ARMY R,D&A

- RESEARCH
- DEVELOPMENT
- ACQUISITION

SEPTEMBER—OCTOBER 1983

# THE DOD SCIENCE AND TECHNOLOGY PROGRAM

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# ARMY R,D&A

**Vol. 24 No. 5 SEPTEMBER-OCTOBER 1983**

OFFICIAL MAGAZINE OF THE RDA COMMUNITY, established 1959




## FEATURES



## DEPARTMENTS



## ABOUT THE COVER:

A comprehensive overview of the DOD Science and Technology program is the subject of this month's front cover feature story. Specifically, this article addresses some of the key management aspects of the S&T program. Displayed on the back cover is an artist's concept of how robotics and artificial intelligence might be applied to meet armament requirements.


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*Purpose:* To improve informal communication among all segments of the Army scientific community and other government R,D&A agencies; to further understanding of Army R,D&A progress, problem areas and program planning, to stimulate more closely integrated and coordinated effort among Army R,D&A activities; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

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# The DOD Science and Technology Program:

## *Some Management Perspectives*

**By Dr. Edith W. Martin**

***Deputy Under Secretary of Defense for Research and Advanced Technology***

In Fiscal Year 1983, the Department of Defense will spend slightly more than four billion dollars on science and technology (S&T) efforts. Although this amount is less than two percent of the DOD budget, it represents a program of considerable magnitude and diversity.

The program includes a wide range of "front-end" technology development, from the exploration of basic scientific phenomena to the demonstration of technology in full-size fighter class engine configurations and 200-ton models of advanced ship designs.

Technology disciplines of interest vary across an equally broad spectrum, from food technology and water purification to autonomously guided munitions capable of discriminating among target classes. The bulk of this activity is conducted through our 73 DOD laboratories in over 20,000 separate tasks.

It is an understatement to say that the management of this enterprise constitutes a challenge! The aim of this article is to outline some of the more important management aspects of the program. These aspects will be concerned with the goals and objectives of the program, the resources — both money and performers — which are employed, the responsibilities and functions of DOD management, and the specific management structure within the Office of the Secretary of Defense which deals with the S&T program. Although highlights of some current activities are included, they are primarily intended to illustrate certain management features. It is clearly not possible in a single article to describe the entire S&T program adequately.

### Goals and Objectives

The obvious starting points for management are the overall goals and objectives of the S&T program. In broad terms, there are five:

• Offset Soviet Numerical Superiority. The United States has made the decision not to attempt to match our potential adversaries, mainly the Soviet Union and the Warsaw Bloc, on a person-for-person, weapon-for-weapon basis. Instead, we have decided to rely on our superior technology, and particularly on our ability to apply this technology, to give us the needed military advantage.

• Keep Ahead of Growing Soviet Technical Threat. It follows that to offset Soviet numerical superiority on a continuing basis, we must maintain a technological edge. This is becoming increasingly difficult, given that Soviet RDT&E expenditures are about twice as large as ours, and more ominously, their training of scientists and engineers is proceeding at five times the rate of ours. In addition, the Soviets are acquiring significant amounts of Western technology, both by overt and covert methods.

• Reduce Complexity and Costs. As I am sure any reader of this article will appreciate, affordability and readiness considerations require that we develop technology which can be used to reduce the cost and complexity of weapons systems; these same considerations also require that we apply the technology for these purposes.

• Improve Productivity of Industrial Base. We have a continuing need for improved productivity in our industrial base. Our strong and innovative industrial base represents one of our largest advantages vis-a-vis the Soviets, and the intent is to keep it that way.

| | FY 82 | FY 83 | FY 84 REQUEST |
|---|---|---|---|
| Research (6.1) | $ 698 | $ 779 | $ 850 |
| Exploratory Development (6.2) | 2,235 | 2,434 | 2,693 |
| Advanced Technology Development (6.3A) | 751 | 820 | 1,233 |
| TOTAL | $3,684 | $4,033 | $4,776 |

**Figure 1. DOD Science and Technology Funding**

• Enhance Return on Investment. It is axiomatic that, in the definition of major thrust areas and selection of programs, we endeavor to achieve the greatest possible return on our investment.

The preceding goals and objectives provide the basis for identification of major thrust areas, specific programs, and for the related resource allocations. The payoff criterion is the extent to which a specific activity will contribute to one or more of these goals and objectives.

## S&T Program Resources

Resources which are devoted to the S&T program can be categorized in several different ways: by budget category, by DOD component or agency, or by nature of performer. The S&T program encompasses three categories of Program 6 (Research, Development, Test and Evaluation) of the DOD budget: Research (6.1), Exploratory Development (6.2) and Advanced Technology Development (6.3A). Funding in these categories is shown in Figure 1. The first two categories taken together provide long-term solutions and opportunities, and are commonly referred to as the technology base.

The third budget category, advanced technology development, encompasses those activities in which we seek to prove that the know-how is sufficient to permit the commitment to be made to use new technology in operational systems. This is a vital step — one we call technology transition — and, as can be observed from Figure 1, a step in which DOD is placing increasing emphasis.

One management action which is high on our priority list is to request real growth in the technology base. Our goal is to achieve the same buying power we had in Fiscal Year 1965, which predates the major Vietnam buildup. As can be observed from Figure 2, we are making progress, but there is still quite a way to go.

The pressures of short-term fiscal needs for current systems, and the associated procurement "bow-waves" makes even the two percent charge for technology a difficult price to pay. This issue of long-term investments versus short-term payoffs is not amenable to permanent resolution; efforts will always be required to insure that proper attention is given to the vital need for long-term investments in technology.

All of the DOD S&T efforts are funded through the individual Services and the DOD agencies. The split among these components is indicated in Figure 3. As can be observed, in FY 1984 the Air Force still has the largest program, while the request for the Navy is the smallest. From Fiscal Year 1982 to Fiscal Year 1984, the Army has shown the largest percentage change, primarily due to an increased emphasis on technology transition in several important areas.

The performers of our S&T program are private industry, the DOD

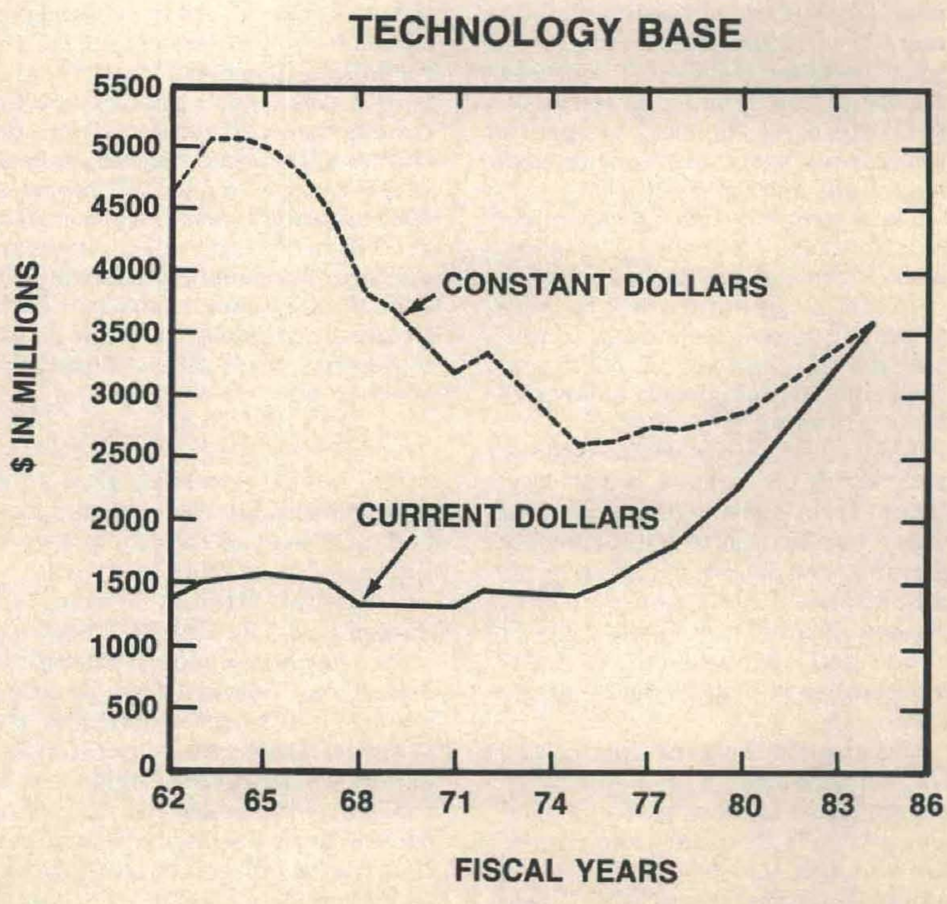


**Figure 2. DOD Technology Base Funding History**

laboratories, and universities — private industry receives about 54 percent of our S&T funds, the DOD laboratories about 32 percent, and universities about 14 percent. We need contributions from all three groups.

The universities constitute a rich supply of fundamental research work, as well as much needed science and engineering graduates. The DOD laboratories serve to satisfy special military needs which cannot be met by the nation's industrial base, to focus some attention on our mid-term and long-range needs, and to enable us to act as a smart buyer of military technology and equipment. Private industry, of course, not only develops technology, but ultimately applies it in new military systems.

An important point to note is that approximately two-thirds of our program is performed outside of DOD. We do, however, provide the management for the entire program.

## DOD Management Structure

The responsibility for the management of the major portion of the DOD S&T program is in the Office of the Deputy Under Secretary of Defense for Research and Advanced Technology, ODUSD (R&AT). Its position in the DOD management structure is shown in the simplified diagram of the organization of the Office of the Secretary of Defense in Figure 4.

The ODUSD(R&AT) interacts with the offices of the other Deputy Under Secretaries in three major ways. The first way is through the mission area planning process, to determine the technology prospects and needs for future weapon systems. The second way is by providing assessments of technology readiness and payoffs for nearer term system developments. The third way is through efforts devoted to international technology exchange, cooperation, and export control; in this area, ODUSD(R&AT) also interacts with the Office of the Under Secretary for Policy.

The *responsibilities* of the ODUSD(R&AT) are to provide policy, guidance, and oversight for the major part of the DOD S&T program. (The ODUSD(R&AT) does not normally deal with the funding for the DOD agencies, which is typically about 25 percent of the total S&T program). In addition to these responsibilities, the ODUSD(R&AT) has the *roles* of the scientific advisor for the Under Secretary of Defense for Research and Engineering and the DOD point-of-contact for the scientific community. Primary *functions* of the ODUSD(R&AT) are to: structure the S&T program across Service lines, so as to eliminate overlaps and gaps; resolve technical differences; and enhance return on investment.

The formal role of the ODUSD(R&AT) in the formulation of the DOD science and technology program is in accordance with the normal planning, programming, and budgeting system (or PPBS for short). This consists of preparing the S&T portion of the Defense Guidance; review (and, if appropriate, take issue with) the Services' Program Objectives Memoranda (POMs); review the Services' budget submittals; and review the Services' expenditure plans at apportionment time. This process, for a given year's budget, spans the 2-year period immediately preceding the beginning of the fiscal year. A less formal, but equally important, function of the ODUSD(R&AT) is to work with the Services on a continuous basis to achieve mutual S&T objectives.

Areas emphasized by the ODUSD(R&AT) are those of multi-Service interest specifically, for the obvious reason that these areas are the most difficult ones for each individual Service to handle adequately.

As a practical matter, areas which

| | FY 82 | FY 83 | FY 84 REQUEST |
|---|---|---|---|
| Army | $ 803 | $ 922 | $1,155 |
| Navy | 924 | 971 | 1,095 |
| Air Force | 1,028 | 1,102 | 1,336 |
| Defense Agencies | 929 | 1,038 | 1,190 |
| TOTAL | $3,684 | $4,033 | $4,776 |

**Figure 3. DOD Science and Technology Funding**

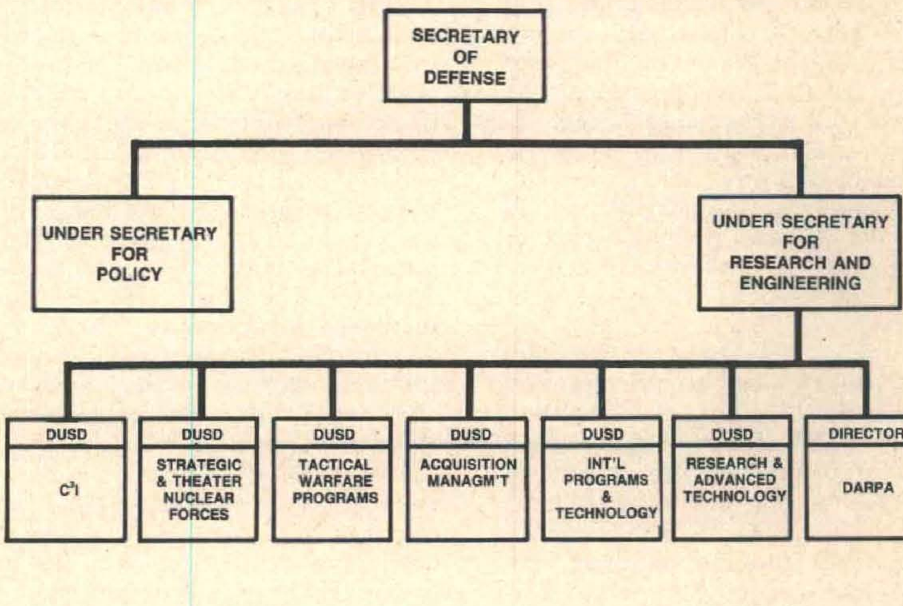


**Figure 4. Partial Organization of the Office of the Secretary of Defense**

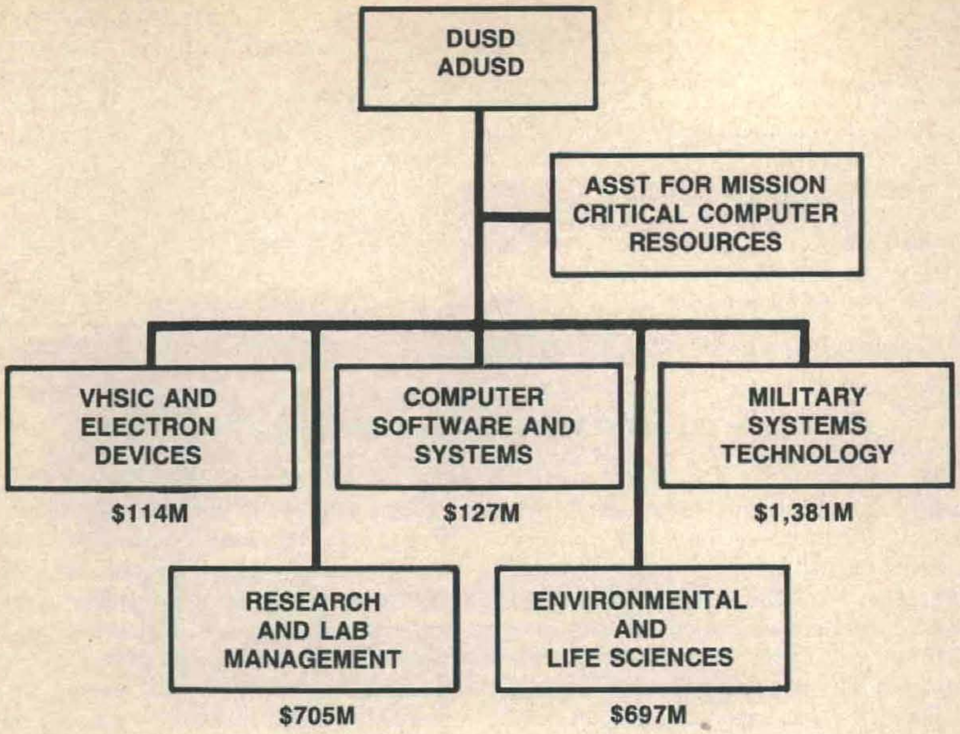


**Figure 5. Organization of the Office of the Deputy Under Secretary of Defense for Research and Advanced Technology.**

are unique to one Service do not receive as much attention. In this regard, however, it should be stated that in the world of science and technology, as compared to the world of end-items, Service-unique areas are considerably less numerous. For example, no one would argue that major surface combatants are not unique to the Navy; on the other hand, the S&T considerations relevant to the surveillance, target acquisition and fire control systems, ordnance systems, structures and materials, propulsion systems, and the like utilized in major surface combatants have many areas in common with weapons systems of other Services.

During the past year, the ODUSD(R&AT) has been reorganized to have five directorates, as shown in Figure 5. The numbers below each directorate indicate the amount of FY 1983 funding for which they have responsibility. As might be deduced from these funding numbers, the Very High Speed Integrated Circuits/Electron Devices and Computer Systems and Software Directorates operate differently than the other three directorates. These two directorates are unique, and are commonly called "thrust directorates." In both instances, the ODUSD(R&AT) will take a very active role in the planning and execution of programs; the other three directorates are in the more traditional policy-guidance-oversight posture.

This organizational structure specifically addresses four important management needs. The first is the need for more focus on our efforts in computer-related technology, in accordance with the unarguable high payoffs which it offers. The second is the need to insure that both the hardware and software aspects of computer technology receive appropriate attention. The third is the need for increased attention to laboratory management. The fourth is the need for more emphasis on the transition of all aspects of technology to operational systems. The relationship of the organization to these needs is reasonably apparent, but will become clearer with a more definitive exposition of areas of responsibility of each directorate.

The VHSIC/Electron Devices Directorate has responsibility for Very High Speed Integrated Circuits, infrared and electro-optical devices, microwave and millimeter wave devices, and microelectronics. The most visible program in this directorate is the VHSIC program, which it both directs and manages, and which is our highest priority program.

The VHSIC program is aimed at gaining and maintaining a qualitative lead over our potential adversaries, and providing affordable complex military functions in small packages that can be easily repaired or replaced. There are six contractor teams currently at the mid-point of a 3-year effort to develop 1.25 micron chips, which should yield a hundred fold increase in throughput over their predecessors.

In order to facilitate the use of VHSIC technology in operational military systems, three new initiatives have been added to the VHSIC program: a yield enhancement, manufacturing technology program; a technology insertion program to demonstrate chip performance in selected weapon systems; and a program to develop a computer-aided design capability to enable other contractors to use the technology with ease.

