office. LRAO acts as a central source of ammunition operational expertise, and serves as the Army's agent in assuring that ammo logistics problems are identified and rectified before a hazardous situation can occur.

LRAO staff members must possess expertise in every aspect of ammo logistics, because their primary mission is to perform logistics reviews at all Army installations with ammo storage, maintenance, demilitarization or transportation functions. During these reviews, LRAO staffers take a close look at accountability, explosive safety, security and storage, and work with installation employees to come up with solutions to any problems that are found in these areas.

Last, but certainly not least, is the newest of USADACS' seven organizations, the Technical Center for Explosive Safety. The center was established in 1987 to serve as a sort of "think tank" where ammo safety issues could be considered in detail.

The center serves as a focal point for explosives safety issues and is designed to analyze and issue guidance to the field in all safety-related areas. One of its major tasks at present is establishing a computerized data base incorporating all available information on ammo safety.

Conclusion

The world of ammunition changes constantly, and USADACS is prepared to keep up with those changes. In the coming years, it is possible that the organizational structure of the center and school will change, that it will take on new missions and encounter unexpected new challenges. USADACS fully expects to be there to meet these challenges.

PAUL LEVESQUE is a public affairs specialist at the U.S. Army Armament, Munitions and Chemical Command, Rock Island, IL. He has a master's degree in English from the University of Iowa.

TACOM GETTING ROBOTIC COMMAND CENTER

By George Taylor III

FMC Corp. has begun efforts to design and build for the U.S. Army Tank-Automotive Command (TACOM) a robotic vehicle control system test bed capable of controlling up to four robot vehicles simultaneously.

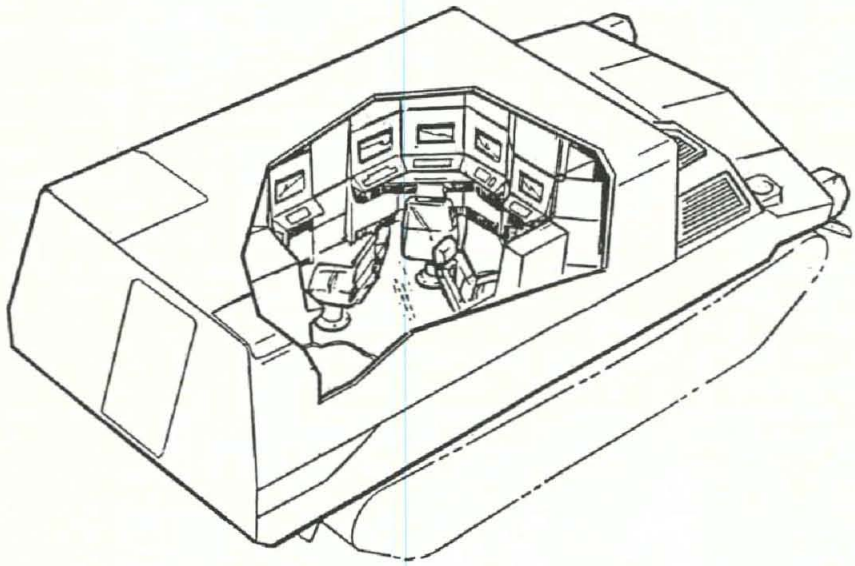
Referred to as the Robotic Command Center (RCC), it is being built under terms of a 34-month, $8.69 million contract awarded to the firm last September. The RCC is expected to play an important role in TACOM research aimed at developing and evaluating advanced robotic concepts for use in vehicles that may someday enhance troop survivability by performing high-risk battlefield missions.

TACOM's research is part of an Army-wide robotics program. Key developmental agencies participating with TACOM include the Defense Advanced Research Projects Agency (DARPA), Rossyln, VA; the Human Engineering Laboratory, Aberdeen, MD; the Engineer Topographic Laboratory, Fort Belvoir, VA; and the Army Armor Center, Fort Knox, KY.

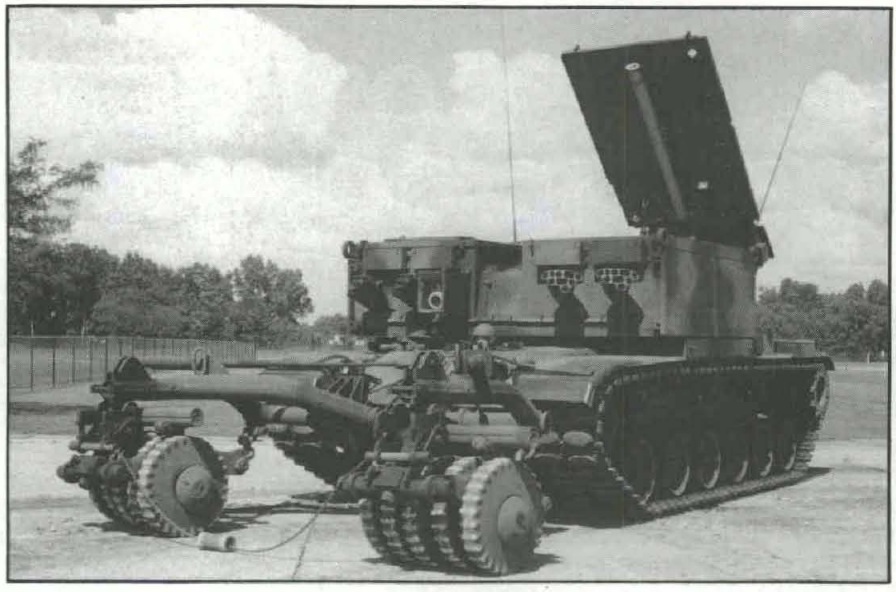
The RCC will be a module that will mount on the chassis of an XM975 ROLAND vehicle. This is an M109-series howitzer chassis that was modified during the late 1970s for use as a carrier for the German and French developed ROLAND surface-to-air missile system. The module will be 15.4 feet long, 9.6 feet wide and 6.1 feet high and will carry a three-man crew, a commander and two robot operators. An additional crew member will drive the module carrier vehicle.

The module will have two robot driver's stations that will permit each operator to control two robots simultaneously. It will also have a commander's station which will have all the capabilities of the driver's stations, plus additional equipment to allow the commander to perform route planning.

Each station will include a control panel that will enable the operator to start and stop the robot vehicles and perform the various other driving functions and three television monitors. Two of these will provide him with stereo vision ahead of the robots he is controlling and the third one will give him peripheral vision.



ROBOTIC COMMAND CENTER CONCEPT



ROBAT
Remote Controlled
Mine-Clearing Vehicle.

The module will also have onboard two-way radio communications equipment to control the robots, an intercom for the module crew and vehicle driver, and a turbine-powered auxiliary power unit to run the module systems.

"The key element of the RCC," said the Robotics Division's Jerry Lane, in charge of technology integration in TACOM's RDE center, "is that it will be very flexible in terms of being able to be integrated with other robotic vehicles. Its architecture will be designed to be adaptable to different robotic systems with a minimum of modifications. With this kind of flexibility," he added, "we will be able to continually upgrade the RCC to evaluate future technology as it comes along."

Steven Schehr, senior RCC project engineer, talked about some of the RCC's features that will give it its flexibility. According to Schehr, the RCC will have three types of robot vehicle communication links: a microwave link, a VHF radio frequency (RF) link, and a fiber-optic link. He said the microwave link will be used solely to transmit video images from cameras and sensors aboard the robot vehicles to the RCC.

Schehr also said robot command and control signals and vehicle status information will be sent via the RF link, while the fiber-optic link will be used to carry all three types of data signals. "The idea here," said Schehr, "is that with three separate links, we can try out different links for different mission scenarios to find out which one is the most effective for a given type of mission.

"Each type of communication link has its good and bad points," Schehr explained. "For example, microwave is only good for line of sight. So once you get over the hill, a microwave communication link is useless. But it is good for transmission of video images.

"With fiber optics you don't have to worry about hills, but you are always dragging a cable around, which could be cut by the enemy. An RF link eliminates the line-of-sight and cable problems, but the frequency range designated for military use which we plan to use (138 to 150 megahertz) is not suitable for video transmission."

Schehr said that the RCC will incorporate computer-aided remote driving software developed by the Jet Propulsion Laboratory and autonomous road-following software developed for DARPA by Martin Marietta Corp.

In computer-aided remote driving, cameras aboard each robot vehicle will produce images of the scene ahead of the vehicle. These images will be sent to the operator's display in the RCC. The operator will then be able to designate where he wants a vehicle to go by moving an electronic cursor on the display to specific points in the scene, and a computer in the RCC will generate the appropriate control signals needed to drive it to its destination.

For autonomous road-following, the images produced by the robot vehicle cameras and sensors will be fed into an image processor in the RCC, which will analyze the images to find the edges of the road, and the computer will produce the proper driving commands needed for the vehicle to follow the road.

"With this arrangement," said Schehr, "it will be possible for each operator to have one vehicle autonomously following a road while simultaneously teleoperating another vehicle."

According to Jerry Lane, when FMC completes fabrication of the RCC, which is expected during the summer of 1990, it will be sent to Fort Knox, KY. There it will participate in three months of exercises with two TACOM-built Robotic Obstacle Breaching Assault Tank (ROBAT) prototypes to demonstrate the feasibility of multiple-vehicle control.

Under development for the past several years, the ROBAT is a remotely controlled mine-clearing vehicle. It consists of a modified M60A3 tank that would accompany assault forces and breach enemy mine fields by launching rocket-propelled lines of explosives into them. Upon landing, these explosive lines would detonate sequentially across the mine field and cause nearby mines to explode, thereby clearing a path for other vehicles.

Lane said that in addition to using the RCC to control the ROBATs, future plans call for using it to control four West German-built Wiesel armored weapon carriers now being procured by TACOM, and other robotic vehicles developed by LABCOM, MICOM and possibly the Marine Corps.

GEORGE TAYLOR III is a technical writer-editor for the Army Tank-Automotive Command. He holds a bachelor's degree in journalism and a master's degree in communications form Michigan State University.

CONFEREES DISCUSS MANPRINT/SAFETY ISSUES

By Roscille W. Nelson

Army and industry concerns relating to the integration of manpower, personnel, training and safety (MPTS) in systems acquisition were discussed during the 8th National Security Industrial Association Conference held earlier this year in Orlando, FL.

Designed for exchange of current MPTS issues, these conferences focus on relevant technological advances among the DOD, military services, academia and industry. The objective of this conference was to enhance integration of MPTS in the systems acquisition process.

Two major Manpower and Personnel Integration (MANPRINT) presentations at the conference were given by Army Materiel Command (AMC) Chief of Staff BG Jerry C. Harrison, who provided the keynote luncheon address and Dr. Kenneth J. Oscar, acting deputy chief of staff for development, engineering and acquisition, HQ AMC. The following abstracts are taken from those presentations.

BG Harrison:

MANPRINT is an Army initiative which seeks to re-emphasize the need to ensure the soldier in the loop. Our basic MANPRINT philosophy is that the soldier is our most important resource and that the weapons and equipment we develop and acquire must serve him — not vice versa. We must produce systems that are capable of being operated, maintained, and supported by soldiers at the lowest overall cost. We must improve the total system (soldier, hardware, software) performance by continuous integration of manpower, personnel, training, human factors engineering, system safety, and health hazard considerations throughout the materiel development and acquisition process.

MANPRINT is a process whereby we put the soldier first in the system design. Simply stated, we are clothing the soldier with the equipment. The basic elements comprising MANPRINT are not new, but in the past we generally treated them in isolation during the system design/acquisition process, often resulting in redundancy, inefficiency, and a general lack of cohesiveness. MANPRINT, as we now recognize it, is a systems approach to address the six critical disciplines necessary to achieve optimum man-machine interface.

MANPRINT is a process whereby we put the soldier first in the system design.

The Army has been in the process of institutionalizing MANPRINT during the past several years and, as evidenced by recent company advertisements in Defense Journal, etc, I believe it's beginning to take root. Using this forum, I'd like to emphasize further the Army's commitment to MANPRINT, where we're implementing it, and what we would like to see from the defense industry in helping us carry out this important effort.

Basic MANPRINT policy, AR 602-2, was published in 1987. It requires that the MANPRINT concept be applied to all developmental, non-developmental, and product improvement programs. MANPRINT requirements are developed early by Joint Working Groups and key issues are articulated in System MANPRINT Management Plans (SMMPs). These plans are available to industry early in the design/development process (before Milestone I), and then continuously as issues are updated.

MANPRINT requirements are now identified in basic requirements documents, requests for proposals, and are major factors in the source selection criteria. Dedicated MANPRINT training programs are available to industry. A one-week Mid-level Managers' Course which alternates between TRADOC schools and AMC MSCs is given 10 times a year. A three-week Action Officer Course is also given 10 times annually. MANPRINT compliance/progress is verified at MSC Materiel Acquisition Review Boards. SMMPs, initiated by TRADOC, serve as management guides and identify all tasks, analyses, trade-offs, and decisions that effect MANPRINT issues of a system.