The Computer Software and Systems Directorate deals with three broad areas: the Ada Joint Program Office, software research and engineering, and software technology transfer. Ada is the DOD higher-order programming language, and our efforts to produce and support a common language are progressing well. The other major initiative in this directorate is the Software Technology for Adaptable, Reliable Systems program, or STARS.

Software has gradually become the dominant factor in military systems, not only because of increased reliance on the digital computer, but also because modifications to system capabilities are potentially easier with software changes rather than with hardware changes. This increasing reliance on software has produced difficulties within DOD, both in the development of software and in the adaptability of the final product.

Goals of the STARS program are to make software development and support faster, more predictable, and less expensive; and to make operational software more powerful, more reliable, and more adaptable.

Together, this initiative and the VHSIC program offer a coherent and balanced strategy to maintain our world leadership in the vital area of computer technology.

The Research and Laboratory Management Directorate deals with four major areas of responsibility: Defense Research Sciences, which is the DOD Research (6.1) program and which constitutes our largest connection with universities; oversight of the DOD laboratories; other defense-related research and development in the industrial sector, including the Independent Research and Development (IR&D) program; and the flow of scientific and technical information.

In short, the primary concern of research and laboratory management is improving the quality of our research establishment, including not only the contracted 6.1 program, which provides the basis for later 6.2 and 6.3A efforts, but also the general operating environments of all of the major performing segments.

Within the recent past, we have undertaken management initiatives to assist all major performing segments: the universities, the DOD laboratories, and private industry. Space does not permit a discussion of all of them, but efforts to strengthen our interface with the universities are illustrative. We are particularly concerned about this interface because of the problems we face in science and engineering education: unfilled facility positions, decreasing student populations, increasing foreign student enrollments, and obsolete equipment, to name a few.

Three major steps have been taken to address these difficulties. First, DOD has established a DOD/University Forum, co-chaired by the Under Secretary of Defense for Research and Engineering and the President of Stanford University, with 20 members drawn equally from DOD and academia.

The Forum has been most useful for an informal exchange of views, and has formed three working groups: one on science and engineering education, one on foreign languages and area studies, and one on technology export control. Second, DOD continues to expand support for both students and faculty: the three Services in Fiscal Year 1983 are supporting more than 100 fellows in defense-related disciplines; the Research (6.1) program supports an estimated 4,000 graduate students; and the authorizations for the DOD laboratories for summer research opportunities for faculty members have been increased from the more than 200 which were utilized last year.

Finally, DOD has initiated a 5-year, $150 million university research instrumentation program, for the purpose of stimulating and supporting the basic research underlying DOD technology goals. More than 2,500 proposals were received, and we hope that this beginning will lead other funding agencies to similar action.

The Environmental and Life Sciences Directorate deals with the five key supporting disciplines: training and personnel technology; medicine and life sciences; chemical warfare and chemical/biological defense; and environmental quality. The directorate is concerned with technology applications to virtually all aspects of operational systems and support, other than the major weapons systems themselves; consequently, emphasis is placed on technology transition.

A few of the current initiatives in these areas include, in the training area, the development of computer-based training and performances aids for operation and maintenance tasks, which will have high payoff in improving the productivity of these activities.

In the medical arena, we are initiating parallel efforts to develop and field, first, a rapid identification system for infectious organisms and, second, a series of new drugs and vaccines to protect against natural infectious disease threats.

In the environmental sciences, we continue to push the modernization of our data acquisition and processing capabilities; the upgrading of our 1950's technology radar, tactical sensor, and tactical decision-aid capabilities is the major effort for the next several years.

The Military Systems Technology Directorate is the "firepower and mobility" directorate, with responsibilities in the five related areas: electronic systems; combat vehicles; propulsion and fuels; conventional weapons; and materials and structures. A major objective of this directorate is to foster technology transition through advanced technology demonstration directed toward meeting clearly defined end-use goals.

A few examples will illustrate the nature of these activities. In search and surveillance, concepts are being pursued to provide day/night, all-weather capability. This work is complementary to our thrust in precision guided weapons, and with activities to develop automatic high resolution target identification, classification and tracking technology.

One major thrust in combat vehicles is the development of an enhanced tactical aircraft vehicle through advanced control concepts such as integrated fire control and flight control, which provides the ability to execute highly evasive maneuvers while still maintaining a line-of-fire on the target. This technology is aimed for transition to the next generation fighter.

In the aircraft propulsion area, a program has been initiated to demonstrate a 20 to 30 percent reduction in fuel consumption in a 5,000-6,000 hp class engine configuration, which is anticipated to transition for use in the Joint Vertical Lift Aircraft.

In the materials and structures area, the original focus on organic composite materials is now paying off with use in almost all production aircraft; metal matrix composites are the newest materials to evolve, and their application to large spacecraft structures is being emphasized.

## Concluding Remarks

This has been a necessarily brief and incomplete indication of a variety of management considerations which are applied to the DOD S&T program. We obviously anticipate that these considerations will significantly improve the payoffs which will be achieved. Nevertheless, we are acutely aware that the ultimate success of the program depends upon the performers, both individually and collectively. In this regard, we welcome assistance from all interested parties — particularly in the realm of new ideas — in achieving mutual success.

*1983 Winners Announced*

# Army R&D Achievement Awards Recognize 109 In-House Personnel

Winners of this year's prestigious Army R&D Achievement Awards have recently been announced by LTG James H. Merryman, Deputy Chief of Staff, Research, Development and Acquisition, DA. There were 49 awards involving 109 persons.

The largest number of awards to a single command went to AMCCOM (formerly ARRADCOM) which garnered 12 awards involving 31 people. The Corps of Engineers captured 11 awards involving 18 people. ERADCOM collected 9 awards with 18 people, MICOM received 3 that totaled 20 people, and the Army's Medical R&D agencies won another 5 involving 5 people. Other winning awards went to AVRADCOM (2), AMMRC (2), MERADCOM (1), TECOM (1), NATICK (1), ARO (1), and ARI (1).

The awards by commands were as follows:

## *U.S. Army Armament, Munitions and Chemical Command:*

*Ballistic Research Laboratory: Drs. A. Gauss, Jr.*, and *S. Cornelison* were cited for their work involving joint theoretical/experimental efforts in developing a distinctly new type of radar absorbing material.

*Mr. George E. Hauver* was selected for his work in designing, developing, and using new experimental techniques to determine penetration phenomenology in conventional and advanced armors.

*Dr. Gordon L. Filbey, Jr.*, and *Dixie M. Hisley* were chosen on the basis of their contributions to the basic understanding of advanced armor mechanisms.

*Dr. Walter B. Sturek, Messrs. Charles J. Nietubicz* and *Jubaraj Sahu* won their award for their work in applying highly sophisticated, thin-layer Navier-Stokes computational modeling techniques to predict the Magnus effect on shells and the base region flow at transonic and supersonic velocities.

*Drs. William J. Gillich, Gordon L. Filbey, Jr., William S. deRosset, William J. Bruchey, Jr.*, and *Messrs. E. Allen Murray, Jr.*, and *Walter R. Rowe* were recognized for development of an armor system exploring advanced technology.

The team of *Dr. Mark D. Kregel* and *Messrs. Anthony F. Baran, Timothy L. Brosseau*, and *Robert P. Kaste*, received the award for the conceptualization, design, and fabrication of an innovative fire control system for use on aerial and ground vehicles.

*Chemical R&D Center (CRDC): Mr. Achille Silvestri's* selection was based on his work in developing a kit for the detection of toxic chemical agents in water.

*Dr. Joseph E. Matta* won his award for his scientific contributions that resulted from the investigation of breakup and fluid characterization of viscoelastic solutions.

A group award recognized *Messrs. Donald N. Olson, Joseph Huerta*, and *Miles C. Miller* for their managerial and technical efforts in the successful demonstration of a gun-fired solid fuel ramjet tubular projectile.

A second group award to a CRDC team went to *Dr. Charles Harden*, and *Messrs. David A. Blyth, John A. Parsons*, and *Donald B. Shoff, Jr.*, for the team's contributions to significant advances in the defensive posture of the U.S. and U.K. against toxic chemical agents.

*Fire Control and Small Caliber Weapon Systems Laboratory:* An individual award for pioneering advances in pattern recognition and image processing for tactical target imagery purposes went to *Dr. Frank P. Kuhl*.

*Large Caliber Weapon Systems Laboratory:* A team award for efforts in developing and applying an improved technology for steel-making for cannon tube forgings went to *Dr. Vito J. Colangelo*, and *Messrs. Peter A. Thornton*, and *John Renslow*.

## *U.S. Army Aviation R&D Command:*

*Aeromechanics Laboratory, Ames Research Center: Mr. Lloyd D. Corliss* won recognition due to his contributions leading to the first clear understanding of the importance of engine dynamic response characteristics to handling qualities for nap-of-the-earth helicopter flight operations.

*Applied Technology Laboratory:* For his outstanding contribution in the field of an advanced infrared suppression system for Army helicopters, *Mr. Wallace R. Conway* received his R&D Achievement Award.

## *U.S. Army Electronics R&D Command:*

Eighteen personnel were honored by nine awards for research conducted at ERADCOM headquarters, the *Harry Diamond Laboratories (HDL)* and the *Night Vision & Electro-Optics Laboratory (NV&EOL)* at Adelphi, MD, and the *Atmospheric Sciences Laboratory (ASL)* at White Sands Missile Range, NM.

Under a joint effort between the *Electronics Technology & Devices Laboratory (ET&DL)* and the *Electronic Warfare Laboratory (EWL), Mr. William J. Skudera, Jr.*, and *Drs. Dirk Klose* and *William A. Novick* have designed, implemented and evaluated prototype subsystems that provide the basis for new classes of electronic warfare systems with breakthrough capability.

The results of their work, achieved under a recently concluded "in-house" effort, will have an important impact on electronic intelligence and electronic countermeasure systems.

ET&DL researchers *Messrs. Charles M. DeSantis* and *Louis J. Jasper, Jr.* received a team award for their major contributions in the analysis and design concept for low-cost, high-power microwave/millimeter wave tube amplifiers. Their innovative design, fabrication and demonstration of the circuitless electron beam amplifier represents a breakthrough in microwave tube design and the elimination of the high-cost circuit will reduce the cost of high-power microwave tubes used in radar, electronic warfare and communications applications.

Another R&D award went to ET&DL nominees *Dr. Herbert A. Leupold* and *Dr. Arthur Tauber* for advancing the state-of-the-art of microwave/millimeter traveling wave tubes and extended interaction amplifiers. According to their citation, this innovative technological development of hybrid periodic permanent magnet stacks affords a 15-fold bulk and weight reduction of the

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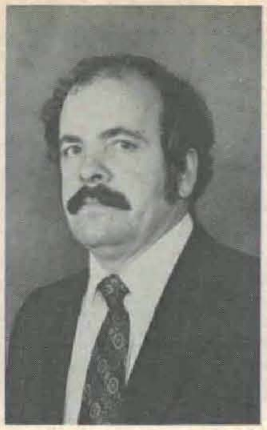

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## R&D Achievement Award Winners

**U.S. ARMY ARMAMENT, MUNITIONS AND CHEMICAL COMMAND — (1) Dr. A. Gauss, Jr. (2) Dr. S. Cornelison. (3) George E. Hauver. (4) Dr. Gordon L. Filbey, Jr. (5) Dixie M. Hisley. (6) Dr. Walter B. Sturek. (7) Charles J. Nietubicz. (8) Jubaraj Sahu. (9) Dr. William J. Gillich. (10) Dr. William S. deRosset. (11) Dr. William J. Bruchey, Jr. (12) E. Allen Murray, Jr. (13) Walter R. Rowe. (14) left to right: Dr. Mark D. Kregel, Anthony F. Baran, Timothy L. Brosseau, Robert P. Kaste. (15) Achille Silvestri. (16) Dr. Joseph E. Matta.**

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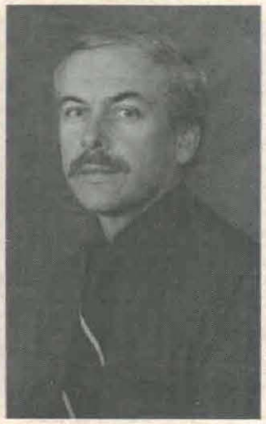

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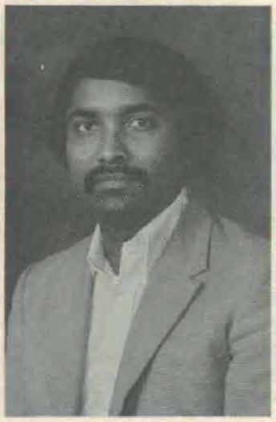

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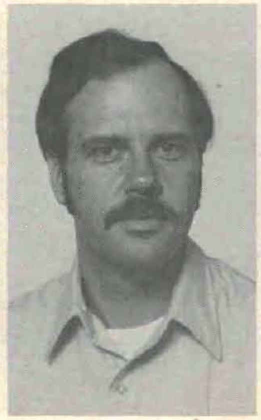

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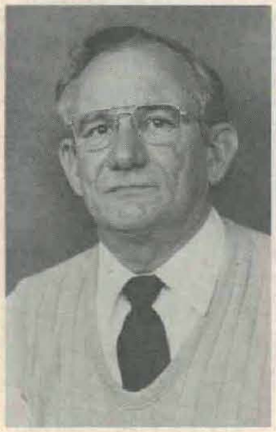

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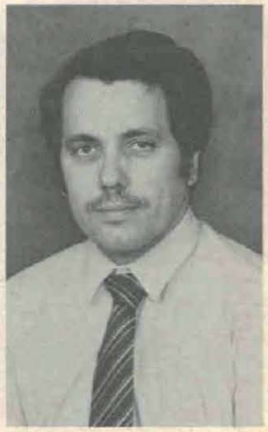

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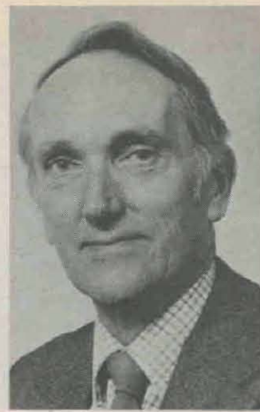

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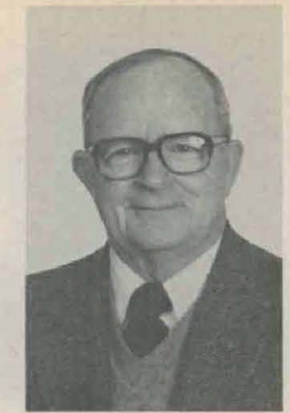

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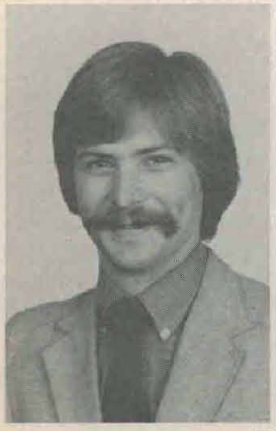

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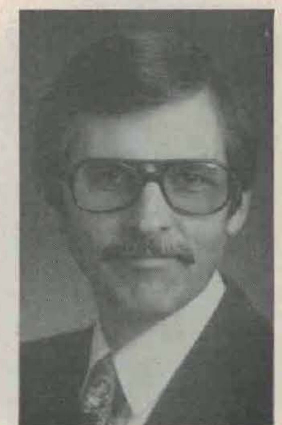

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## R&D Achievement Award Winners

**U.S. ARMY ARMAMENT, MUNITIONS AND CHEMICAL COMMAND — (1) left to right: Miles C. Miller, Joseph Huerta, Donald N. Olson. (2) Dr. Charles Harden. (3) David A. Blyth. (4) John A. Parsons. (5) Donald B. Shoff, Jr. (6) Dr. Frank P. Kuhl. (7) left to right: Dr. Vito J. Colangelo, John Renslow, Peter A. Thornton. U.S. ARMY AVIATION R&D COMMAND — (8) Lloyd D. Corliss. (9) Wallace R. Conway. U.S. ARMY ELECTRONICS R&D COMMAND — (10) William J. Skudera, Jr. (11) Dr. Dirk Klose. (12) Dr. William A. Novick. (13) Charles M. DeSantis. (14) Louis J. Jasper, Jr. (15) Dr. Herbert A. Leupold, left, and Dr. Arthur Tauber.**

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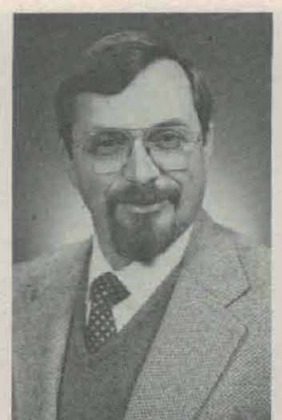

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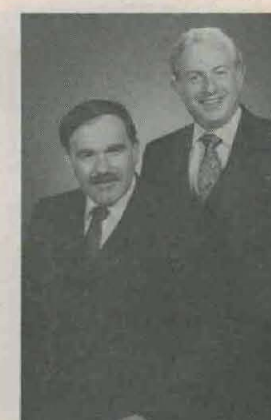

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electron beam-focusing element from those of conventional structure with the same bore size, periodicity and magnetic electron-focusing field ". . . the overall impact of this contribution upon cost and performance of lightweight, high-resolution radar will be considerable."

Combat Surveillance & Target Acquisition Laboratory (CSTAL) researchers, *Messrs. Raymond L. Robbiani, John P. Schoening, Joel H. Schulman* and *Frank W. Wilson*, were selected for their research and development of the Meteorological Data System AN/TMQ-31, a major step in equipping the Army with a new, highly mobile, precise system for providing timely ballistic meteorology, which in turn will enhance the accuracy of the field artillery and lower its ammunition expenditure needed to kill a target.

Three awards for research conducted at Harry Diamond Laboratories are as follows: A 2-man team award went to *Messrs. Dennis R. Cook* and *Klaus H. Sann* for successful execution of an experiment to define the radar backscatter characteristics of chaff by means of an airborne measurement program.

"The data from this experiment reveals previously unknown but extremely significant features of airborne chaff clouds," the citation states. Further, "this contribution has had a vital impact on a critically important hardware upgrade program and is having a major impact on the specification and design of air target weapon systems."

Individual R&D awards were given to *Mr. Joseph R. Miletta* for his work in developing high-altitude electromagnetic pulse mitigation design practices for telecommunication facilities and systems; and to *Mr. John R. Dent* for his outstanding engineering leadership and contributions to the successful development of the M818 PATRIOT fuze and support acceptance test equipment.