Supporting tools developed/in development to assist the acquisition community in carrying out the MANPRINT objectives include the MANPRINT Handbook for RFP Development, published in December 1987; Handbook for Nondevelopment Item Acquisition, (expected by 3RD

The need to consider the soldier in the total system definition has always been a requirement in the Army.

Quarter FY 88); MANPRINT Primer, (expected to be published by DA DCSPER late FY 88). Regularly scheduled video conferences with AMC focal points also provide feedback on MANPRINT related issues and maintain peak awareness.

We need a dedicated MANPRINT team effort among the materiel developer, the combat developer and industry, if we are to succeed fully. I believe we've turned the corner on the mindsets within the Army. We're now counting on our partners in industry to ensure that MANPRINT philosophy is incorporated throughout all phases of the acquisition process and by all supporting sub-contractors. We can no longer form fit the soldier to the equipment — technology is moving too fast and we can't afford the additional training and systems costs. Our aim is to form fit the equipment to the soldier, our most critical asset.

Dr. Oscar:

BG Harrison gave an overview of the Army's MANPRINT program earlier. Building on that, I will provide some details on MANPRINT initiatives that are underway. By continuous integration of the six MANPRINT domains, (manpower, personnel, training, system safety and health hazards) into our planning and development, we can produce equipment which will provide a synergistic performance of the man and machine together.

Why MANPRINT? In the Army as in industry, manpower is a scarce and valuable commodity. Profits are made by multiplying the effects of man and reducing manpower costs. We must overcome more numerous enemy forces with machines — machines that are not only better than enemy machines but that our soldiers can use quicker, more efficiently and better than the enemy. The combined or integrated man/machine must be superior and planned from the start as an integrated unit.

The need to consider the soldier in the total system definition has always been a requirement in the Army. During the early 80s, senior Army leadership determined that the materiel acquisition process should include a greater emphasis in the soldiers' performance and the Army's support capabilities. Because these six domains cut across many Army organizational responsibilities, MANPRINT requires an integrated effort by the materiel developer, that is the Army Materiel Command (AMC), and the combat developer which is the Training and Doctrine Command (TRADOC).

GEN Wagner, the AMC commander and GEN Thurman, the TRADOC commander, are working very closely to achieve an even stronger and more collaborative working relationship. Implementation of MANPRINT throughout the materiel acquisition process requires a totality of effort from all parts of the Army working with industry as a team.

The Army is rewriting regulations and procedures to institutionalize MANPRINT throughout the materiel acquisition process. Such major documents as human factors engineering analyses (HFEAs), requirements statements, and test and evaluation guides are being updated to incorporate MANPRINT guidelines. Request For Proposals (RFPs) and other contractual documents will require contractors to address MANPRINT items.

MANPRINT needs and constraints will be included in RFPs as parts of the Statements of Work, (SOW), system specifications and contract data requirements lists. In addition, AMC is preparing circulars, pamphlets, primers, guides and handbooks dealing with implementation of MANPRINT into the materiel acquisition decision process. Many of these documents are undergoing revision to accommodate recommendation from field elements and actual implementation experience.

MANPRINT considerations are being included by the field in requirements documents (ROCs), soldier-in-the loop testing and voiced in concerns raised at decision reviews.

In addition to those mentioned earlier, AMC efforts to expand MANPRINT awareness have resulted in road show briefings to commanders of major subordinate commands, CG AMC briefings to industry at American Defense Preparedness Association sponsored Atlanta Conferences, and Army-industry MANPRINT roundtable meetings.

Dr. Oscar, in closing remarks stated . . . "MANPRINT is an Army program to maximize soldier/machine effectiveness in combat systems and reduce demands on personnel and training resources. Success will be assured through the Army's corporate commitment, improved analytical tools, strong tech base program, an informed and educated combat and materiel development community, responsive contractors, and a resolute MANPRINT team. With a concerted effort, MANPRINT will improve the effectiveness of our Army of Excellence."

ROSCILLE W. NELSON is an operations research analyst in the Acquisition Policy and Initiatives Division, HQ, U.S. Army Materiel Command.

Acquisition Policy Revision . . .

TASK FORCE UPDATES AR 70-1

By Jim O'Brien

Introduction

In September 1987, the Department of Defense published DOD Directive 5000.1 and DOD Instruction 5000.2, incorporating changes to defense acquisition policy. This, coupled with the Army reorganization, necessitated revision of Army acquisition policy to accommodate those changes.

An Acquisition Policy Revision Task Force was established by the Assistant Secretary of the Army, Research Development and Acquisition (ASA(RDA)) to accomplish the necessary changes to Army guidance.

The primary focus of the task force was to update AR 70-1, *System Acquisition Policy and Procedures*, consolidate or eliminate (where possible) related directives, assure compatibility with interfacing regulations, and identify areas for future action.

The work of that task force has been completed and as this issue of *Army RD&A Bulletin* went to press, the final draft of AR 70-1 has been distributed as interim guidance. This article outlines some of the key changes embodied in the revision to AR 70-1.

General

The regulation contains an order of precedence statement establishing AR 70-1 as first in order of precedence for managing Army acquisition programs except where DOD or statutory requirements override, and applies the regulation to all Army materiel acquisition programs.

AR 70-1 stipulates levels of management review and accountability requirements:

- Major Defense Acquisition Program (DAB and Component);
- Army Defense Acquisition Program; and
- Non-major (Level I, II, III).

Also, the regulation highlights the Army Acquisition Executive (AAE), Program Executive Officer (PEO), and Program Manager (PM) structures, updates overall responsibilities and clarifies the respective roles of the materiel developer, the PM/PEO, and program decision authorities in order to preserve the streamlined decision chain while ensuring proper functional safeguards by the major subordinate command. Also, it provides additional flexibility to materiel developer commanders for Level II and III non-major programs.

Life Cycle System Management Model

Here you will find a better linkage to the user requirements formulation process; provide an update and basic explanation of the acquisition phases and milestones; Low-Rate Initial Production and long lead time item guidelines and safeguards; and practical approaches to the Milestones IV and V established by the new DOD Directive and Instruction. The regulation also precludes additional documentation requirements without AAE approval.

Program Structure and Strategy

The policy revisions include an explanation of DA-directed acquisitions, improved coverage and clarification of strategy alternatives, functional interfaces and how to handle capstone programs. The revision also includes the combination and simplification of the Acquisition Strategy and Acquisition Plan.