NV&EOL research earned *Mr. Herbert Wilson* an R&D Achievement Award for his major contribution toward advancing the state-of-the-art in the epitaxial growth of mercury cadmium telluride infrared detector material for infrared imaging systems.

*1LT David H. Tofsted* and *Dr. Donald E. Snider* were nominated by the *Atomospheric Sciences Laboratory* for identifying atmospheric refraction as a significant error for tank fire control. Their award was based on "their quantification of this phenomenon through field measurements and computer modeling, which has established a scientific basis for future improvements to fire control computers, thus leading to an improved first-round hit probability."

## U.S. Army Missile Command:

Army Missile Laboratory: Three team awards went to this laboratory, in which 20 individuals were cited. These included an award to a team composed of *Messrs. Anthony Blackmon, Jimmy R. Duke, Michael M. Jones, Donald E. Lovelace, James W. McKelvy, Walter E. Miller, Robert R. Mitchell,* and *Robert L. Sitton*, for their development and demonstration of a major advancement in sensor/warhead technology for application to direct fire missile systems.

A team composed of *Messrs. Donald W. Holder, John H. Wright, William J. Lyons,* and *Timothy P. Ricks* was recognized for its efforts in conceiving, developing, fabricating, managing, testing, and conducting a fiber-optics guidance demonstration program for use in secure, bi-directional data links to tactical missile systems.

*Messrs. Robert R. Boothe, Michael D. Fahey, Neal B. Lawrence, Jester M. Loomis, George T. O'Reilly, Thomas C. Pierce, Stanley E. Prevost,* and *William G. Spaulding* comprised a team that won an award for its design of a quiet radar.

## U.S. Army Mobility Equipment R&D Command:

*Messrs. Carl J. Heise* and *Michael A. Mando* received awards in recognition of the development of a high-performance insulation system for high-power density, short-duty cycle electrical machinery. Their citation states that the resultant product has established feasibility of a tactical, pulsed prime-power source for the Army's laser weapons program and will materially assist the design of future laser and beam weapon power supplies.

## U.S. Army Test and Evaluation Command:

*Mr. C. David Brown* has been honored for development of the Moving Target Simulator and the Live Fire Evasive Target. His combination of skills in the electro-optic and digital design areas have been responsible for the success of these systems, according to his citation. "These projects, under his direction, have grown into a unique innovative method for the testing of combat vehicle fire control systems, with the Army-wide recognition for cost savings and unlimited capabilities for testing and training applications."

## U.S. Army Natick R&D Laboratories:

*Messrs. Armando C. Delasanta* and *Gil M. Dias* were selected for the award on the basis of their chemical research that culminated in an improved clothing system that offers increased protection for the individual soldier in a toxic chemical environment.

## U.S. Army Materials and Mechanics Research Center:

*Metals and Ceramics Laboratory:* A team composed of *Dr. Joseph J. Prifti,* and *Messrs. Eugenio DeLuca* and *Dino Papetti* received their award for developing four advanced, low-cost, generic, lightweight, armor materials systems for crew protection in ground vehicles and aircraft.

A second team award was given to *Dr. James W. McCauley, Mr. Norman D. Corbin,* and *Ms. Theresa M. Resetar* of the *Organic Materials Laboratory* and *Mr. Philip Wong* of the *Metals and Ceramics Laboratory* for the successful demonstration of the use of solid state exothermic gasless reactions to produce important materials with minimal energy consumption.

## U.S. Army Research Office:

*Dr. Bernard F. Spielvogel* received the award for his success in the synthesis, characterization, and evolution of boron analogs of the alpha amino acids and related compounds. The products of his research will have application as additives to propellants and also medical protective uses.

## *U.S. Army Medical R&D Command:*

*COL Edward L. Buescher,* director of Development and Production Management, HQ, USAMRDC, was given the award for providing the qualitative and effective scientific leadership required to accelerate the fielding of chemical nerve agent antidotes and to establish a formal management element of the command for the development of medical material and support requirements for the battlefield.

The *Medical Institute for Infectious Diseases* provided two award winners. *Peter B. Jahrling* was singled out for his contribution to research involving the pathogenesis and immunology of lassa fever and the development of the first effective means for laboratory measurement of the protective capacity of the humoral antibody system.

*Stephen H. Leppla* was given the award for his work in toxin purification methods and discovery of the unique way in which anthrax toxin operates to cause malfunction of cultured and host cells.

*The Medical Research Institute of Chemical Defense* saw *Dr. Tsung-Ming A. Shih* of its staff win the award for his basic research on the central neuropharmacological mechanisms of action of anticholincsterase nerve agents.

*COL Carl R. Alving* of the *Walter Reed Army Institute of Research* won the award for developing a novel approach to eliminating the problem of toxicity of antiparasitic drugs, thereby creating an effective treatment for the disease leishmaniasis, endemic in many foreign areas where U.S. military personnel may operate.

*The U.S. Army Research Institute for the Behavioral and Social Sciences:* A team award was given to *Drs. Newell K. Eaton* and *M.A. Fischl* for their contribution to the state-of-the-art of personnel evaluation techniques, producing a significant breakthrough in the level of validity in prediction of success, and for their achievements which resulted in the first application of assessment center techniques to non-management positions and the successful development of the Recruiter Development Center.

## *U.S. Army Corps of Engineers:*

Military RDT&E and civil works have earned the Corps of Engineers 12 R&D Achievement Awards (18 researchers) for projects at the *Construction Engineering Research Laboratory (CERL),* the *Cold Regions Research and Engineering Laboratory (CRREL),* the *Waterways Experiment Station (WES),* the *Engineer Topographic Laboratories (ETL),* and the *New Orleans District of the Corps of Engineers.*

*U.S. Army Construction Engineering Research Laboratory (CERL): Messrs. Joseph E. Matherly, Sharen E. Kloster,* and *Leslie J. Benson* were cited for their work in developing technologies and design criteria to improve Army vehicle maintenance and water pollution control at U.S. Army installations.

According to their citation, "these technologies will allow the Army to comply with water pollution control laws at minimum cost and effort."

*Dr. Paul D. Schomer* and *Dr. Richard Raspet* of CERL received an award for their work in developing the Integrated Noise Contour System and related Installation Compatible Use Zone program. These developments give the Army the capability to predict and assess the noise impact of training activities for cooperative efforts with local communities on noise problems and buffer zones for noise attenuation.

CERL metallurgist *Dr. Ashok Kumar* was selected to receive an R&D Award for inventing a ceramic anode that proved to be a major breakthrough in corrosion protection. A phenomenal reduction in anode size (100 to 400 times) was achieved by plasma spraying conducting ferrites on metallic niobium substrates. This size and weight reduction allowed installation costs of anodes to be cut in half.

Employed as an operations research analyst at CERL, *Dr. Gordon D. Bagby* designed and developed the Engineering Modeling Study, the first operational computer simulation model of combat engineer activities. The EMS quantitatively measures the contribution of combat engineers to battle outcomes. It can be used to simulate the effects of different command and control structures, engineer support relationships, and engineer equipment performance characteristics.

*U.S. Army Cold Regions Research and Engineering Laboratory (CRREL):* Three CRREL scientists, *Dr. Yoshisuke Nakano, Dr. Joseph L. Oliphant,* and *Mr. Allen R. Tice,* have been recognized for their research in the use of nuclear magnetic resonance techniques for investigating and confirming the theory of water transport mechanism.

Through a series of scientific experiments, the trio has proven conclusively that nuclear magnetic resonance techniques permit the accurate measurement of unfrozen water content in soils. This finding is of major significance because the strength and hydraulic conductivity of a frozen soil are dependent in part upon unfrozen water content, and accurate knowledge of water content in frozen soil is an important factor in engineering decision making in all phases of design, construction, and maintenance.

*Mr. Michael G. Ferrick,* a research hydrologist at CRREL was recognized for his leadership of a research team that successfully investigated and provided a basis for resolving a problem associated with development of frost on the fuel tanks of the space shuttle *Columbia.*

Through an experimental program, the team established that the foam insulation on the external tank of the space shuttle was not of uniform thickness as had been assumed, but rather was of irregular formation with peaks and valleys that played a very direct role in contributing to the icing problems on the shuttle tank.

The team's findings were of such quality and completeness that the Air Force was able to eliminate a series of full-scale environmental "witness tank" experiments that were originally thought to be the only completely verifiable method of determining the extent of the icing problems. Eliminating these tests saved the Air Force in excess of $500,000.

*Mr. David S. Deck,* a research hydraulic engineer at CRREL has been recognized for successfully resolving ice related problems which, since the mid-1800's, have resulted in ice jams and flooding at Oil City, PA.

Mr. Deck identified sub-surface frazil ice constriction at the confluence of the Allegheny River and the Oil Creek as the cause of the problem.

To solve the problem, he designed an original ice control structure. This structure has precluded the reccur-


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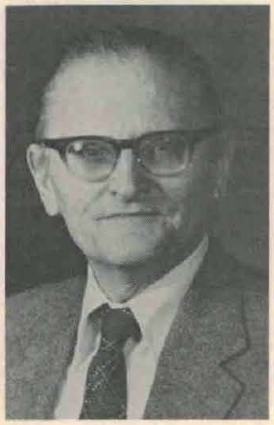
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## R&D Achievement Award Winners

**U.S. ARMY ELECTRONICS R&D COMMAND — (1) Raymond L. Robbiani. (2) John P. Schoening. (3) Joel H. Schulman. (4) Frank W. Wilson. (5) Dennis R. Cook. (6) Klaus H. Sann. (7) Joseph R. Miletta. (8) John R. Dent. (9) Herbert Wilson. (10) 1LT David H. Tofsted, Dr. Donald E. Snider. U.S. ARMY MISSILE COMMAND — (11) left to right: William J. Lyons, John H. Wright, Timothy P. Ricks, Donald W. Holder. (12) Back Row (l to r): James W. McKelvy, Robert L. Sitton, Donald E. Lovelace, Jimmy R. Duke, Walter E. Miller. Front Row (l to r): Anthony Blackmon, Michael M. Jones, Robert R. Mitchell, (13) Back Row (l to r): Jester M. Loomis, Thomas C. Pierce, Stanley E. Prevost, George T. O'Reilly. Front Row (l to r): Neal B. Lawrence, William G. Spaulding, Robert R. Boothe, Michael D. Fahey. U.S. ARMY MOBILITY EQUIPMENT R&D COMMAND — (14) Carl J. Heise.**


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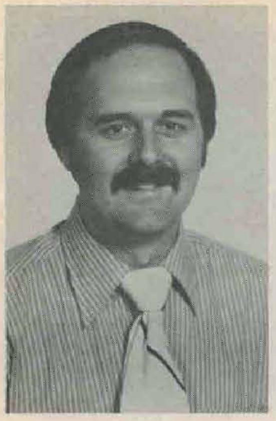
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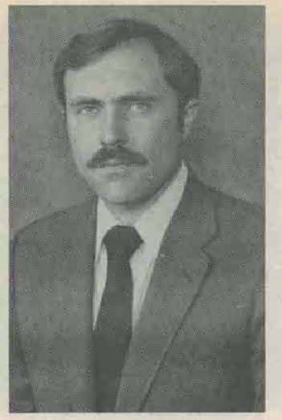
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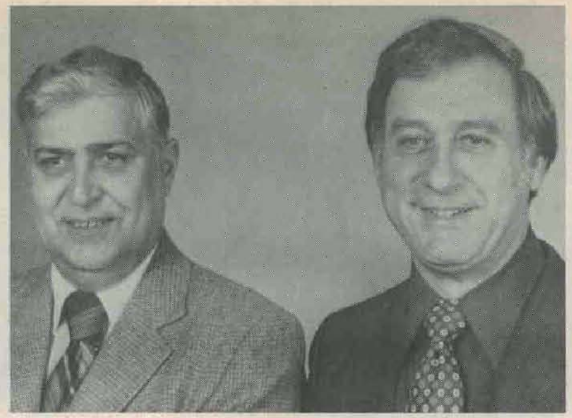
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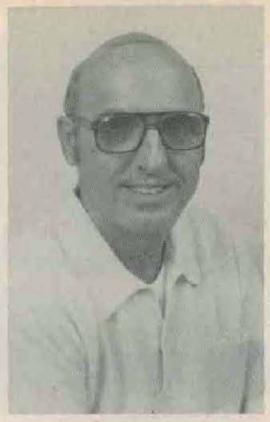
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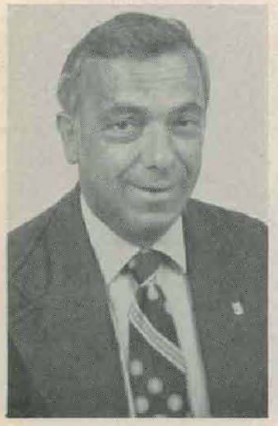
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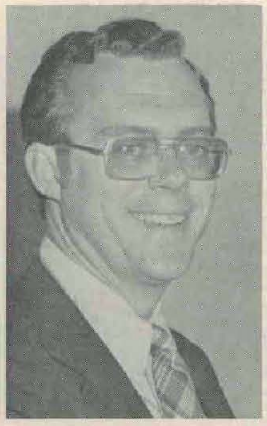
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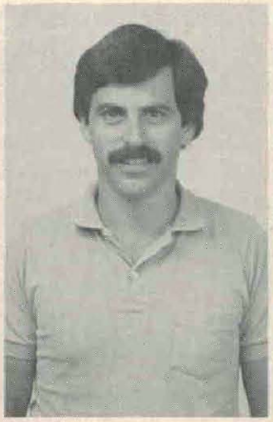
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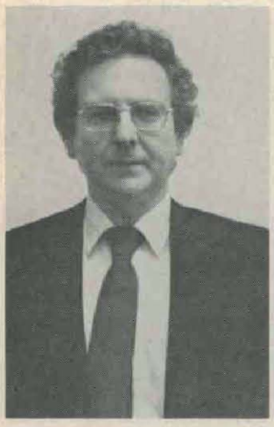
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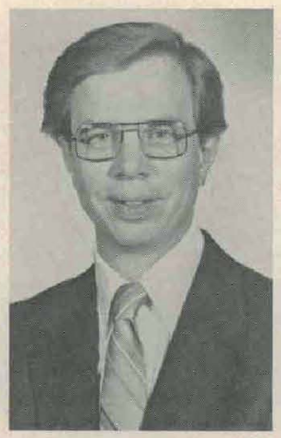
## R&D Achievement Award Winners

**U.S. ARMY MOBILITY EQUIPMENT R&D COMMAND — (1) Michael A. Mando. U.S. ARMY TEST AND EVALUATION COMMAND — (2) C. David Brown. U.S. ARMY NATICK R&D LABORATORIES — (3) Armando C. Delasanta, Gil M. Dias. U.S. ARMY MATERIALS AND MECHANICS RESEARCH CENTER — (4) Dr. Joseph J. Prifti. (5) Dino Papetti. (6) Dr. James W. McCauley. (7) Norman D. Corbin. (8) Theresa M. Resetar. (9) Philip Wong. U.S. ARMY RESEARCH OFFICE — (10) Dr. Bernard F. Spielvogel. U.S. ARMY MEDICAL R&D COMMAND — (11) COL Edward L. Buescher. (12) Peter B. Jahrling. (13) Stephen H. Leppla. (14) Dr. Tsung-Ming A. Shih. (15) COL Carl R. Alving.**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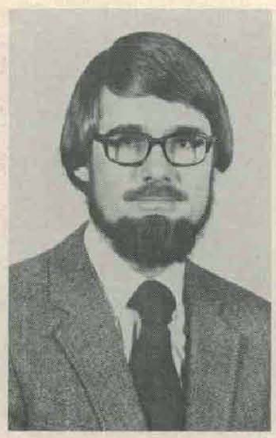
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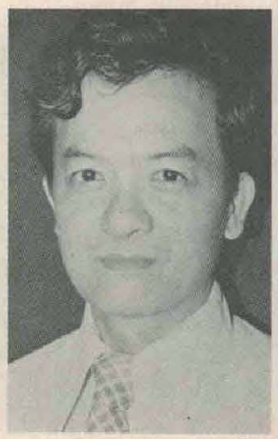
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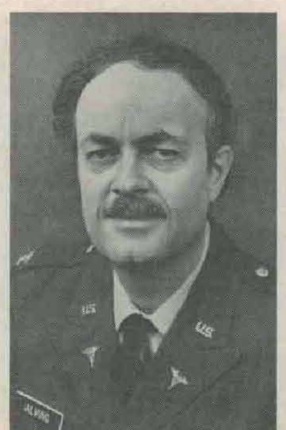
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## R&D Achievement Award Winners

**U.S. ARMY MEDICAL R&D COMMAND — (1) Dr. Newell K. Eaton, Dr. M.A. Fischl. U.S. ARMY CORPS OF ENGINEERS — (2) Joseph E. Matherly, Leslie J. Benson, Sharen E. Kloster. (3) Dr. Paul D. Schomer, Dr. Richard Raspet. (4) Dr. Ashok Kumar. (5) Dr. Gordon D. Bagby. (6) Dr. Joseph L. Oliphant, Dr. Yoshisuke Nakano, Allen R. Tice. (7) Michael G. Ferrick. (8) David S. Deck. (9) Dr. Charles R. Lee. (10) Dr. Bobby L. Folsom, Jr. (11) Dr. John W. Simmers. (12) Dr. George Y. Baladi. (13) Lawrence E. Wright. (14) Dennis C. Strecker.**

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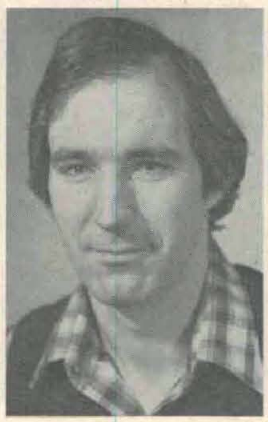

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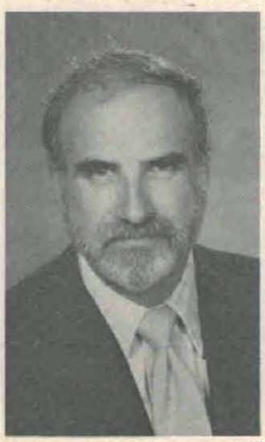

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rence of what had become an annual flood problem for Oil City, causing losses in excess of $5 million in 1982, and has the potential for application to similar locations elsewhere in the world.

*U.S. Army Engineer Waterways Experiment Station: Dr. Charles R. Lee, Dr. Bobby L. Folsom, Jr.,* and *Dr. John W. Simmers,* employees of WES, have been selected to receive Army R&D Achievement Awards for successful development and application of new principles and technologies for predicting contaminant mobility into plants from dredged material.

"The results constitute a significant advance in the state-of-the-art for evaluating the environmental impact of dredged material disposal in wetland and terrestrial environments. The results have widespread applicability to dredged material disposal problems in Corps Districts by providing a predictive technique for evaluating environment impacts of contaminant mobility."

*Dr. George Y. Baladi,* a research civil engineer in the Structures Laboratory at WES, received an award for his contribution to military vehicle mobility/agility programs. He developed sophisticated analytical models that predict the steering performance of tracked and wheeled vehicles in soils, and his efforts ensured the successful completion of an important U.S. Army vehicle technology program.

*U.S. Army Engineer Topographic Laboratories (ETL): Mr. Lawrence E. Wright,* computer specialist with the *Geographic Sciences Laboratory,* ETL, received the Army R&D Achievement Award for the development of the Digital Elevation Data Dubbing Facility, a computer-based system that converts topographic data into a format suitable for use on selected Army systems. It is reported that by using data provided by this system, selected Army radars will improve the speed of their target locating capability by an order of magnitude.

*New Orleans District of the Corps of Engineers: Mr. Dennis C. Strecker* was nominated on the basis of his development of a totally new and cost effective design for tainter gate hoists which can substantially reduce the cost of tainter gate dam structures and associated machinery.

His citation states that his design permits the machinery to be mounted totally within the piers, thereby eliminating the need to elevate gate piers and to cantilever the machinery supports so that the gate can clear the lifting machinery. In addition, the new hoist design eliminated all the expensive gear components of the conventional design, thereby reducing the machinery cost.

# Natick Labs Will Provide New Bomb Disposal Clothing System

Clothing experts in the Individual Protection Laboratory, U.S. Army Natick R&D Laboratories, Natick, MA, are designing an item for the military that will also be useful to civilians engaged in certain hazardous jobs.

A major subordinate command of the U.S. Army Materiel Development and Readiness Command, Natick Labs was recently tasked with providing Explosive Ordnance Disposal (EOD) personnel with a bomb disposal clothing system that would afford the user a maximum amount of protection against high velocity fragments caused by exploding bombs.

The job of EOD personnel is to deactivate and dispose of bombs and other dangerous munitions. Therefore, every bit of protection possible must be provided these individuals when approaching such lethal devices during "render safe/neutralizing" procedures.

Encasing EOD personnel in steel enclosures would provide the ultimate in protection. However, flexibility, mobility, and manual dexterity would be sacrificed. A more practical solution is to shield these soldiers in metal-like clothing that could retain all of these important characteristics. Natick also considers certain other features mandatory such as comfort, low weight, safety from an explosion caused by static electricity, magnetic charge or a spark. Finally, the Army has unusually high requirements for stopping bomb fragments associated with exploding ordnance and improvised explosive devices.

One of Natick's first steps was to investigate the ballistic protective characteristics of several commercially available EOD armor systems. Test data showed that these commercially manufactured systems fell far below the Army's critical needs. In general, bomb fragments of various weights and velocities easily penetrated the test systems. Also, the individual systems were extremely bulky which greatly impaired the movement of the wearers. Consequently, ballistic protection and gross mobility of the test systems were determined to be inadequate.

An advanced prototype bomb disposal system has recently been designed by the Natick Laboratories to satisfy the requirements established by the Department of the Army. Future testing of this protective ensemble will provide data needed to make any alterations and modifications to assure the Army's needs are met.

Natick's EOD system consists of a coat, trouser, helmet, bonnet and one-piece chest and face plate. These items have been designed as a complete system and, to be effective, the entire ensemble must be worn.

The coat is constructed of a fire-resistant Nomex fabric cover with a ballistic insert of 16 plies of Kevlar fabric. A quick-release mechanism is built into the left side of the garment to facilitate donning and removal while the front has a removable groin protector and two pockets — one to carry tools and one to contain the chest and face plate.

The trouser is made of the same fabric as the coat. However, the legs are designed with frontal protection only and incorporate a knee-action system and a scissor-type suspender with quick release adjustable buckles. The back of each leg consists of four Nomex fabric straps with Velcro fasteners. Spats are also provided as part of the trouser to provide the necessary protection to the feet.

The head is partially protected by the Army's new standard helmet, a resin-impregnated ballistic resistant Kevlar material headpiece. Augmenting the helmet is a bonnet made of fire resistant Nomex with 12 plies of Kevlar inserts for additional ballistic protection to the entire head.

Finally, the one-piece chest and face plate will complete the EOD system. The face shield, constructed of a thick transparent polycarbonate backed with acrylic material, is tailored to protect the entire face. The chest plate, made of a molded fiberglass fabric with polyester resin composite, is designed to conform to the contour of the body.

# Applications of Robotics & Artificial Intelligence to Armament

By Dr. K.C. Pan

## Technology Overview

Recent advances in robotics and artificial (or machine) intelligence have spurred efforts to apply these advances to a wide spectrum of industrial and military endeavors. This is the result of the explosive growth of computer technology during the last decade, much progress made in sensor research, signal processing and analyzing techniques, and in advanced control theory/algorithm developments.

The term robot can be loosely defined as a programmable, computer controlled manipulator. By using different end-effectors, it is multi-functional. Artificial intelligence (AI) is referred to as a device which can perform functions normally associated with human intelligence. These include recognition, understanding, learning, reasoning and decision making.

The subject of AI can be grouped into two basic categories, namely, numeric and non-numeric. The latter places emphasis on the use of computer logic and high level computer language capabilities (such as LISP) for analyzing problems, and drawing conclusions based upon certain given facts, statistical information, and probable cause (weak statistics).

Although the information needed may be large in volume, open ended, highly correlated and dynamic, it normally does not require much computation, but does require sophisticated logic operations.

Pattern recognition/image understanding and speech synthesis are the subjects centered around the numeric model based portion of artificial intelligence today. They require not only use of advanced computational methods involving group theory and mathematical statistics, but also interactive sensors and parallel processors for sensing numerous signals.

Programmable controllers have made significant inroads in space and deep sea exploration, material handling, manufacturing, and assembly equipment applications.

Distributed sensory command control computer subsystems have also received considerable attention from robotists seeking fertile research topics in remote system technology for robotic system developments. Most industrial robots to date work "blind," because sensory robotic systems are still mostly at the laboratory stage.

Internal sensors, such as force or torque sensors and shaft encoders, are essential from an operational, safety and basic motion control stand point. External sensors such as photoreceptors, chemoreceptors, tactile sensors, acoustic devices, and other types of proximity sensors will be used in the near future. These will enable a robot to "see," "smell," "touch," "hear," and sense what is going on in its operational environment, what to look for, and what should be avoided.

The quest for implementing smart sensors into a robotic system is desirable and necessary to achieve manipulative skills directly responsive to the environment.

Aside from these uses, many other applications appear possible. They include military information gathering, cartography, explosive handling, and space and deep sea exploration and servicing, to name a few. Extensive R&D efforts are underway to implement artificial intelligence into future robotic systems.

Since vision is the largest sensory input to the human brain, and the work scene has always been the most important feedback to the operator of a remote control system, the emphasis on robotic vision is no surprise. When the use of direct vision is limited, TV is usually employed.

Existing vision analysis systems are capable of analyzing scenes from aerial survey and ground level viewing. They are able to identify background information such as fields (vegetation or bare), wooded areas, linear features (road, rivers, and rail); and objects such as buildings, cars, airplanes, people, and shadows with a high level of confidence.

Although no work has been done, to the author's knowledge, to extend the vision analysis capability to a battlefield scene, a pattern class of weapon systems of various types, military aircraft, ammo supply vehicles, and other military equipment can be developed. However, whether a strong description can be achieved in real time is questionable, such as distinguishing between a T72 tank and an M1 tank at a distance.

Depth information is powerful and is essential to a vision analysis system for military applications. Images are two dimensional while objects are three dimensional.

Image invariants are weak while three dimensional invariants are strong and valuable for object description. However, depth can be inferred from sequences of images and through direct measurements. Many research efforts are now directed toward stereo viewing and image tracking capabilities.

Images can also be constructed by means other than direct vision (video), such as by using infrared, electro-magnetic receptors, and acoustic sensors. However, these non-visual imaging methods presently require a long period of time. If only a weak description of the object(s) identified is needed, such as a potential target, valuable information may still be derived and could be achieved in real time.

Speech understanding is another exciting area of AI research which is being actively pursued. Its applications are almost unlimited in terms of man-machine interface.

Undoubtedly, computer hardware and software will continue to play the leading role for the progress and maturity of these budding technologies. Advances in microcomputers and electro-mechanical devices have stimulated new research into flexible automation and intelligent/hierarchical control.

If much of the state of the art in robotics is "muscle" oriented, an equivalent effort by engineers/scientists in the coming decade will be on "intelligent machines." An intelligent machine, or an intelligent weapon, has not only the muscle necessary to do the work, but an "autonomous nervous system," and "brain." By sensing the environment and weighing these inputs against a programmed decision-making capability, it can make autonomous decisions and then take an action. This mode of operation will make future industrial equipment or military systems more flexible and responsive.

Current trends in the modernization of weaponry are leading armies to plan for the introduction of weapon systems which are capable of operating as autonomously as possible. The fundamental importance of the technologies reviewed can clearly be seen.

## Applications to Armament

Robotic automation may find military applications in a number of functional areas such as on-board ammo handling/loading, ammo resupply, weapon control, gun platform stabilization, and other areas that require manipulative skills. Depending upon specific application, various sensors may be included and a certain level of intelligence will be required.

Potential military benefits from artificial intelligence may be in the areas of real time target recognition and tracking, target priority assessment, tactical decision analysis and display, damage assessment, and operator prompting. All these represent new research efforts which are being actively pursued or will be undertaken by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM) in the quest for high technology applications to armament.

Aside from perceived new capabilities, a reduction of logistic burden and life cycle costs is expected. Trends toward use of common modules and hierarchical control (in which higher elements are used to command lower elements) for future robotic system developments are pronounced. A family of armament components and subsystems may be applicable to a large class of robotic weapon systems such as howitzers, tanks, and air defense gun systems. Furthermore, software packages could be standardized for easily updating.

Voice communication with an intelligent weapon is deemed feasible in view of the fact that many operational steps can be described by using short sentences or even words. Various armament robotics/AI concepts are being developed at AMCCOM both at the componentry/subsystem and at the system levels. All these could lead to a drastic change in future weapon system designs.

While AI presents interested armament communities with the opportunity bordering on science fiction, robotic automation enables us to move ahead from hard automation to flexible automation. Since there are so many ways to approach a design engineerng problem, divergent opinion exists with regard to why robotics should be used instead of other forms of hard automation.

One thing that is almost unanimously accepted and acknowledged is the interface flexibility and life cycle cost savings which result. This is illustrated in Figure 1. By using a 4-degree-of-freedom manipulator, (excluding the closing and opening motion of the griper), a projectile can be picked up and placed onto an ammunition receiving tray, from where the projectile can be rammed into the gun.

As illustrated in Figure 1, simple but useful mechanisms, such as the ammo receiving tray and loading mechanism, would definitely be fully utilized at various concept formulation stages. At AMCCOM our goal for high technology applications is to match technological advances with operational opportunities in terms of user needs.

An effective integration of the high technological components/subsystems could lead to the development of a highly automated, intelligent weapon system. To put the total system approach to a military solution in perspective, an intelligent weapon system is capable of making tactical decisions ranging from real time target information analysis and tracking to the determination of ammunition type and number of rounds to be fired. It will have self-monitoring and self-acting capabilities.

Man-machine interface will be in the form of "two-way intelligent communication" by using a language which makes it easy for man to "talk" to the weapon and is not hard for the latter to understand. The dialogue can be carried out without need of an operating crew on-board or nearby. Thus, an intelligent weapon can be operated remotely without degradation in performance.

In addition to the perceived technological characteristics and sophisticated performance capabilities, a number of high payoff opportunities exist which can hardly be done without these technological ingredients.

If an intelligent weapon is designated to be "unmanned," a number of design constraints, which normally severely limit the growth potential of conventional types, can be eliminated. The noticeable ones are riding comfort; shock load/overpressure limitations; toxic fumes; nuclear, biological and chemical considerations on board, and other design and human factors engineering considerations. If this is the case, it would definitely open up a new dimension for innovation. To cite one, high performance guns which may not be acceptable for physiological reasons could be deployed in an unmanned weapon system. By taking the man physically out of the weapon, new carrier design concepts can be exercised in terms of strategic mobility enhancement, weapon survivability, and fightability.

Probably the most attractive aspect associated with the deploy-

### APPLICATION OF ROBOTS IN AMMO HANDLING/LOADING

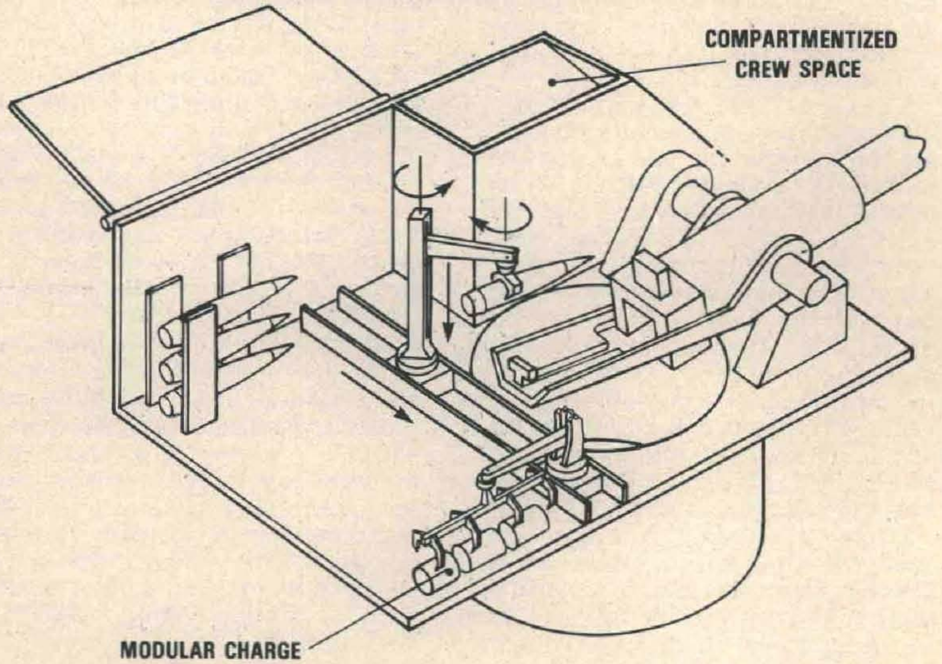


Figure 1.

AN UNMANNED HOWITZER CONCEPT

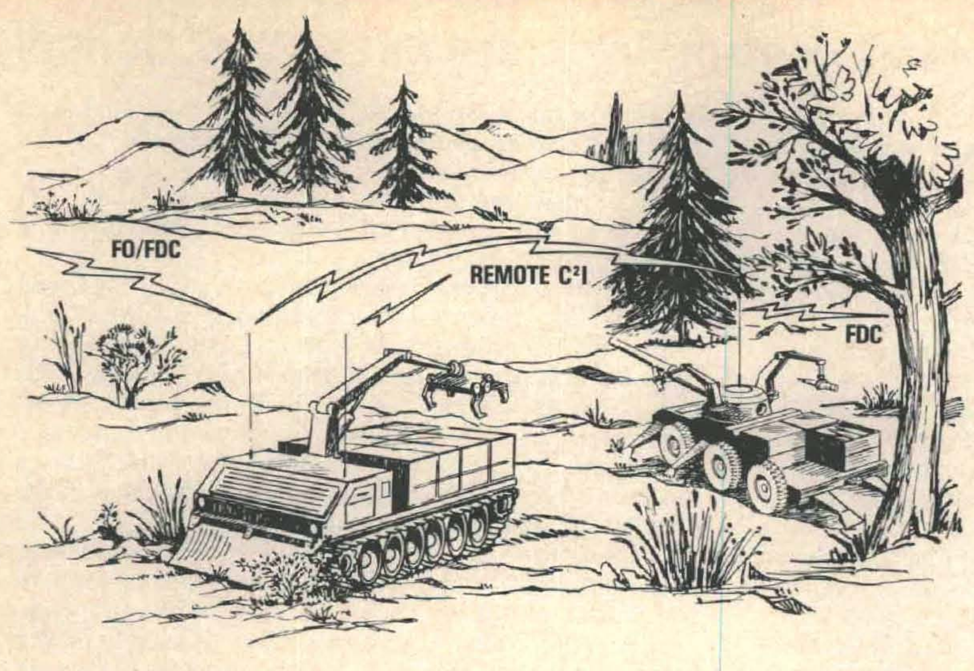


**Figure 2.**

ment of unmanned intelligent weapon systems is the potential improvement in crew survivability. Large caliber weapon systems have always been the obvious and primary targets to be engaged by threat forces as long as they function. Killing mechanisms concentrate primarily on neutralization of "fire power" and mobility. With the crew on board or operating nearby a large caliber weapon system, they automatically become a major part of the "point target" to be engaged.

If the target is said to be neutralized, chances are that there is a loss of human life. Intelligent weapons will change this. Since they can be placed or made self-maneuvering in one area, groups of operators located elsewhere can operate these weapons remotely. As for the enemies, they would have to concentrate either on neutralizing the intelligent weapons operating at close quarters, or disable the operators located in relatively secure areas. It is understood that all these concepts make sense if secure control can be achieved and if their performances are at least competitive with manned weapon systems of the same class. Building around the basic premises of the intelligent weapons, more sophisticated tactical options could be exercised.

An unmanned howitzer concept is shown in Figure 2. Through use of remote command/control/intelligence, the weapon can be fired by crews on board the control/ammo resupply vehicle shown. It can also be fired by the fire direction center. Target information can be sent directly from forward observers to the control vehicle where major decisions will be made. Target information and instructions will then be sent to the unmanned howitzer for carrying out ballistic computations and firing on the target.

## Future Needs

Potential benefits that could be derived from an intelligent robotic weapon system have been discussed so far on the basis of the state-of-the-art and projected advances. Although the technological building blocks required are within the state-of-the-art, the technology transfer is by no means simple. This is due primarily to the fundamental difference between industrial and military environments and requirments.