Perhaps most importantly, the AR fully integrates tailoring and streamlining principles and methodology into the mainstream acquisition process while avoiding the confusion of labels separate from established and accepted terminology.

Consolidation and Integration

The new AR 70-1 also:

- Integrates ASARC preparation guidelines from AR 15-14;
- Adds a chapter on resource management interfaces;
- Incorporates AR 70-61, Type Classification of Army Materiel, as a type classification chapter and provides for type classification coverage of the Low Rate Initial Production;
- Adds a chapter on computer resources associated with materiel systems acquisitions; and
- Provides expanded assistance tools by way of appendices, including attachment of DODD 5000.1/DODI 5000.2.

These are only some of the major changes in the new AR. Our challenge now will be to carry through these revisions into the secondary directives and guidance regulations in order to provide consistent guidance to the field in the acquisition arena. You'll hear more from us on that in future issues of *Army RD&A Bulletin*.

JIM O'BRIEN heads the Acquisition Policy Branch in AMC's Office of the DCS for Development, Engineering and Acquisition. He has a bachelor's degree in aerospace engineering from Northrop Institute of Technology and a master's degree in industrial engineering from Texas A&M University, obtained in conjunction with the AMC Graduate Engineering Program. He has held his current position since June 20, 1988.

From the MAM/FA 51 Proponency Office

New AMC Proponency Office

The U.S. Army Materiel Command has recently consolidated the Materiel Acquisition Management (Skill 6T) and Functional Area 51 Proponency Offices under the Office of Project Management. The proponency office will be headed up by LTC Dan Ziomek. In order to facilitate a smooth transition for Training With Industry (TWI), J.L. Green will remain the POC for the 1988-89 TWI training cycle.

Points of Contact

The following is a current list of career managers for Skill 6T (MAM), and Functional Areas 51 (R&D) and 97 (Contracting and Industrial Management). AMC point of contact phone numbers may change subject to the physical relocation of the proponency office within the headquarters:

Proponency Managers

- LTC Daniel D. Ziomek, chief, AMC Proponency Office, AV 284-9570
- CPT Pat Kastner, FA 51, AV 284-9572
- J.L. Green, FA 51 TWI, AV 284-8538
- Jim Coats, Skill 6T, AV 284-9572
- COL Al Greenhouse, chief, SARDA Proponency Office (FA 97), AV 289-2782

TAPA Assignment Personnel

- LTC(P) Roy Beauchamp, FA51, Skill 6T Assignment Officer, Colonels Division, AV 221-7878
- MAJ Ed Coughlin, FA 51 Assignment Officer, AV 221-3125
- MAJ Nancy S. Austin, FA 97 Assignment Officer, AV 221-3125
- Barbara Head, Skill 6T Assignment Manager, AV 221-3125

Materiel Acquisition Management News

In the May-June 1988 issue of *Army RD&A Bulletin*, we announced that the Soldier Support Center, National Capital Region was going to conduct an Army Occupational Survey Program survey of all incumbents of MAM (Skill 6T) positions. Good news, the survey is scheduled to be mailed in early September, and with a little help from the recipients, we could have the results as early as December 1988. If you receive a survey questionnaire, please complete and return it as soon as possible. The survey is an important element of the recently approved MAM FY 88-89 Action Plan. Other actions addressed in the plan are: regularly scheduled MAM Proponency Committee meetings and general officer reviews, identification of key jobs in MAM, validation of MAM positions in TAADS, better control of MAM assignments and schooling, revision of the MAM certification process and criteria, and improving the publicity of MAM throughout the Army.

MAM Certification

The Army MAM Proponent GEN Louis C. Wagner Jr., recently approved changes to certification criteria, tieing certification to new policies contained in Public Law 99-145 (FY 1986 Defense Authorizations Act) and DOD Directive 5000.23 (System Acquisition Management Careers). Officers currently certified will not be effected by the changes. One of the major changes includes "Acquisition Experience." For lieutenant colonels to be certified they must have at least three years of experience in the acquisition, support, and maintenance of weapon systems or other military equipment. At least one of the three years must have been in a procurement command. For continued certification at colonel, the requirement is eight years total acquisition experience and two years in a procurement command. The changes in certification criteria will be phased in during the FY 89 and FY 90 boards. Another significant policy change establishes certification as a prerequisite for PM selection, to be phased in during upcoming PM selection boards.

The FY 88 MAM Certification Board (#4) will be held during the week of Sept. 19-23; officers should be notified of the board results by the end of October. All non-certified officers in the MAM Program in the grades MAJ(P) — COL will be considered. For the first time, guidance was given to the board to establish a standing list of officers who only require PMC to complete certification. TAPA will automatically award certification to officers on the standing list upon graduation from PMC.

Army Tests New Aircraft Tool System

The New Aircraft Tool System (NATS), an instant inventory toolbox designed to improve Army aviation safety by reducing tool foreign object damage, is currently undergoing concept evaluation.

Developed by the U.S. Army Aviation Research and Technology Activity's (AVSCOM) Aviation Applied Technology Directorate (AATD), Fort Eustis, VA, NATS is being field tested by the 24th Aviation Brigade, Hunter Army Air Field, Fort Stewart, GA.

The system is specifically tailored to provide higher quality tools and to enhance safety, mobility and aviation maintenance by decreasing inventory time while reducing weight and space required for tools.

The system consists of a flight and a phase maintenance toolbox for the UH-1, AH-1, OH-58 and UH-60A helicopters; component repair toolboxes for the T-53, T-63, and T-700 engines; sheet metal repairs; armament maintenance; and electrical work.

A six-man team from the 97th Transportation Company, 10th Transportation Battalion, 7th Transportation Group, Fort Eustis, cut, formed, fabricated, painted, assembled and outfitted 15 different kits for 184 toolboxes.

Each kit weighs approximately 35 pounds and is tailored to provide only those tools required to perform its intended function. Tools are secured within the toolbox in a specified location and held in place via retaining clips, racks or custom cutouts.

James Skates, AATD model maker, designed and fabricated tool shadow templates and coordinated the NATS fabrication effort. Over 11,000 individual retaining clips were installed and adjusted to hold the tools in the proper location. The location of each tool is shown through the use of painted tool shadows to facilitate quick tool return and toolbox inventory.

"The tool kits designed for NATS can be inventoried in less than 30 seconds," says Steve La Paugh, AATD project engineer. "With implementation of NATS, tools and tool kit can be inventoried before each maintenance task and at the end of each day. This ensures aircraft are not flying with lost or loose tools onboard."