It has already been established that military applications of robotics require very different approaches. This is due to the need for low weight, operating at high speed, mounting on a moving platform rather than a stationary factory floor, and the harsh military environment.

Most of the robotic manipulative control schemes used by industries require firm, stable platforms. System weight to weight lifting capability is high (20 to 1). Because of the general inflexibility and nonportable structure of present robot software, as well as hardware systems, much R&D and implementation efforts are needed to make a robotic system become more transparent to the user.

Potential applications of vision analysis systems have been discussed. However, a severe limitation presently facing their use has been the inability to compute more complex visual descriptions in real time. Voice communication with a robotic weapon system is deemed feasible. Whether it can be effectively integrated into a field environment remains to be demonstrated.

As medium scale integration bipolar circuits are replaced by very large scale integration circuits, there is a concern about the radiation resistance of the products of n-channel metal oxide semiconductors.

Many tactical systems are required to meet certain gamma radiation, dose rate, and neutron flux rate levels. Much work needs to be done to test the radiation resistance characteristics as well as other environmental effects of many semiconductor memory devices and microprocessors.

The need for establishing a general framework for carrying the technology transfer and the interdisciplinary design and synthesis tasks has never been so demanding. Not only do all robotic/AI armament components and subsystems need to be stringently tested, but they need to be effectively integrated into a work system.

Integrating such a robotic/AI armament system will not be easy, since developers and users must be aware of and design around the other's needs. Consequently, the area must be approached from a system point of view where the system provides for close cooperation between developer and user.

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*Key Techniques Cited*

# Profitability/Resource Management Conferees Stress Cost Control

How can defense contractors best meet the challenge of producing affordable weapon systems while earning a fair profit, and how can the government improve its stewardship to the taxpayer through the application of innovative resource management approaches? These were the primary issues probed during a "Profitability and Resource Management" Conference, 7-8 June, at the U.S. Naval Post Graduate School, Monterey, CA.

Sponsored by the American Defense Preparedness Association, the meeting attracted more than 100 attendees. Specifically, the conference was designed to provide a forum for the review and critique of major techniques or "tools" for enhancing resource management and profitability — all impacted by the important subject of controlling costs.

Conference chairman Mr. L. Lee Allison, senior vice president, Finance and Administration, Sikorsky Aircraft Division, United Technologies Corp., opened the meeting with brief introductory remarks, stating at the outset that profitability and resource management are terms which really relate to "cost control."

He noted that cost control must become a prime objective, not just a cliché if costs are really going to be controlled, and that responsibilities for cost control must be specifically assigned and goals clearly defined. The purpose of the conference, said Allison, was to explore how some management tools could best be applied to reduce costs.

RADM J. J. Ekelund, superintendent of the Naval Post Graduate School welcomed the conferees to his installation. He then gave a comprehensive overview of various programs available at the school.

The first formal presentation, that of keynote speaker Mr. John D. Blanchard, was devoted to the meeting's objectives and scope. Blanchard, who is DARCOM's principle assistant deputy for Research, Development and Acquisition, stated that there can be no single award winner for "most conscientious" or "best manager." Cost control is a joint effort, he said, at which industry and government must work closely together.

Blanchard maintained that if the Army's combat readiness is going to be improved then defense programs must be carried out in a more timely, efficient, and economical manner. If this is not done, some programs will have to be cancelled to provide the additional resources required, he said.

The cornerstone for improved combat readiness, stressed Blanchard, is discipline — personal discipline, organizational discipline, and managerial discipline. Said he: "The number one priority must be cost control, and the tools of cost control must be set in place from the very beginning of a program."

Some specific "needs" the Army must fulfill in order to enhance the materiel acquisition process, explained Blanchard, are as follows:

• The Army needs to spend more time on the introduction of some new systems. "We spend too much time on some programs and too little on others," noted Blanchard.

• There is a need to get everyone involved in the requirements process; not the least of whom is the industry technical community that must be capable of fulfilling those requirements, as opposed to the marketing departments.

• There is a need to improve our stewardship for R&D resources, with more emphasis on areas which offer the greatest payoff.

• Relative to program documentation, the Army needs to spend less time detailing individual parts of a program, and more time thinking through and documenting the interfaces of the total program. That documentation should reflect policy issues, but above all it must reflect much closer attention to the implementation process.

• The Army needs to implement stronger discipline to upgrade both civilian and military career patterns in the acquisition business.

• Competition must be an integral part of the entire acquisition process, not a response to enthusiasms that are introduced intermittently in the life cycle of a program.

• Regulations and policies should not be used to hinder innovations; they are guide posts — aggressively seek waivers and deviations when good management of a specific program suggests that action.

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*"Cost control must become a prime objective, not just a chiché if costs are really going to be controlled, and responsibilities for cost control must be specifically assigned and goals clearly defined."*

*Mr. L. Lee Allison,*
*Sikorsky Aircraft Div.,*
*United Technologies Corp.*

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Blanchard closed his remarks by asking the conferees a number of questions. Among these were: Are you building some things in-house which might be more economically done at a specialty house? Would the expenditure of additional engineering resources during design be more productive than waiting until the design is set? Have you really defined the term profitability lately?

## Producibility

The first formal conference session, which was devoted to the general topic of producibility was chaired by Mr. Joseph E. Montalbano, executive vice president and chief operating officer of AAI Corp. The basic approach of this session was to show the need for an objective review of programs and end items prior to production to assure the producibility of the item.

Mr. Leonard J. Wroten, Copperhead program manager, Martin Marietta Aerospace, opened this session with a review of the Copperhead Program. Copperhead, he said, was one of the first design to unit production cost programs. This technique was in fact used as a design tool, he added. The Quality Circles concept — used so extensively in Japan, — has also been applied successfully to the Copperhead effort.

Wroten noted that the challenge of Copperhead was how to apply current missile technology in such a way so as to permit firing the missile out of a cannon. Most of the problems encountered by Copperhead were due to errors created up front, concluded Wroten.

Mr. James Pritchard, assistant project manager for Guided Projectiles Production, U.S. Army Armament R&D Center, Dover, NJ, followed Wroten with an Army view of the Copperhead Program. He traced Copperhead's transition into production and looked at some of the ensuing problems of the program, relative to "lessons learned."

Copperhead, said Pritchard, experienced problems transitioning into production, some as a result of Copperhead's status as a "new technology." In addition, producibility problems caused schedule slippages, cost overruns and low reliability during initial production.

Pritchard explained that Copperhead was one of the earliest systems to undergo a production readiness review, and as a result of this, some problems were identified and eliminated. However, he added that many problems were underestimated or not identified during the production readiness review.

Pritchard concluded that an earlier identification of producibility problems would have been valuable to the Copperhead Program, but at the present stage, Copperhead appears to have overcome many of its problems and the future of the program looks bright.

A discussion of "Quality Through Accountability" and its relationship to producibility was provided by Mr. Edward Elko, president, Aeroject Ordnance Co., Aerojet General Corp. He stressed at the outset that credibility by both government and industry is very important if a higher quality of product is to be produced. He added that higher quality does not have to cost more. Said he: "Higher quality results when people and their companies are made to be accountable for the quality of their products."

Higher quality, continued Elko, is a concept whose time has come, but it is a concept which must be initiated at the highest levels of management. He then cited examples of how quality emphasis played a key role in 30mm and 40mm ammunition programs. Elko stated that production costs for the 30mm round are as low as the quality is high. He summarized by stressing that higher quality and lower costs can be addressed through an accountability systems approach.

Mr. Richard Dewey, chief of the Producibility Engineering Branch, Physical Protection Division, Chemical R&D Center (CRDC), concluded the producibility session with an overview of producibility engineering efforts at CRDC. PEP, he said, has a very high priority at the laboratory.

Dewey explained that CRDC is so serious about producibility engineering that it has established separate producibility branches. He noted also that producibility and development objectives receive equal consideration. Some producibility objectives, he added, are simplicity of design, low unit cost, and short production/procurement lead times.

Typical applications of producibility engineering at CRDC, continued Dewey, include analyses of the design for manufacturing methods and technology requirements, value engineering, producibility evaluations of components, and risk analyses.

CRDC's experience with producibility engineering has led to some lessons learned, according to Dewey. For example, he stated that developers generally don't want to do producibility engineering and don't properly allocate resources for this purpose. Additionally, developers don't understand the importance of producibility, and that late submissions of engineering drawings limits producibility assessments.

In summary, Dewey emphasized that producibility engineering is vital to optimum resource utilization; that it should be included in the acquisition strategy; it must be started early with an integrated team approach; it must be demonstrated with proof of hardware; and that it requires top management support.

> ***"Relative to program documentation, the Army needs to spend less time detailing individual parts of a program, and more time thinking through and documenting the interfaces of the 'total program.'"***
>
> ***Mr. John D. Blanchard, DARCOM Principle Asst. Deputy for RD&A.***

Producibility session chairman Mr. Joseph E. Montalbano returned to the podium to summarize key conclusions of the producibility panel. Among these are that producibility must begin early; there must be a controlled production buildup; management must assure for accountability; and preproduction reviews play an important role.

Luncheon speaker Mr. Thomas O'Connor, group director, National Productivity Group, General Accounting Office, explained at the beginning of his presentation on "Defense Productivity Issues," that DOD productivity is a major concern of Congress and others because it is a major way of minimizing costs.

He indicated that his group has developed a long-range audit plan which applies to DOD productivity. Through this plan, he said, GAO, has tried to systematically direct efforts at improved productivity and look at long-range institutional changes resulting from the improvements.

The GAO also reviews programs where improved productivity has reportedly been achieved and evaluates whether real progress has been made. Two specific areas that the GAO are monitoring, according to O'Connor, are value engineering and manufacturing technology. End results of these programs are being examined rather than how they are being managed, he said.

When the GAO looks at productivity, it has recently seen both positive and negative factors, said O'Connor. The Carlucci Initiatives, for example, are very positive because they evidence DOD's concern. However, he cautioned that other efforts are only being treated as appendages to larger programs.

Basically, the GAO sees productivity as something that is viable in the DOD, but something that needs even more attention, said O'Connor. He added that in order to achieve improved productivity there needs to be greater support from top management and the results of various productivity efforts will have to undergo close scrutiny.

## Value Engineering

The second session of the conference probed the topic of value engineering as a technical discipline and management tool to reduce weapon system costs. Presented papers examined current VE policies, programs and applications in government and industry. Session chairman Mr. Carl Wilson, Day and Zimmerman Corp., set the tone for discussions by asking why so many DOD contractors have failed in their VE efforts.

Mr. Richard H. Pickering, plant manager, Defense Systems Division, Honeywell, Inc., began the VE session by providing a management perspective of value engineering. His firm, he said, believes that value engineering and cost reduction are inseparable.

Honeywell, according to Pickering, has been engaged in VE efforts for 20 years and VE cost proposal savings are divided about equal between industry and government at his company. Said he: "During the past seven years, Honeywell has received seven VE awards from the Army."

The benefits of value engineering are many and varied, said Pickering, adding that VE promotes conscious attitudes, increases profits, improves a company's competitive position, and it is a good sound management philosophy.

Pickering's recommendations for a successful VE effort are to establish an active management supported cost improvement program, train employees in VE principles, and understand contract VE incentive sharing provisions. The bottom line, said Pickering, is that the same effort must be expended on value engineering change proposals that is expended on any other proposal and customer needs must be clearly defined.

Value engineering and its relationship to productivity was the subject of a follow-on briefing by Mr. Dean Voegtlen of Hughes Aircraft Corp. Value engineering, he said, is designing products or services to enhance the ratio of value to cost. Traditionally, VE has been limited to cost, but it can also be applied to keep contracts current with available technology, according to Voegtlen.

The essentials of a good VE program require an environment of innovation and constructive change with accepted VE objectives and a recognition of VE as a major tool to achieve productivity objectives.

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>
> *Mr. Edward Elko,*
> *Aerojet Ordnance Co.,*
> *Aerojet General Corp.*

Concluding presentations of the value engineering session included a discussion of creativity, innovation and organizational effectiveness by Mr. William L. Kelly, president, Value Engineering Services, Transworld, and a review of value engineering efforts at DARCOM by Mr. Henry Mlodozeniec, manager of VE Programs, HQ DARCOM.

Kelly stressed the importance of innovation and creativity and said that any successful organization must have a positive philosophy, a system to maximize human resources, and a steady flow of ideas.

Mr. Mlodozeniec began his presentation by discussing DARCOM's VE policy and organizational structure and stating that value engineering can and does increase productivity while at the same time adding considerably to contractor profitability. Abundant proof of this can be found in the 600 plus contractor submitted value engineering change proposals applicable to designs, drawings, specifications, packaging requirements and numerous other areas which resulted in net savings to the government of $58 million in FY 1982.

Since contractors share up to 50 percent of net savings on value engineering change proposals submitted in accordance with the VE Incentive Clause, an approximately similar amount was earned by the contractor community, said Mlodozeniec.

Mlodozeniec emphasized that value engineering, to be successful, must be understood and supported by top level management. Such support is evidenced by the DARCOM in-house VE Program where major subordinate commands, PM Offices, arsenals and army depots totaled $371 million in VE savings during the past fiscal year.

He added that DARCOM recognizes in-house value engineering accomplishments through the presentation of a VE Certificate of Achievement and the VE Exceptional Service Award. Contractor VE efforts are cited with an Award for Outstanding Achievement in VE and a VE Certificate of Achievement.

Mlodozeniec closed his presentation by outlining what a well prepared contractor value engineering change proposal submission contains and encouraged the conferees to expand their participation in the DARCOM VE Program.

## Quality Circles

The third conference session, which was chaired by Mr. Robert Howie, chief, Systems and Value Engineering, Production Base Modernization, Picatinny Arsenal, examined the management tool of quality circles. The session began with a description of employee management participation through quality circles, by Dr. Bonnie Hunt, General Dynamics, Corp.

Dr. Hunt stated at the outset that her company has realized savings of about $4 million from the use of quality circles since 1980. Her firm now has about 145 quality circles at its facilities. She defined quality circles as an employee involvement process that embraces communications through voluntary problem solving groups which makes recommendations to management. The bottom line of quality circles, said Dr. Hunt, is that management and employees share responsibility for quality.

Some of the myths and misconceptions about quality circles, continued Hunt, are that management will lose control of its operations and that quality circles are really not intended for white collar employees, but only for blue collar workers.

CPT Billy Adams, U.S. Army Depot Systems Command, followed Dr. Hunt with a review of how DESCOM is approaching the quality circles concept. DESCOM, he said, is attempting to institutionalize quality circles, but that it requires continued management support, patience, commitment of resources, and a well developed planning strategy.

The final presentation was an address on quality circles applications at Boeing, by Mr. W. Michael Richardson of Boeing Aerospace. One of the goals of Boeing's quality circle program, said Richardson, is to show the importance of the individual worker. Boeing, he continued, encourages its managers to give recognition to their employees, not just in the form of awards. He stressed that what an individual thinks really counts at Boeing.

## Robotics

What technological innovations are being applied to enhance manufacturing engineering and cost reductions? Responses to this question were provided in a series of three presentations during the fourth conference session devoted to computer-aided design, computer-aided manufacturing, and robotics.

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*Mr. Henry Mlodozeniec,*
*VE Programs Manager, HQ, DARCOM*

Ms. Sherilyn G. Anderson, Ford Aerospace and Communications Corp., began this session with a review of her company's computer-aided manufacturing efforts. Said she: "Our objective in CAM is to automate certain functions of manufacturing engineering and quality control in the interest of saving money, reducing errors, maintaining product quality, improving consistency, reducing information cycle times, and ultimately trying to create a paperless manufacturing environment."

Mr. Charles Snead, Westinghouse Corp., followed Anderson with a description of group technology and its role in the planning and problem solving process. One interpretation of group technology is that it is the realization that many problems are similar and that if we group them together then a single solution to these problems might be developed.

Most group technology, said Snead, involves coding and classification and the application of the classifications. This classification system, if it is to be effective, must be flexible, standardized, accurate, and have a predictive capability.

The final CAD/CAM robotics session presentation was "Robotics for Flexible Electronic Assembly," by Mr. Robert Stewart, also with Westinghouse. In order to have a successful robotics operation, he explained, it is necessary to assemble items into groups or families, and quality engineering processes are needed. Additionally, unattended operations are needed and hardware and software commonality are desirable.

## Design to Cost

The concluding conference session — and the one which probably sparked the liveliest discussion, explored the management technique commonly referred to as design-to-cost. This is used basically to establish unit cost as a design parameter equal in importance to that of performance and fielding of weapons systems. Presentations during this session highlighted both positive and negative experiences with the design-to-cost approach.

Mr. Norman Whitaker, AVCO Systems Division, began this session by relating his firm's formula for a successful design-to-unit-cost program. First and foremost, he said, is an understanding between the customer and the company relative to what each requires. The objective, he added, is to get a cost effective product at or near the original estimate.

Whitaker indicated that a company's manufacturing costs are the result of material, labor and information generation overhead. Material costs normally consume about 50 to 75 percent of manufacturing costs, while the remainder is from labor and information generation costs. He concluded that the impact of design-to-cost is proportional to the size of the manufacturing program.

Mr. William McMillian, LTV Corp., followed Whitaker with what he termed one of the "real success stories" of design-to-cost — the Multiple Launch Rocket System. MLRS is on schedule and within cost estimates, he said. Reasons for this, he added, are that funding has been stable, the quantity of units has remained the same, and that MLRS subcontractors have been locked in from the beginning.

Some of the problems encountered with design-to-cost were examined by Mr. Robert Blackert of Motorola, Inc. His company experienced problems, he said, largely because of changing requirements and because of inadequate program planning. In summary, he said that design-to-cost, from his perspective, should be implemented on small rather than large programs and the design-to-cost considerations must include production quantities and rates, mechanization proposals, and processes and methods.

The final conference speaker, Mr. Gordon A. Frank, chief, Resource Management and Analysis Division, DOD Product Engineering Services Office, stated at the outset of his presentation that design-to-cost is an acquisition management technique, not an engineering technique, and that it must include early attention to cost, rigorous but realistic goals and a determined effort to achieve these goals.

Frank added that design-to-cost can be viewed as a timetable of costs driven by prices to win and maintain a market share. He explained some of the new DOD guidance relative to design-to-cost and concluded that both the contractor and the government will gain some real benefits from a good design-to-cost program.

Conference chairman Mr. L. Lee Allison closed the conference with praise for the high quality of presentations which contributed to what he termed a "most meaningful and valuable" meeting.

# The Low Vulnerability Ammunition Program

By CPT Sean Wise and CPT Harold C. Law

The Low Vulnerability Ammunition (LOVA) Program began almost 10 years ago with the goal of developing a gun propellant which was insensitive to many of the threats it faces inside an armored vehicle while at the same time being capable of delivering performance equivalent to the material it replaced. These two objectives would seem to be mutually exclusive, particularly considering the high energy propellants used in today's tank guns.

It is well established now that both these goals can be achieved and the program is nearly ready to bear fruit for the user. This article will explore the history of this new class of gun propellants and trace the technological developments that have brought us this far.

## Background and History

The Mid-East war of October 1973 demonstrated the very important role of ammunition stores in the combat loss of tanks; armor penetration followed by initiation of the stores was found to be the primary kill mechanism.

Surprisingly, the propelling charges were found to be much more sensitive than the high explosive warheads. The reasons for this are that the propelling charges are less protected, have a much greater presented area inside the vehicle, and are more easily initiated than the warheads. It was established then that there was a need for a propellant which could survive the principal threats faced by tank ammunition.

In December of that same year, the LOVA concept evolved at the Army Ballistic Research Laboratory (BRL) to respond to this pressing need. A good starting point for the search for propellants which could survive the antiarmor threats was provided by the technology developed by the Small Arms Systems Agency for the Small Arms Caseless Ammunition Program. These materials were known to be very insensitive and much less flammable than conventional nitrate ester propellants.

It was also believed that the technical problems encountered in the small arms application could be overcome in application to a large caliber cannon. By the following summer, sufficient quantities of a material containing 75 percent HMX and 25 percent polyurethane-crosslinked polyether binder had been made so that it could be evaluated in vulnerability tests.

This first material, dubbed LOVA-X1A, demonstrated the feasibility of the LOVA concept. Within a year, the material was fired in a 37mm gun which demonstrated that it could give acceptable interior ballistics and the LOVA Program began in earnest with the effort to scale up to the 105mm tank gun.

A cooperative effort was begun in 1976 with the Naval Ordnance Station at Indian Head, MD, and the Feltman Research Laboratories (now the Large Caliber Weapon Systems Laboratory) at Dover, NJ, to screen other nitramine/inert binder propellants for LOVA applications.

By late summer 1978, successful interior ballistics had been demonstrated in the 105mm tank gun for LOVA-X1A and a second propellant consisting of 80 percent RDX and 20 percent of an epoxy cured CTBN binder.

Shortly after the LOVA feasibility was demonstrated, the existing LOVA technology base was made available to the DOD/DOE Insensitive High Explosives and Propellants (IHEP) Study. The objective of this effort was to determine if combat effectiveness and survivability could be enhanced through use of a new generation of energetic materials with lower sensitivity to combat-related threats.

The primary study recommendation was to expedite LOVA propellant development and introduction into the tank cannon ammunition inventory. To implement this recommendation, a joint Army-Navy program was established as IHEP Task 1 in July 1979 and an accelerated propellant development program was undertaken. Dr. Joseph J. Rocchio, who had been spearheading the project until this time, was made task leader and he continues in this capacity today.

The success of this program led in February of 1981 to the beginning of an ARRCOM (now Army Armament, Munitions and Chemical Command) sponsored engineering study which involved the large scale production and testing of three LOVA propellants. Only one of the propellants still remains in the study at this time and it is currently undergoing validation testing.

A product improvement program is planned to incorporate this propellant into the 105mm family of ammunition pending successful completion of the last phase of testing. Additionally, in FY84, the Navy will begin ammunition development programs for LOVA propellant charges in the 5-inch/54-caliber and 76mm gun systems.

Since September of 1981, coordination of LOVA technology has been under the auspices of the Joint Technical Coordinating Group on Munitions Survivability (JTCG/MS). A key achievement of this program has been the effective intra- and interservice cooperation between research laboratories in pooling their expertise and resources to achieve a common goal.

## LOVA Technology

The IHEP study did much more than provide the impetus to develop a new class of propellants, it also proved to be the spark needed to catalyze a comprehensive investigation into the way the propellants worked. This investigation was needed to learn what would be the tradeoffs between performance, vulnerability, and cost so that the very best possible propellant could be made.

The magnitude of the task at hand was monumental. Consider that no one had ever extruded, in any quantities beyond laboratory scale, materials with solids loading levels approaching 80 percent. There were no set guidelines on how to measure the vulnerability of gun pro-

**Figure 1. Standard nitrate ester propellant.**

**Figure 2. LOVA propellant after spall impact.**

pellants and the detailed mechanism of why the materials in hand were insensitive was unknown.

In addition, there were many preconceived notions in the propulsion community as to why HMX and RDX should not be used in gun propellants. If the LOVA propellants were to ever become a reality, these obstacles had to be overcome. At least there was a material in hand that worked and it provided the departure point from which to explore the problem.

Since the LOVA-X1A consisted of HMX in an inert binder, a whole matrix of propellants was prepared in which the type of nitramine was varied (HMX or RDX) along with the type of polymeric binder holding it together.

As each of these materials was made, its production characteristics were evaluated to make sure it would be practical to scale up production of the materials in the quantities required for tank gun ammunition. These propellants were then subjected to a comprehensive test program to look at their performance and vulnerability.

The performance testing on each propellant began with closed bomb combustion, followed by interior ballistic computer simulation for grain design and finally interior ballistic testing in a 105mm, M68 tank gun. In this testing, erosiveness, muzzle blast and flash, and reproducibility of pressures and velocities were looked at for each propellant under cold, ambient, and hot conditions.

It was found that while the combustion properties of the LOVA propellants were not identical to the nitrate ester materials they are designed to replace (they tend to burn more slowly, particularly at ambient pressure), they were similar enough that the interior ballistic evaluation of these materials could be conducted in exactly the same manner as for a nitrate ester propellant.

In addition, the LOVA propellants proved to be much less erosive and their use did not significantly affect muzzle blast and flash. The LOVA propellants were found to give larger standard deviations in pressure and velocity data but this is not unusual for very small propellant batches such as those produced for this early study.

Performance at ambient and hot temperatures was found to be normal while at cold temperatures, relatively low pressures and velocities were encountered. Only standard igniters were used in this study and new igniters, optimized for the more difficult to ignite composite nitramine propellants, should alleviate this problem.

The vulnerability evaluation of candidate formulations involved subjecting the propellants to the threats they would face in combat such as direct impact from a shaped charge jet, impact from shaped charge jet generated spall, and impact from kinetic energy penetrator generated spall.

Laboratory tests were also conducted to model ignition processes so that these mechanisms could be better understood. The major focus of this effort was on the different types of spall ignition since this is the primary threat these propellants are designed to survive.

In the vulnerability studies conducted at BRL, it was shown that the primary mechanism of propellant initiation by spall is one of conductive thermal ignition. When metal armor is penetrated, numerous spall fragments are generated. These fragments are thermally heated by the shear forces from the penetration process and when they make contact with the propellant, ignition can occur.

The accompanying photographs illustrate the varying degrees of response of propellants subjected to a spall test. The cartridge case in Figure 1 contained a standard nitrate ester. Pressure generated inside this case by the burning of the propellant caused it to rupture.

Figure 2 shows what happens when one of the LOVA formulations is used. It did not ignite when hit by spall.

The understanding of the spall ignition mechanism is an important contribution to the vulnerability assessment methodology for propellants. It has greatly streamlined the testing procedures of new formulations. This streamlining has permitted the careful evaluation of the many parameters that might affect a propellant's vulnerability and helped focus on the most important ones.

As a result of this careful performance and vulnerability testing, some very important conclusions were formulated regarding what directions to take in the development of a fieldable propellant.

Initially, it was learned that RDX, which is less thermally stable than HMX but only one-fourth the cost, worked almost as well as HMX in the formulations. This has great implications on the ultimate cost of a LOVA propellant.

More importantly, it was established that the polymeric binders which hold the propellants together were the real key in designing a propellant with adequate energy and low vulnerability and that the proper choice of binder could more than compensate for the greater thermal sensitivity of RDX over HMX.

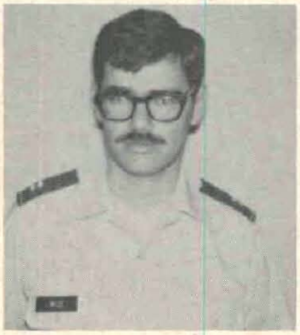
Further, the important binder properties as they related to propellant performance and vulnerability were established. This should allow the development of optimal binder systems so that improved propellants can be made.

## The Future

Currently, while the best material from the accelerated propellant development program is undergoing validation tests in the engineering study, work is continuing to improve the characteristics of LOVA propellants. These improvements will be the result of minor formulation changes, ignition system changes or even packaging. With these changes, the LOVA propellants will meet the challenge of significantly reduced vulnerability and equivalent performance to today's propellants.

It is realized however, with the emphasis on improved hit probability and better terminal performance, higher energy propellants will be needed which do not sacrifice survivability. To fill this need, High Energy Low Vulnerability Propellants are being developed which potentially will have as much energy as any propellant ever used in tank guns.

Since the time was taken from the start to learn about and try to understand the way in which LOVA propellants work, it is believed that this new challenge can be met and these propellants will stay abreast of future needs.



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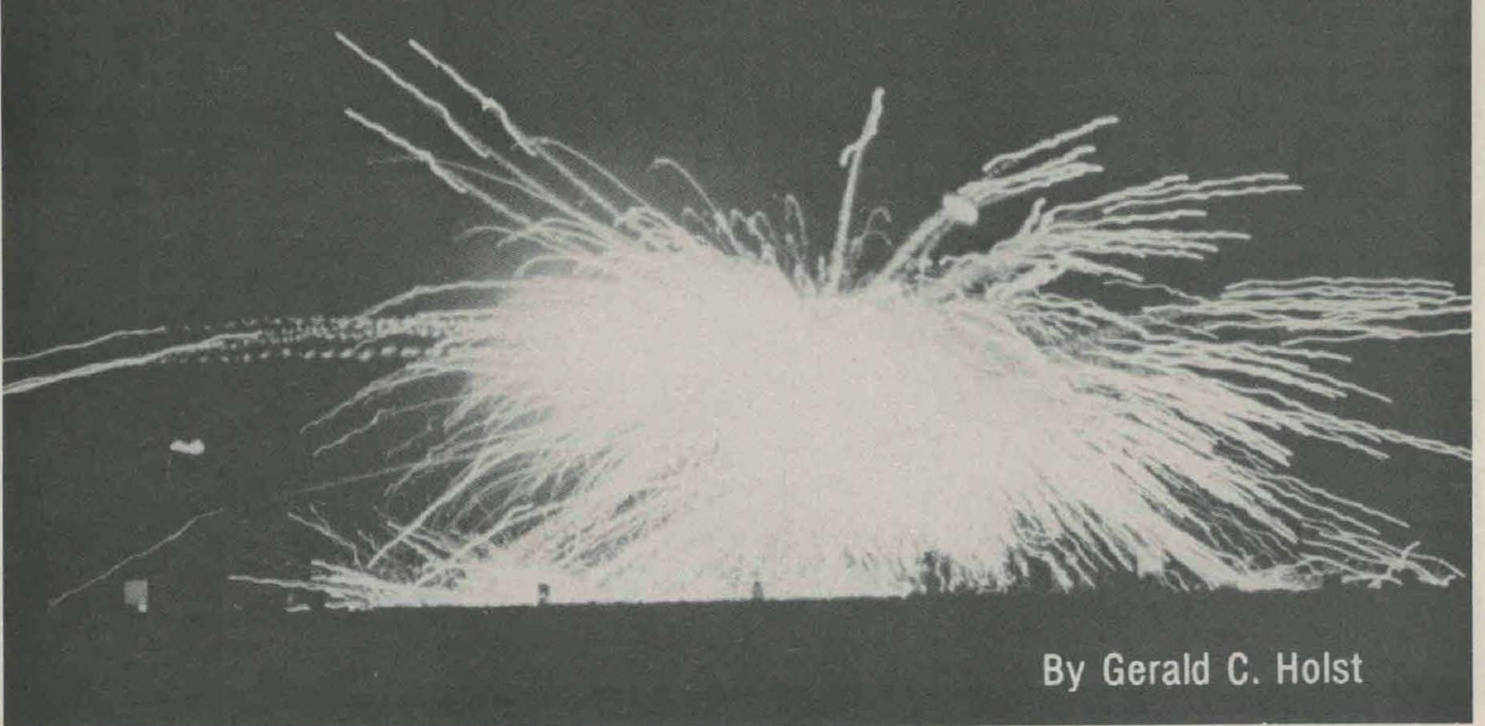
# NATO Smoke Trials in France and Norway



By Gerald C. Holst

*Project Group 16 Night Firing at Bourges, France, of a phosphorus base infrared screening smoke.*

Several years ago the NATO Conference of National Armament Directors instructed the NATO Army Armaments Group (NAAG) to study the antiarmor problem and recommend courses of action to correct known deficiencies. The NAAG created Project Group 16 to investigate anti-infrared smokes and their ability to screen armored vehicles.

Effective use of self-screening smokes can substantially increase the survivability of these vehicles on the modern battlefield. Highly efficient, rapidly deployed and well placed smokes can provide the desired protection.

According to the Project Group Terms of Reference, the anti-infrared smoke should "defeat surveillance, sighting and guidance devices in the optical and infrared portions of the electromagnetic spectrum".

In November 1981, Belgium, France, The Federal Republic of Germany, the Netherlands, Norway and the United States signed a Memorandum of Understanding (MOU) to evaluate various anti-infrared screening smokes. The resulting demonstrative field trials emphasized self-screening systems for armored vehicles.

The NATO Staff Target compiled by the Project Group furnished the desired operating characteristics of the smoke systems. These systems must be able to defeat enemy passive optical responses operating in the visible through far infrared wavelength region during both day and night.

The NATO Staff Target criteria are similar to the desired operating characteristics of the U.S. infrared screening grenade XM76 as specified in the Requirements Document MN (ED) XM1 tank.

The main body of Project Group 16 created the Trials Panel in December 1980. The Trials Panel planned, organized, and directed the field trials. In less than two years, the Trials Panel was able to rectify the field test philosophies of the participating six nations and overcome language difficulties and other communication barriers.

The test philosophy was based on the need to conduct a large number of trials in a relatively short period of time. National positions however, prevented the use of standard field methods to obtain the characteristics of the test obscurants. Hence, a field methodology procedure using relatively new techniques and instrumentation was set up.

The trials were designed to simulate realistic battlefield operational conditions commensurate with the acquisition of meaningful data; minimize any variational effect due to major meteorological parameters; and obtain quantitative and subjective data.

The quantitative data produced information from which future smokes can be referenced; the effectiveness of smoke for other applications (e.g., mortar and artillery) can be estimated; and the effectiveness of the smoke in defeating future electro-optical systems can be evaluated.

Two field trials were held. Summer tests were held September 6-24, 1982, at the Etablissmeent Technique de Bourges in Bourges, France and the winter ones were held January 31-February 11, 1983 at the Raufoss Ammunisjonsfabrikker in Raufoss, Norway.

As a NATO cooperative effort, the most advanced state-of-the-art smoke measuring equipment and thermal imaging systems from the participating nations were used and technical expertise was willingly shared.

Several DARCOM agencies participated in the field trials. The Chemical R&D Center (CRDC) (formerly the Chemical Systems Laboratory) chaired the Trials Panel, supplied the summer and winter test plans and provided overall test management. CRDC also

**PROJECT GROUP 16 MILESTONES**

| | |
|---|---|
| June 78 | First Project Group Meeting |
| Sept 79 | NATO Staff Target Accepted |
| Dec 80 | First Trials Panel Meeting |
| Nov 81 | Memorandum of Understanding signed |
| July 82 | NATO Council Approval and Support |
| Sept 82 | Summer Field Trials, Bourges, France |
| Feb 83 | Winter Field Trials, Raufoss, Norway |
| Aug 84 | Memorandum of Understanding expires |

provided overall data analysis methodology and the unique format final report.

Dugway Proving Ground, another participant, obtained micrometeorological data at the test site and measured the smoke transmission along various lines of sight. Additionally, the Army Night Vision and Electro-Optics Laboratory obtained thermal imagery in both the mid-infrared and far-infrared bands. The Atmospheric Sciences Laboratory mapped the cloud size as a function of time and wavelength.

For the winter trials, the Corps of Engineers Cold Regions Research and Engineering Laboratory characterized both ground snow and falling snow. Project Manager Smoke/Obscurants provided the overall administrative function of coordinating the activities of the various U.S. agencies.

In addition to the eight candidate smokes tested, the British-manufactured L8A3 red phosphorus grenade was used as a reference. The U.S. candidate, the XM76 grenade, designed and developed at the CRDC provides excellent screening at the infrared wavelengths. To improve obscuration in the visible, the second U.S. candidate system combined the XM76 with L8A3 grenades.

Since the various candidate smoke systems had different launching systems, it was necessary to mount each launcher on an I-beam gantry to facilitate loading and safety requirements.

The target was the French manufactured AMX-10 Armored Personnel Carrier for the summer trials and a modified U.S. manufactured M113 Armored Personnel Carrier, for the winter trials. The vehicles were radiometrically characterized just prior to moving to the gantry area.

After firing a smoke system, the target vehicle would return to the characterization area for recalibration and then move to a new gantry location. If wind direction and wind speed met previously established criteria, a smoke system could be fired approximately every 10 minutes.

This schedule permitted each candidate to be tested 14 times during the summer and 11 times during the winter trials. This large number of firings under nearly identical meteorological conditions (summer or winter) allowed statistical evaluation of the data.

A system called PRESTO (Personnel Response and Evaluation System for Target Obscuration) was used to record and to summarize responses of those who observed the target in the visible and infrared thermal imaging regions. From these responses statistical prediction of obscurant effectiveness was obtained.

The statistics associated with such concepts as probability of detection, average obscuration time, and probability of having a clear view (or hole) in the cloud have given new insight to screening effectiveness. Accordingly, terms such as smoke "half life" may become important parameters in the future when describing smoke effectiveness.

As with many scientific field tests, extensive data were collected yet only portions are of interest to the scientific communities. The smoke trials proved to be no exception. To address the specific needs of the research, development and acquisition communities as well as the combat user, the final report was compiled for each specific user and his special requirements. The final report format was conceived by scientists, engineers, munition developers and combat users.