NATS will be issued to units based on the number and model of aircraft assigned. A similar system is currently in use by the U.S. Air Force and the Navy.

James Skates, model maker, installs a retaining clip in the New Aircraft Tool System.

Army Lab Gets Tough With Track Pads

The Army is getting tougher "where the rubber meets the road." As a result, tank commanders will need fewer "pit stops" — and gain an edge in combat. The Belvoir Research Development and Engineering Center is making this a reality with a new rubber compound for track pads. Recent field tests verified the improved elastomeric formulation more than doubles pad life of the M60 battle tank.

Performance tests for the M60 included three phases: paved surface, hilly cross-country terrain and a combination course. Commercial pads failed at 1,200 miles of pavement. The experimental pads held up for more than 3,000 miles and could have gone at least another 400, triple that of current pads. They lasted 2.5 times longer in the more severe cross-country operations.

Center scientists developed the unique blend for the pads from a highly saturated nitrile polymer — designated as NBR-12 — that they cured and reinforced so it is greatly resistant to heat and aging. A patent for this material has been filed. Members of the Rubber and Coated Fabrics Research Group at the center presented their findings at an American Chemical Society meeting at Dallas in April.

Track pads of this material are being tested on several armored combat vehicles. Performance tests on the Counterobstacle Vehicle — a multipurpose engineering system — and the M1 tank indicate at least double the wear life for pads. Further tests on the M60 and M1 are planned at Yuma Proving Ground, AZ. Pads and roadwheels made from the compound for the Bradley Fighting Vehicle will also be tested.

Feedback from the tests will be used not only to confirm projected gains in wear, but also help improve the rubber formulation and reduce future production costs. The overall effort is being sponsored by the Tank-Automotive Command and the Army Materials Technology Laboratory.

TACOM Establishing Foreign Vehicle Resource Center

The Intelligence Division of the U.S. Army Tank-Automotive Command (TACOM) in Warren, MI, is establishing a Foreign Vehicle Resource Center (FVRC). The FVRC will be an assemblage of foreign (free-world) wheeled and tracked vehicles supporting a variety of current and projected R&D programs.

Due to the broad mission of TACOM in the design, development, maintenance, and procurement of equipment, the availability of the FVRC within a major subordinate command of the Army Materiel Command (AMC) will allow program/project managers and engineers an opportunity to conveniently observe the best aspects of foreign vehicle technology.

Some likely candidates for display at the Foreign Vehicle Resource Center include a Swedish BV 206 track articulated vehicle and a French TRM 2000 2-ton tactical truck.

The Army's growing emphasis on employment of nondevelopment items (NDI), along with reductions in R&D funds, has led to the increased activity regarding foreign military items. This increased interest in foreign materiel has resulted in the need for a centralized data base and repository of foreign technology such as the Foreign Vehicle Resource Center.

The FVRC will be the only centralized state-of-the-art foreign technology center of its kind, with vehicles and equipment being rotated on a regular basis. Previously, there was no facility designated as a central foreign vehicle display area within AMC. There are a number of museum areas (APG, Fort Knox, . . . etc.), but these are dedicated primarily to vehicles of historical value.

The FVRC will accommodate only vehicles in the forefront of current technological trends, eventually becoming the focal point for commercially available foreign military vehicle data.

Vehicles displayed at the FVRC will be part of ongoing TACOM/AMC test evaluation programs of foreign equipment. A large number of vehicles being examined by AMC through the Intelligence Division are on a contractual free loan basis, and in many cases the loan duration can be extended to accommodate display and demonstration purposes. Experience has shown that manufacturers are most willing to have their equipment examined by AMC engineers, scientists and various other personnel.

With the establishment of the FVRC in a location where the personnel will benefit from it most — TACOM — it is foreseen that there will be a reduction in travel time and costs, and a better informed AMC community through on-site exposure to foreign technology trends. Also, the TACOM RDE Center's computer simulation laboratories can be utilized for specific performance evaluations of the vehicles. In the event that vehicles are requested by other agencies for loan, the FVRC management will accommodate these requests based upon justification and priority.

Inquiries concerning the Foreign Vehicle Resource Center should be directed to Robert Kaczmarek, TACOM Foreign Materiel Program Manager (Commercial: (313) 574-5604/7029, AV: 786-5604/7029), or Associated Program Managers/Engineers Ronald Supal, Timothy Kler or Michael Pozolo.

Spectra Fibers Improve Personnel Armor

Mobility equates to survivability on the battlefield of the future. The U.S. Army Natick Research Development and Engineering Center, Natick, MA, is, therefore, interested in

lightening the load of the individual soldier to increase mobility and hence survivability.

One area of technology being emphasized in that regard is reducing the weight of the ballistic protective vest and helmet through the use of new or improved high performance fibers. One of the fibers being investigated is polyethylene material from Allied-Signal Corp. known as Spectra 1000. Natick and the U.S. Army Materials Technology Laboratory, in Watertown, MA, are working together to bring this project to fruition.

Army engineers and scientists, working with industry, are developing technology in fabric engineering, resin coatings, and molding techniques to be used in conjunction with Spectra. The Spectra fiber, targeted for incorporation into the helmet of the Personnel Armor System for Ground Troops (PASGT), is expected to provide a 33 percent reduction on weight compared to the current Kevlar version.

Similar efforts utilizing the Spectra fiber to reduce the weight of the PASGT vest from nine pounds to six pounds, are also in progress. In both applications, the same level of protection and performance provided with the current aramid fiber, Kevlar, will be maintained.

This undertaking is expected to evolve technology to enhance the survivability of the combat soldier and give the United States an alternative material for the PASGT helmet and vest. Furthermore, item costs are likely to be reduced through this competitive situation.

Initial ballistic evaluations and helmet fabrication trials are in progress to determine the most effective fabric construction and optimum resin system for Spectra 1000. This will be followed by final ballistic and environmental testing along with field trials to evaluate overall durability. A decision on the suitability of the Spectra fiber for the PASGT helmet application is expected early in 1990.

Based on the initial promising laboratory results with Spectra, the Natick Research, Development and Engineering Center and the Materials Technology Laboratory are optimistic about its future in improving the Army's personnel ballistic protective equipment.