The final report consists of eight volumes: They are executive summary; combat user data matrix; countermeasures and electro-optical system developer data matrix; smoke/obscurant developers data matrix; smoke munition developer data matrix; test data and data analysis methodology; description of site and equipment; and conclusions and recommendations.

Each volume contains distinct information to satisfy a particular need. For example, Volume II would serve the needs of the combat user.

There was no "winner-take-all" aspect of the trials. Rather, the participants recognized early that national requirements vary. Individual nations can therefore rank the smokes in order to make decisions concerning future development, production or purchase. The final report contains the data necessary to execute such a ranking. Each nation only has to add a weighting factor to each data entry according to priority.

Additionally, Project Group 16 has recommended to NATO that standard formats for all areas of field testing should be considered. Thus far, NATO Panel XII on meteorology, chaired by the Atmospheric Sciences Laboratory, has included portions of the Project Group 16 Test Plan in its "NATO Smoke Munitions Expenditure/CB Defense Meteorological Test Plan."

The group is also recommending standard formats for all laboratory and field data. It is anticipated that the final report format will be used by others.

The group also demonstrated that approximately 50 percent of the field data collected can be analyzed and distributed within 24 hours of each daily test. This conclusion is extremely important to the R&D community where the results of a field test can determine if modifications are required.

The equipment used during the field trials was a collection of state-of-the-art technologies from smoke characterization to thermal imagery. Because no one nation can afford to amass the instrumentation that was used, only a cooperative effort like Project Group 16 can develop this type of testing.

Data analysis was also a cooperative effort drawing upon the technical expertise of each nation. Such cooperation insured that every conceivable method of analysis was considered and only the best selected.

In summary, the NATO Army Armament Group Project Group 16 summer and winter trials were an unqualified success. They offered a clear picture of the current technology of these obscurants and standards against which to judge future developments. It is likely that sufficient information has been generated to permit improvements to the candidate obscurants to meet, as closely as possible, the NATO Staff Target.

In particular, the trials demonstrated that smokes can increase armored vehicle survivability.

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# Geographical Information Systems for Training Land Evaluation

By William D. Goran and Robert E. Riggins

It is becoming increasingly important for the Army to make the best use of available training lands. As training units have become more mechanized and the range of weapons has increased, the land required to conduct training exercises also has increased. However, the total land available for firing ranges and maneuvers has, at most installations, remained unchanged.

In recent years, identification of environmental constraints, such as endangered species habitats and historic and prehistoric sites, has further reduced the total lands available for training use. As a result, the intensity of use of available range and maneuver lands has steadily increased.

The U.S. Army Construction Engineering Research Laboratory (CERL), Champaign, IL, has developed Geographic Information Systems (GIS) to help solve problems related to training on limited lands — scheduling, multiple-use planning, site placement, impact assessment, analysis of access problems and cross-country mobility assessments.

## What is a GIS?

A GIS is designed for organizing, managing, manipulating and displaying geographic information. Virtually any form of data that relate to the landscape can be included. For example, a GIS developed by CERL for Fort Hood, TX, includes information for major landscape features, such as soils, watersheds, elevation, slope steepness, streams, vegetation, land cover, and wildlife habitat areas. In addition, many cultural and management features are also included, such as roads, airfields and airstrips, pipelines, political boundaries, training areas, ranges, historic and prehistoric sites, bridges, towers, cemeteries, and zones of noise levels. Data were obtained from satellites, soil survey maps, special installation reports and from other Army sources.

The Fort Hood system provides a number of options for users to combine and manipulate data items. Information taken from tables and maps can be displayed on video screens (in color or black and white)

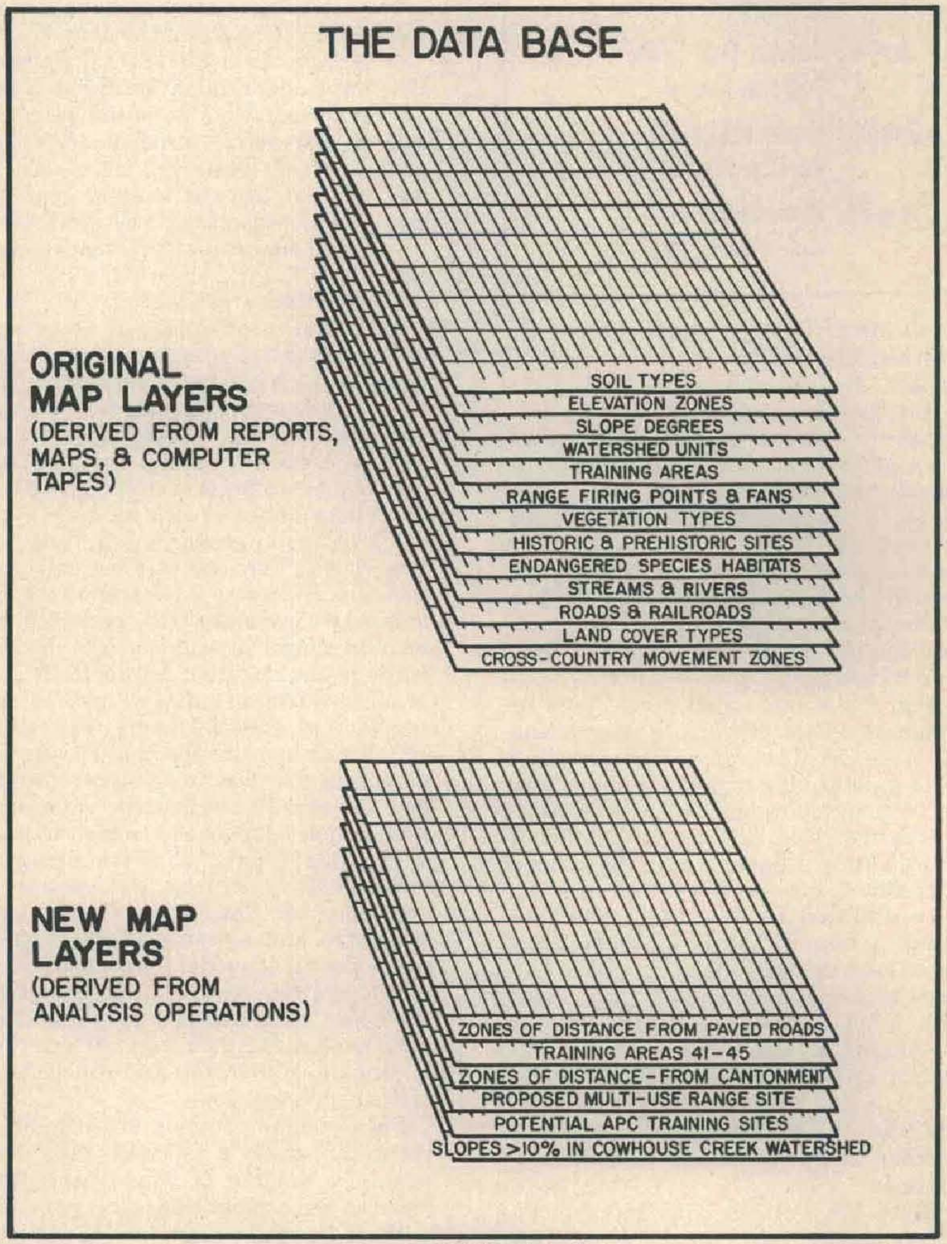


FIGURE 1

*Figure 1 illustrates a set of gridded map layers that comprise an original data base, and a set of new map layers. These new layers can be created by performing analysis operations on the original data, or by entering new data items. While the original layers comprise the permanent data base, the user can save or discard the layers created during usage sessions.*

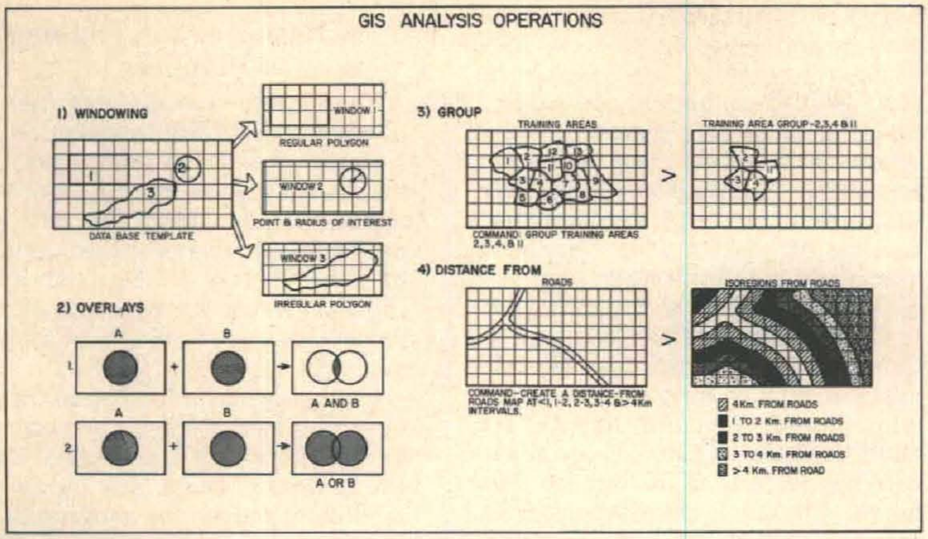


*Figure 2 shows how individual map layers can be used to generate information.*

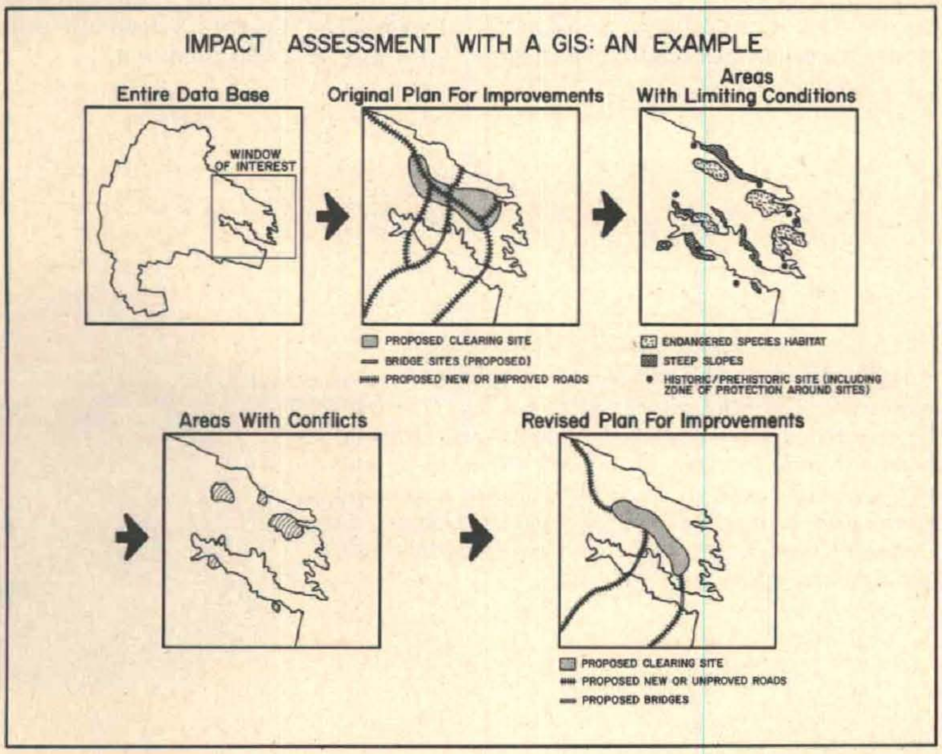


*Figure 3 shows the sequence of map layers used to perform an impact assessment.*

or on paper. Similar systems currently are being developed for other installations.

Information is stored in map layers. Each map layer is divided into grid cells, and each grid cell is assigned a class value. For each data type, such as soils or elevation or slope steepness, there is a separate map layer that is divided into several classes, such as soil types, zones of elevation and degrees of slope steepness.

All map layers have associated tables that provide statistics on the number and percent of cells (land area) in each class, and background information about the data sources and class divisions.

Figure 1 illustrates a set of gridded map layers that comprise an original data base, and a set of new map layers. These new layers can be created by performing analysis operations on the original data, or by entering new data items. While the original layers comprise the permanent data base, the user can save or discard the layers created during usage sessions.

## How Does a GIS Work?

A video display terminal is a key component of the system. Procedures include identification of an area of interest, selection of map layers and classes of interest, analysis and manipulation of the data layers, and display of the resulting map layers and tables.

Generally, each analysis results in the creation of a new map layer, as well as a set of associated tables. Some analyses, however, generate only tables that compare or describe information on existing map layers.

Figure 2 illustrates several of the operations available in a GIS system. These include the following:

• Windowing. Often, GIS users will want to perform an analysis on a specific area within the data base, rather than the entire region. Windowing tools allow the user to define this area of interest, either as a new map layer which "masks" this area, or as a "window" through which to examine the area in existing map layers. Figure 2, section 1, illustrates some windowing functions.

• Overlays. With overlay tools, users combine two map layers to create a new map layer. These new map layers then can be recombined as often as desired. Figure 2, section

2, illustrates some of these overlay combinations.

• Group. The group function allows users to identify classes of interest from an original map layer, to create a new map layer consisting only of the identified classes. This group function can be used to describe an area of interest from an existing map layer, as illustrated in Figure 2, section 3.

• Distance-from. For many analyses, users may wish to define areas within a certain distance zone from some item in the data. For example, it may be desirable to have a new range within a 250-meter zone from an existing improved road. With the distance-from tool, users identify an item of interest in a particular map layer, and specify zones of interest, such as 500 meters, 1 kilometer, 2 kilometers, etc. Figure 2, section 4, illustrates use of this function.

## Use of the GIS for Site Selection

A GIS can be used to locate candidate areas for a particular training event or site placement. For example, an installation needs a new site for an armored personnel carrier training course. The site should be within 8 kilometers of the cantonment area, within 500 meters of an existing trail, and be at least 200 hectares in size.

Other desirable landscape features include 10 to 50 percent forest cover, slopes less than 10 percent steepness and the absence of environmental constraints such as endangered species habitats or prehistoric sites.

The first step in the search for potential sites is to run a distance-from analysis that creates a new map layer identifying all areas within 8 kilometers from the cantonment. This map layer defines the area of interest. The next operation is to perform another distance-from analysis, locating all areas within 500 meters of existing trails within the area of interest. This operation again creates a new map layer.

Next, the map layers forest cover, slope steepness, endangered species habitat, and historic and prehistoric sites are called up from the data base and the group function is used to create map layers with only the classes of interest. Overlay operations then are performed with these maps and the two new distance-from maps.

The result of these map overlays is a new map layer, on which all sites that meet the qualifying requirements are identified. An analysis can then be performed on this new map, to determine which, if any, potential sites meet the minimum size requirement. This map is sent to a video screen or a printer. (All of the intermediate map layers also can be displayed.) In addition, several tables of statistical data are associated with each map layer, and each of these also can be displayed.

The final site selection will still require field inspection, but the GIS system quickly identifies potential sites, based upon user inputs. An analysis, such as the one described, can be performed in one to two hours. (Creating the distance-from map layers is the longest operation, other operations require only a few moments.)

If, after a search, no potential sites are identified, the user easily can eliminate the least important requirement and generate a new map layer. On the other hand, if numerous areas still qualify, the user can perform one more overlay operation and create another map layer with fewer but more selective qualifying sites.

## A Resource for Training Planners

There are numerous potential applications for GIS to enhance the training use of the landscape. One potential usage is for impact assessment. At Fort Hood, the GIS was used to evaluate a proposed upgrade of a relatively underused area. Figure 3 shows the sequence of map layers that were used to perform this analysis.

One of the major limitations of any information system is the accuracy and resolution of the original data. Fortunately, there are numerous reliable resources for geographic information on major military installations. However, these data are often scattered at various offices on-post and among various agencies. It is only when all of the data are brought together in a uniform structure and can be examined at a uniform scale, as with a GIS, that it is all accessible for analysis and planning.

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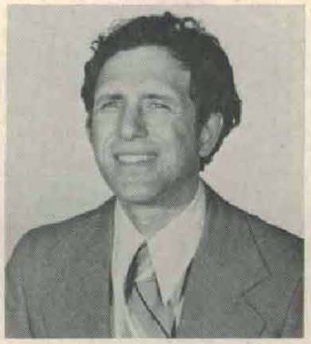
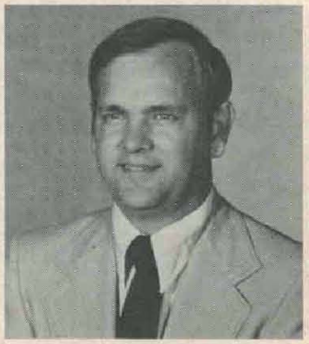




*ROBERT E. RIGGINS is the program manager for the Environmental Division of the U.S. Army Construction Engineering Research Laboratory. He holds bachelor's and master's degrees in photogrammetric engineering from the University of Illinois in Urbana-Champaign. His memberships include the Society of American Military Engineers.*

# The Changing Face of Tactical Trucks

By Roger Gay

One of the major problem areas encountered in the development of any new system, large or small, is the selection and concurrent fielding of the necessary support equipment — particularly vehicles. Methods of interfacing the tactical wheeled vehicle fleet of the Army with various weapons systems, in particular the electronic sytems, are of primary concern to both developers and users.

The Tactical Wheeled Vehicle Management Office, a DARCOM chartered office located at the U.S. Army Tank-Automotive Command, Warren, MI, was formed in mid-1979 to provide a coordinated planning effort devoted to the tactical wheeled vehicle fleet. This office, along with a parallel Training and Doctrine Command (TRADOC) office located at Fort Lee, VA, provides overall fleet coordination. All phases of the life cycle are addressed, from the science and technology base through the disposal phase. . . or, as frequently referred to — womb to tomb.

In addition to any vehicles required to transport the system, all vehicles needed for maintenance, equipment, spare parts, etc., must also be considered. If a new TOE is involved, the common equipment required for command and control and troop support must also be addressed to assure fielding of a complete, operational unit.

The classical system development procedure assumes that the user representative, normally TRADOC, identifies a requirement which is then forwarded to the developer (DARCOM) for development and acquisition. In the area of support equipment such as vehicles, however, the major development commands, project managers, and other services also become "users" in that they identify unique requirements which must be responded to by TACOM as the vehicle development agency for the Department of Defense.