Natick Works on Camouflage Concepts

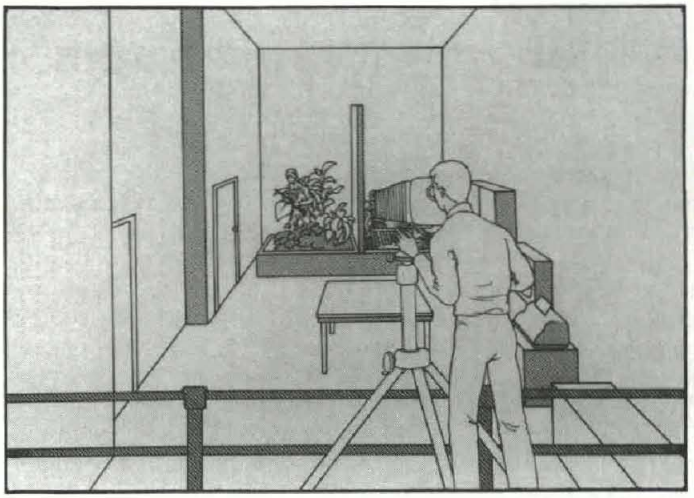
In addition to the 4-color woodland camouflage battledress uniform worn by the soldier today, equipment such as rucksacks, cold weather clothing and any items that are large enough are also provided in the camouflage print. There is a separate uniform for desert use, and a white garment and equipment covers for snow camouflage. The woodland camouflage provides an added advantage of countersurveillance against detection by near-infrared (IR) devices, such as the starlight scope.

Therese Commerford of the U.S. Army Natick Research, Development and Engineering Center's Individual Protection Directorate said, "We intend to give further advantage to the soldier and support his objective to "not be seen." This includes efforts that are being conducted to provide countersurveillance measures against radar, thermal imagers and other devices. "The scientific investigations into these areas fall under the umbrella of "low observables," a term that denotes the Army's classified work in these areas.

Commerford said "stealth" is also associated with the efforts being conducted to protect against radar. Scientists at Natick are optimistic that they will develop protection against these threats just as they have done to provide a means to defeat detection by near-infrared devices.

Natick continually works toward improving existing camouflage and conducting research and development to defeat new and emerging threats. An example is a new desert camouflage battledress under development which shows an improved pattern and color scheme. The objective is to produce one desert pattern/color which is compatible with the most important strategic desert areas in the world. Camouflage patterns and color schemes are being developed too for urban terrain. The challenge for urban camouflage is similar to that of the desert in that the color of terrain types are so varied.

The Natick Center's latest camouflage development is an Individual Camouflage Cover. It was recommended for type classification at the last Army Clothing and Equipment Board meeting. This cover is popular with the infantry soldiers because it protects against detection in woodland, desert



Artist's drawing of viewing area within the Countersurveillance and Processing Technology Branch at Natick. A raised platform enables engineers to assess and evaluate camouflage items in simulated desert and verdant terrains.

and snow environments. Fabricated from a see-through netting material, it is lightweight and compresses to a size that can be easily stored in the cargo pocket of a Battledress Uniform trouser.

Natick Center now has equipment to analyze terrain and digitize the information. Through sophisticated computer programs, engineers develop dominant colors in a scene, and quantify the amounts of each color to produce the appropriate camouflage. In the near future, computerized field work-stations will provide on-site assessment of the effectiveness of existing or developmental camouflage uniforms for any given terrain area.

In-house camouflage effectiveness/assessment has recently been added to the center's camouflage laboratory. This amounts to a large viewing area with a platform, overlooking a divided field on which is simulated desert and verdant terrain. Eventually it will include a snow area too. This gives Natick engineers the ability to evaluate camouflage by visual means and incorporate threat devices available to an adversary.

Army commanders are also concerned with combining camouflage and other forms of protection. The result of one such effort is a new technology which facilitates printing woodland camouflage on Nomex material. Nomex is used for fire protective clothing.

Camouflage Nomex material will be incorporated into future battle-dress clothing, cold weather ensembles and chemical protective suits. Additional work includes combining camouflage with chemical, ballistics, anti-static and environmental protection. It all adds up to a force multiplier since it extends the ability of soldiers to deceive the enemy and maintain the all important element of surprise.

MTL Works With Army Commands to Improve Towbar

Three separate Army organizations can share credit for recent towbar improvements that allow more efficient recovery of disabled tracked vehicles.

A less failure-prone metal towbar has been designed, and a lightweight composite towbar is currently under development as a result of months of research and testing by representatives of the U.S. Army Materials Technology Laboratory (MTL), Watertown, MA, the Ordnance School, Aberdeen Proving Ground, MD, and the Tank-Automotive Command (TACOM), Warren, MI. Although each group's responsibilities varied widely, they worked cooperatively to make changes that have substantially improved and will continue to improve the existing towbar.

The towbar currently used by Army personnel utilizes 1950s design and technology. Weighing over 340 pounds, the towbar requires a four-man crew to deploy, even under battlefield conditions. Thus, the modifications are directly in line with the Army's present mandate to lighten the force.

Speaking before an MTL-sponsored research and development symposium on solid mechanics in October of 1985, guest speaker COL David H. Staley, then chief of the Recovery and Evacuation Management Office of the Ordnance School, singled out the cumbersome towbar as the key problem in traditional recovery procedures. "While we seem to have programs geared toward more sophisticated systems, here's one area that may be low-tech, but it still needs attention," Staley said.

MTL engineers present at the conference recognized the potential for using advanced composite technology to solve this existing Army problem. They approached Staley, who agreed that if MTL could develop a towbar that was lighter and more durable, it would be a significant contribution to the Army in general and to the field soldier in particular.

According to Len Cuzzupe, an MTL mechanical engineer, here is where the real challenge began. "The first step was agreeing that we actually could provide a solution to the towbar problem," he said. "The next step was putting everything in gear and receiving the cooperation of other AMC commands."

While generating support for the project, Cuzzupe researched the history of the existing towbar and examined it's design structure and data. After completing initial research, Cuzzupe and MTL physicist John Beatty took a "hands-on" approach to the problem. "Research can take you only so far," said Cuzzupe. "We felt it was necessary to go right to the field and see the towbar in action to fully understand the problem."

To get a firsthand understanding of recovery and evacuation procedures, Cuzzupe enrolled in the recovery and evacuation field training course at Fort Knox, KY. He participated in recovery missions and talked to soldiers who used the towbar. "COL Staley was right," Cuzzupe said. "It was clear that there was a problem. The soldiers made some key suggestions on how it could be improved, and we went from there."

A joint team comprised of members from MTL, TACOM and the Ordnance School was formed to conduct field tests on the existing towbar to determine the magnitude of the loads being applied to it and the amount of strain these loads put on it. These tests were possible thanks to MTL's state-of-the-art data acquisition equipment, which is portable, compact and able to operate at high speeds.

"Without this equipment, these tests couldn't have been conducted in such a timely and cost-efficient manner," explained Beatty. "Now we can get right to the field — where the problems really exist. This opens the door to conduct additional field tests on other Army systems to gather actual service data, which is essential to conducting and performing design analyses."

MTL scientists identified problem areas regarding towbar reliability and weight and outlined steps for improvements. In particular, the clevises, which hook the towbar to the

disabled vehicle and permit vertical movement, were found to cause interference between the towbar and the chassis, causing severe bending stress on the towbar.

Using the test data, TACOM developed design modifications and produced a set of prototype clevises that were again field tested by the team. The new clevises dramatically improved overall durability and performance.

SGT Thomas Jordan, a recovery instructor at the Ordnance School with more than 15 years experience in recovery and evacuation procedures, praised the new clevis design. He said, "Field maneuvers were executed that were never possible before." Previously, the towbar could only be used on primary and improved secondary roads. On off-road terrain, two vehicles, one pulling and one breaking, would be required for recovery missions, and a tow cable would be used instead of the towbar. The new clevis allows one vehicle, using the towbar, to recover the disabled vehicle even on cross-country landscapes.

Under the direction of MTL, Foster Miller Co., a consultant in composite design and manufacturing, is presently incorporating changes that should reduce weight and further increase reliability of the towbar. The completely modified, lightweight towbar should be ready for field testing in the fall of 1989, according to Cuzzupe.

ETL Awards Contract for QRM Printer

The U.S. Army Engineering Topographic Laboratories has awarded a contract for $26 million to Xerox Special Information Systems, Pasadena, CA, for full-scale engineering development of the Quick Response Multicolor Printer (QRMP).

The printer, scheduled for fielding in the mid 1990s, will provide engineer terrain teams at division, Corps and echelons above Corps with the capability to produce quick turnaround, low-volume, hard-copy, multicolor terrain graphics to support tactical commanders. The QRMP system will provide these products from both hard-copy input graphics and digital data supplied by the Digital Topographic Support System, All-Source Analysis System or from other automated battlefield systems.

The projected length of the contract is 5½ years. During this time, two ruggedized, fieldable QRMPs will be developed and integrated into standard shelters. Testing of the two systems will take place in an Army field environment during the final year of the contract.

When fielded, the printer will turn out 70 full-color copies per hour without the time-consuming labor involved in the current reproduction process. Today, it can take almost eight hours to reproduce a map. With one operator and one 5-ton truck, the QRMP will handle the work which now takes 27 soldiers and ten 30-foot vans full of equipment.

Horace Shipp (right), CTX program manager for the MLRS at RRAD, discusses the functions of an electronic unit for the MLRS with Curtis Aaron.

Red River Provides Weapons Support

The Bradley Fighting Vehicle System, Multiple Launch Rocket System, M981 Fire Support Team Vehicle, and the Apache helicopter are just some of the latest and most sophisticated weapons systems that Red River Army Depot's (RRAD) Force Modernization/Integrated Logistics Support (FM/ILS) Office supports.

However those systems and the associated overhaul programs just don't appear overnight. It takes a lot of long range planning to get the depot overhaul assignment and to prepare the depot to perform overhaul on the major end item and/or its many secondary items, according to MAJ R. Wayne Masters, chief, FM/ILS Office.

The Force Modernization Office has been around for several years, but it wasn't until 1987 that force modernization and integrated logistics support were combined into one office. The staff responds directly to the commander.

RRAD's FM/ILS Office becomes involved as early as possible in the life cycle of a weapons system. The life cycle begins with the Training and Doctrine Command identifying a need for a new capability and preparing a basic needs document, Masters said. Then the document is forwarded to the U.S. Army Materiel Command (AMC) which handles the research, development and acquisition of the hardware that will provide the capability to meet the newly identified need.

Once both TRADOC and AMC reach an agreement on the hardware concept, AMC passes the project on to a contractor.

At this time, depot ILS participation is key to the future maintenance and supply support of the system.

The FM/ILS Office mission is to provide centralized management of depot actions for the support of combat and materiel developers during all phases of the acquisition life cycle for new or product improved systems. The staff also has to consolidate all resource requirements for support of modernized systems and ensure that these requirements are identified in the appropriate planning and budgeting documents.

The FM/ILS Office also provides staff supervision, coordinates with staff elements and consolidates for input to higher commands the requirements for manpower, personnel skills, equipment, tooling, training, technical data, and facilities for support of new and product improved systems. The staff provides assistance to materiel developers and guidance to staff elements in identifying and preparing support documentation for facilities, maintenance equipment, and test measurement and diagnostic equipment. These functions become very critical as the Army proceeds in the development and production phases of a new weapons system.

"The Force Modernization Office at the Depot System Command (DESCOM) and Red River become heavily involved in the process when the Army approves the production of a new system such as the Bradley, MLRS or FIST-V," said Masters. "The item must be supported once its fielded and somebody is going to have to do the supply support and the overhaul of the item, otherwise it will be a throw-away item."

The actual repair and overhaul work usually doesn't begin until sometime after fielding; however, the depot overhaul capability must be in place at the time of fielding.

Some new projects require more than just nuts and bolts. A weapon system might need a new building with new overhaul and inspection/test equipment made specifically for its testing application. Buildings 406 and 407 in the depot's Electronic Division, were designed and built to support the Bradley, MLRS and FIST-V. In addition to facilities for new missions, there may also be a requirement for training, equipment, publications, and additional overhaul support personnel.

With new weapons systems, configuration changes are very common. As these changes are made, corresponding changes must be made at the depot, whether it facilities, equipment or acceptance testing software. For example, a group went to a contractor's office in California recently and reviewed some 419 engineering change proposals for the MLRS. Some changes were minor and some were very significant. However, all must be reviewed to determine the impact on the depot's overhaul program.

Planning and getting a new system, like the Bradley or the M113A3, to the depot is what takes the longest time. Plans are being made for equipment three to five years before it actually arrives on depot. Planning for the Bradley began in 1979. Making sure the depot is capable of supporting a new system is the key to getting new missions, Masters noted. The force modernization activity sells Red River to item and program managers in order to get new missions.

"If you have the capability, it's fairly easy to get a mission," said Masters. "All you have to do is advertise your capabilities. However, in order to obtain the capability and to get equipment, tools, space and facilities built, you have to have a mission. The dilemma we face everyday is which one comes first — the capability or the mission, but, it's really a combination of the two."

Having the capability and the mission is what makes RRAD's FM/ILS process work. The depot continues to gear up to support the Bradley, MLRS and FIST-V and other systems. The future looks good. The FM/ILS staff also has its eye on the proposed weapons system of the future — the Armored Family of Vehicles.

THE PEDERSEN DEVICE

The Pedersen device is an excellent example of cover and deception used in the development of arms and equipment.

An invention of the American arms designer J.D. Pedersen of the Remington Co., this device was a noteworthy secret of World War I. The device consisted of a receiver unit that could be locked into the receiver of a Springfield (U.S. .30 caliber rifle Model 1903). Installed, it converted the bolt action rifle into a semi-automatic weapon that fired .30 caliber pistol-type cartridges from a 40 round box magazine. In addition, it was found that because the muzzle velocity was less than that of sound, the weapon was quiet or "silent."

To hide its identity, the mechanism was officially listed as the U.S. .30 caliber automatic pistol Model 1918. Only about 65,000 of the devices were actually manufactured and the device never saw combat. Following the war, instead of storing them, all of them were reportedly destroyed in 1921, although a few can still be found.

The preceding was provided by James W. Conlin, senior analyst in the Threat Evaluation Division, Office, Assistant Deputy Chief of Staff for Foreign Intelligence, HQ, Army Materiel Command.

ATTENTION AUTHORS

Do you have an article you would like to submit for publication in the Army RD&A Bulletin? If so, we would like to hear from you. We will consider all articles based on importance of the subject matter, factual content, timeliness, and relevance to the bulletin's mission. The following are general guidelines for submissions:

- *Length*. Articles should be about 1,500-1,800 words (8 double-spaced typed pages). Shorter or longer articles are acceptable, depending on what is required to adequately tell the story.
- *Photos*. Include any photographs or illustrations which complement the article. Black and white or color are acceptable. We cannot promise to use all photos or illustrations and they are normally not returned unless requested.
- *Biographical Information*. Include a short biographical sketch of the author.
- *Clearance*. All articles must receive appropriate clearances and be approved for open publication. This may require reviews by the author's security/OPSEC and public affairs offices. A cover letter stating that these clearances have been performed must accompany the article.

Articles should be sent on 5 ¼-inch floppy disk in ASCII format. Articles should also be sent in regular mail. OPSEC clearances and photographs must be sent by regular mail even if articles are sent on floppy disks.

Letters. If you have a comment or view about an article we have published in a recent issue of Army RD&A Bulletin, feel free to submit letters to the editor explaining your views on the subject.

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Headquarters
U.S. Army Materiel Command
5001 Eisenhower Avenue
Alexandria, VA 22333-0001

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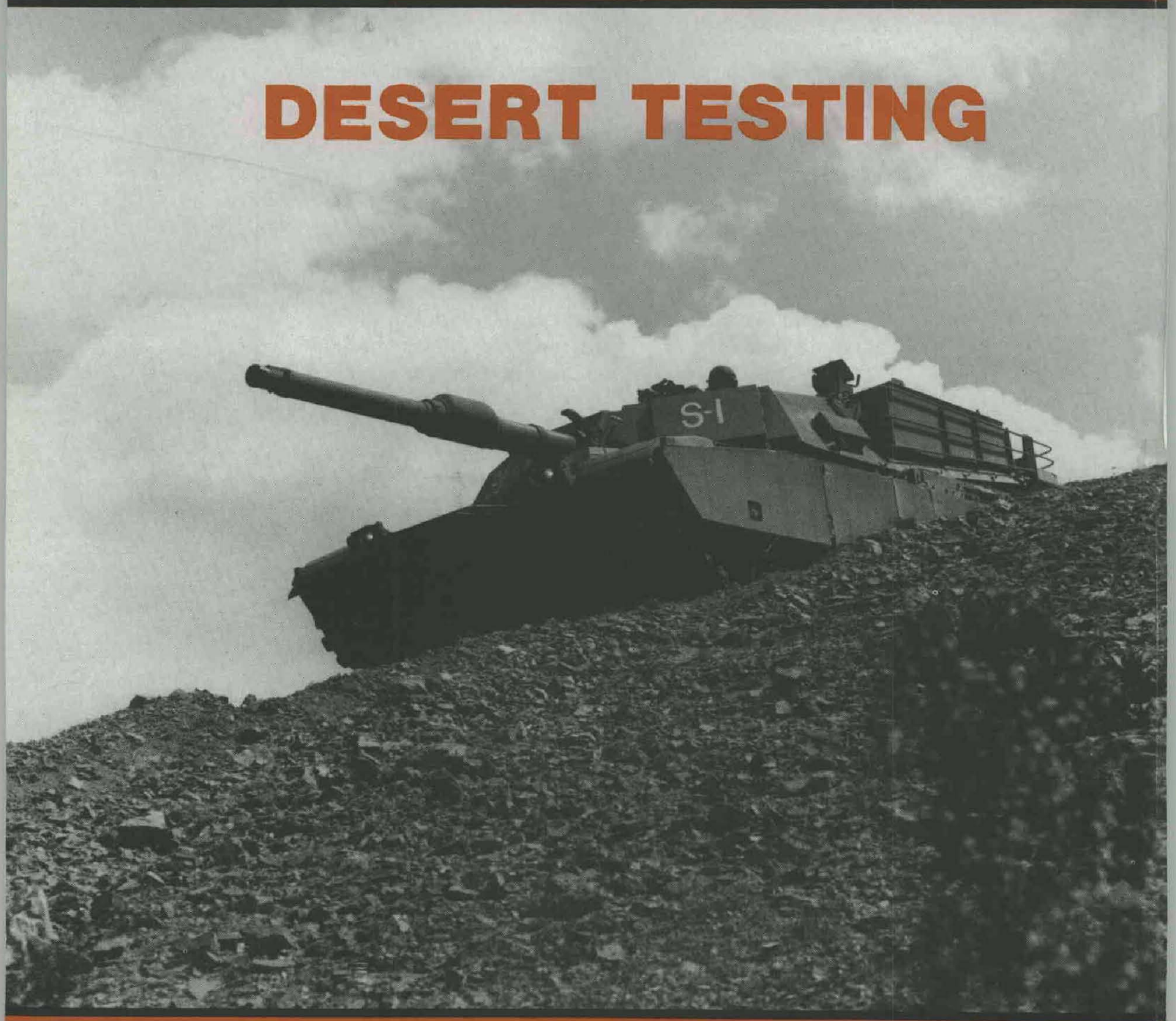

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