This article will concentrate on the area of technical support to system developers. However, before getting into this area, let's briefly review the current vehicle fleet. The magnitude and complexity of this fleet are frequently not appreciated. Note that tactical trucks are in essentially every organization of the Army and that approximately 10,000 different missions are being performed by the vehicles in the fleet.

The Army's tactical vehicle fleet is the largest single vehicle fleet in the free world. For illustration, the U.S. Post Office Department, which is usually quoted as having one of the largest fleets, contains only 120,000 vehicles compared to the Army's 369,000.

Fleet management acitivities are also much more extensive than those of most other fleets. For example, complete logistics support is maintained. Spare parts, training, manuals, and all associated support are provided entirely within the Army structure. This makes it possible to redeploy the fleet to any area of the world and still have its logistics support.

This approach is unique. Our NATO allies, for instance, generally return their vehicles to the manufacturer or his representative for higher level maintenance, particularly at the General Support (GS) level. Also, the manufacturer usually provides the equivalent of our depot spare parts stockage in one form or another.

In order to provide maximum commonality and interchangeability of parts and streamline the logistics burden, the fleet is configured with a minimal number of basic vehicle types. This is where TACOM's Tactical Wheeled Vehicle Management Office becomes important. It acts as the single point of contact for identifying vehicle capabilities and interfacing with users until a single vehicle system can be identified. Here, the primary contact is with the system manager for the vehicle.

While in concept formulation, the system's payload, weight, cube, ground mobility requirements, and overall time frame for the development and fielding are identified. During this phase, the Tactical Wheeled Vehicle Management Office acts as the single point of contact to provide data on the weapons systems needs.

Currently, every major truck class is in some stage of transition from the old type to a new vehicle configuration. As of today, only the new truck tractors, the M915, M916, M920 and the M911, have been fielded. The main truck fleet will be entirely changed in this decade. However, this transition will take place through attrition rather than wholesale replacement of the existing assets. This means, of course, that existing vehicles will have to operate along with the new vehicles through the rest of this century in some of the vehicle fleets.

A brief description of the major new vehicles which will be introduced in the near future follows. First, the High Mobility Multipurpose Wheeled Vehicle (HMMWV), being built by AM General, will provide forward-area command control, communication, cargo transport, weapon carrier, and ambulance capability. Thus it is a primary candidate for high-mobility electronics transport requirements within its payload capability. One version of this vehicle will be able to transport an S-250 Electronics Shelter which has a gross weight of 3,600 pounds.

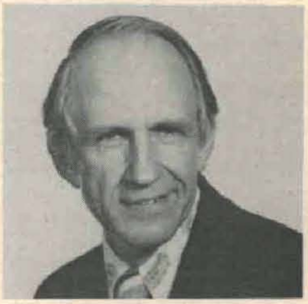
A companion vehicle, the Commercial Utility Cargo Vehicle (CUCV), is being built by General Motors Corp. It provides the same payload capability as the HMMWV but with tactical standard mobility the primary consideration instead of high mobility. It is the primary candidate for rear-area applications which do not demand the mobility or special military features of the HMMWV.

The replacement for the current 2½-ton truck is to be the new Medium Tactical Truck (MTT). Currently, this development program has not progressed sufficiently to present a photograph of even the prototypes. However, current plans are to initiate production sometime between 1985 and 1987. Unfortunately, during the interim, 2½-ton trucks are not being procured.

For those payloads which exceed the capabilities of either the 2½-ton or the new MTT, the 5-ton series trucks provide an increased payload capability. The new, product-improved M939-series model is just now being fielded.

In the 8-10 ton weight class, are the high mobility M520 Goer series vehicles. There are three body styles in use — the cargo truck, wrecker, and fuel tanker. And while the application for electronics transport is limited, the Heavy Expanded Mobility Tactical Truck (HEMTT), being built by Oskosh, will provide the capability for those missions requiring payloads up to 11 tons.

In conclusion, TACOM is ready, willing, and able to support system developments with the proper automotive equipment. However, early coordination is required to identify the correct equipment and to assure its availability at the proper time for system development and fielding.



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# Adding Color Graphics To Telephone Conferences

**By Dr. Neil S. Dumas**

The Army Research Institute for the Behavioral and Social Sciences (ARI) has just developed an entirely new system of computer-enhanced telephone conferencing. This new system, called Voice Integrated Presentations (VIP), lets you send or receive color graphics during ordinary telephone conversation. Thus, VIP provides dial-up audiographic communication.

ARI's development takes color graphics, which you make on your office "tube" with ARI's Army Graphics Program, and converts them to sound for transmission on regular phone lines. During routine use for a long-distance briefing, the speaker can make any graphic appear on all receiving screens simultaneously with only an 8-second delay in speech — almost as fast as the Carousel Projector. Although you have to stop talking during picture transmission, your micro-computer controls the speaker phone, turning it on and off at appropriate times.

The Army objective behind VIP development is to "move the 'poop' and not the troops." Application of the new system might include the following scenarios:

Scenario 1: The person on the other end of the telephone is just not following your explanation, so you tell him "turn on your tube" and transmit one of your color briefing charts. In less than one minute, the message is received and understood.

Scenario 2: You've got the action but are not really up to speed in the subject. Back in your office, you call up an "Army Central Reference" and ask for the 30-minute course. The receptionist tells you to "turn on your tube" and starts the tape that puts the trainer's voice on your telephone and color graphics on your screen. You've got on-demand training.

Scenario 3: To talk to someone in Seoul means you've got to wait until 2100 hours to call. Of course, you could write it all out and mail it. . . Instead, you call at 1000 hours (2400 hours Seoul) and their answering machine gives the message: "There's no one in at the moment . . . leave your message at the tone." At the tone, you transmit the PERT chart (remember, the picture transmits as sound) and state your request.

The next day, you "turn on your tube" and play the message that was on your answering machine. Korea's revision to the PERT chart appears along with a budget sheet and the action officer's verbal explanation in sound and pictures. One quick review, print a few copies of the PERT chart and budget sheet, and off to brief the boss.

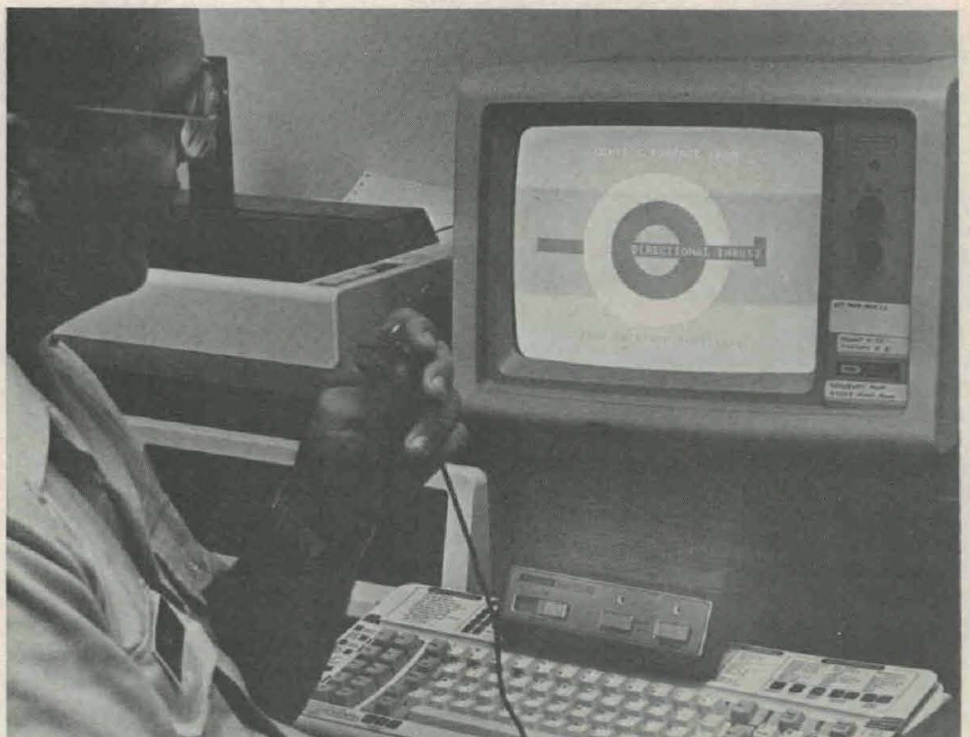
By this time you probably have a knowing smile on your face that says you've heard it all before and it's just another pie-in-the-sky idea that will either never be produced or cost too much. Not so! ARI has already installed a small number of working systems. Authorized units that want this capability can get the equipment from the GSA schedule for about $7,500 and the Army-developed software from ARI — including other programs such as a word processor, color graphics (briefing chart) generator, and a "smart" terminal.

ARI will be testing the VIP prototype in FY 1984 as part of its program in advanced information technology. Individuals or units that would like to participate in the field trial must fund their own equipment, but will receive consultation and customizing assistance from ARI. More information on field trial participation appears at the end of this article.

## Form and Function

The VIP system takes the form of a personal computer that is both economical and useful enough to be individually issued to selected personnel. The configuration would generally include an IBM Personal Computer and high resolution color display as well as hard and soft disk drives, joystick, color printer, programmable modem and speakerphone. Alternative arrangements of this equipment can be customized for SES and General Officers, action officers and equivalent civilians, as well as clerical personnel.

VIP equipment is designed to be located at each individual's work station



**Action officer using VIP to conduct an audio-graphic teleconference briefing.**

and used with the existing telephone. "Meetings" are thus accomplished without leaving one's desk (and records).

VIP is designed to be unobtrusively "on" during every telephone call and is silent unless ordered to transmit. In its most likely use, VIP retrieves business color graphics from the computer's storage and sends it simultaneously to all participants at the appropriate moment in a conversation. This informal briefing mode currently requires approximately 40 seconds per picture in which conversation is not possible. This mode would most often be used for unplanned meetings or to transmit graphics that were developed spontaneously during a briefing.

The VIP formal briefing mode was described earlier and involves forwarding the graphics in advance and transmitting only the "identification number" of the picture during conversation. This cuts delay in conversation to 7-8 seconds per picture. The "forwarding" process could be accomplished either during a set-up period just prior to the briefing or even the night before if each participant leaves his microcomputer powered. Note that the transmission is simultaneous to all participants, i.e., five pictures travel at 30 seconds each ($5 \times 30 = 150$ seconds) to 2 locations or even 10 locations at once.

Each participating location needs only one voice grade telephone line. Everyone is directly connected via telephone net (i.e., there's no central computer) and the VIP picture transmission process functions exactly as the voice portion does in that everyone can hear and see simultaneously what anyone communicates.

In short, what's special about VIP is that:

- VIP *adds pictures* to telephone conferences so that they can be used for staff meetings, planning sessions and to deliver briefings (voice and color charts) without traveling.
- VIP *eliminates typing* from the current format of computer conferences and substitutes faster, more efficient voice communication.
- VIP can be used to leave *verbal and pictorial* (color graphics) *messages* (e.g., organization flow charts, PERT diagrams, budgets) for individuals in different time zones.
- VIP can be used to establish a *real-time training* or a field service (reference) system.
- VIP is an *inexpensive*, add-on feature to widely and commercially available equipment right off the GSA schedule.
- VIP needs only one regular telephone line or radio channel (untested) for voice/graphics and is thus *easy to install* at any location that has access to standard power and an outgoing voice-capable channel.
- VIP should provide a *productivity boost* as part of an effective, coordinated system of ARI developed software that provides needed services such as word processing and time-sharing access to critical data bases.

## The Cost of Adding Pictures

Since the VIP effect is to add pictures to telephone conversations, it's reasonable to compare it to the costs/benefits of the alternatives to demonstrate VIP's value. The best known, lowest cost option is the conference call. No travel and low cost make this an attractive but limited option. A conference room equipped with an electronic blackboard, on the other hand, adds the ability to use hand drawn diagrams during a conference call at the cost of traveling to the nearest conference site and using a second, dedicated data phone line. Hidden costs include a dedicated facility, electronic blackboard and local administration/management staff.

At the next level of technology, TV conferencing facilities are slowly becoming available nationwide. Since they are still few in number, the use of this option greatly increases administration, rental, travel, and personnel costs but does add "talking heads" to the common audio-visual aids such as slides. This technique is only a simulation of real meetings, which actually are the most costly in every respect — preparation, facilities, travel and personnel.

None of the above options takes more than incidental advantage of the availability of computers for conferences and other communications. Unfortunately, computer conferences (as currently known) are usually limited to text (typing) communications with other participants via a central (host) computer. A relatively permanent transcript of the typing is produced as a by-product of using the computer, thus allowing participants the unusual option of "entering or leaving the meeting" at uncoordinated times and reading the proceedings which were missed.

Computer conferences offer, but do not as yet realize, the potential of using the computer as a meeting participant (e.g., as a consultant or an analyst). Computer conferences are economical enough to allow individuals with "issue" equipment to confer without leaving their offices.

All of the above options either lack certain desirable features (computer augmentation, voice, pictures, etc.) or just cost too much to be economically viable. VIP, on the other hand, is an alternative which is simultaneously low cost and offers more features than any single option described above.

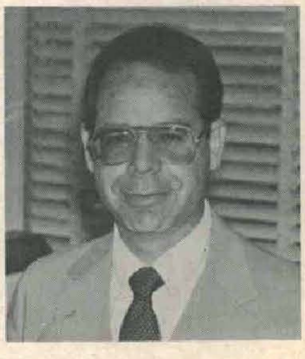
What VIP lacks is the warmth of personal contact and the visual cues that one gets by looking into someone's eyes during a meeting. What VIP provides is a means of doing everything else: delivering voice, graphics and text on a real-time or delayed basis at the lowest possible personnel and dollar cost. In addition, because VIP is computer-based, there is the realistic potential of improving the conferring process through instantaneous data retrieval and the use of mathematical decision tools.

In a world where a word processor can cost over $10,000 per secretary, VIP is notably economical. The components can be bought for about $7,500 of OPA or R&D funds, replace a word processor, and include a graphics terminal (capable of communicating with most central computers) and a color printer. The system also functions as a stand-alone personal computer for numeric/accounting analyses.

## Testing and Improving the System

The VIP project is currently limited by the laboratory environment in which it has been developed. In FY 84, it's time to take the show on the road for test and improvement.

We'd like to hear from those of you who want to start using the VIP system now as subjects in an experiment. Unfortunately, volunteers will have to fund their own equipment, but ARI will provide software, close-in consultation and customizing assistance. Participants will provide valuable feedback on information system features and VIP's ability to effect better and faster day-to-day business decisions. Additional information can be obtained from the U.S. Army Research Institute, 5001 Eisenhower Avenue, Alexandria, Virginia 22333 (202) 274-5572 or Autovon 284-5572.



*DR. NEIL S. DUMAS is a research psychologist with the U.S. Army Research Institute for the Behavioral and Social Sciences. He holds a PhD in psychology from the University of Wisconsin and has completed post doctoral research in computerized information systems and operations research resulting in an MS degree in systems research from the same institution.*

# Armament, Munitions, Chemical Command Replaces ARRADCOM, ARRCOM

The U.S. Army Armament, Munitions and Chemical Command (AMCCOM, pronounced A-M-C-COM), with headquarters at Rock Island, IL, was formally established on July 1, 1983.

A major subordinate command of the U.S. Army Materiel Development and Readiness Command, AMCCOM incorporates the mission and resources of the U.S. Army Armament Materiel Readiness Command (ARRCOM), which was headquartered at Rock Island, and the U.S. Army Armament, Research and Development Command (ARRADCOM) at Dover, NJ. No geographical relocation of people was involved in disestablishment of the two commands.

The AMCCOM commander is MG Benjamin F. Register, Jr., formerly the ARRCOM commander. Three AMCCOM deputy commanders are each responsible for a specific aspect of the total AMCCOM mission:

- BG Fred Hissong, Jr. serves as AMCCOM's deputy commander for Procurement and Readiness. He is responsible for the readiness mission and field operating functions of the single manager for conventional ammunition. He will remain at Rock Island, where he was formerly deputy ARRCOM commander.
- BG Robert W. Pointer, Jr. is AMCCOM's deputy commander for Armaments and Munitions and commander of the U.S. Army Armament Research and Development Center, Dover, NJ. He came to AMCCOM from an assignment in Korea, where he was assistant chief of staff, C4, for the United National Command/Combined Forces Command and the assistant chief of staff, J4, for the United States Forces Korea/Eighth U.S. Army.
- BG Howard C. Whittaker is AMCCOM's deputy commander for Chemical Materiel and commander of the U.S. Army Chemical Research and Development Center, Aberdeen Proving Ground, MD. He was formerly Hawk project manager at the Army Missile Command.

AMCCOM's primary mission is the life cycle management of weapons, ammunition and chemical materiel. This includes accomplishment of total research, development, engineering, procurement and materiel readiness of assigned materiel. AMCCOM is also the single manager for the procurement, production, supply, maintenance and transportation of conventional ammunition for the DOD.

The AMCCOM complex consists of 47 installations and activities in 26 states. In addition to the headquarters and two research and development centers, facilities include four arsenals and 30 ammunition plants and activities. Also, the Central Ammunition Center and School is in Savanna, IL.

AMCCOM includes project managers for the Cannon Artillery Weapons System/Joint Project Manager Semi-Active Laser Guided Projectiles, Sergeant York Air Defense Gun, and Smoke/Obscurants. Other activities include the Technical Escort Unit, Aberdeen Proving Ground, and the Munitions Production Base Modernization Agency, Dover.

Consolidation of the armament, munitions and chemical community into a single command is expected to permit greater flexibility and efficiency in using the available resources to perform an expanding mission, especially the increasing demands of force modernization.

AMCCOM will provide a single focal point to the user in the field, permitting quicker response to soldier-identified equipment problems. This will also permit utilization of feedback in research and development programs, with single engineering responsibilities assigned, and a unity of command in life cycle management.

In addition, better use of force modernization functional resources is anticipated, with coordination of materiel fielding plans, new equipment training, materiel hand off, and post fielding reviews.

Overall, AMCCOM will have more than $30 billion in assets, an annual budget of nearly $9 billion, and a workforce of over 40,000 employees, including military, Federal civilian workers and contractor employees.

## ATTENTION Authors

**Do you have an article you would like to submit for possible publication in the *Army RDA Magazine*? If so, we would like to hear from you. Consideration will be given to all articles, based on importance of the subject, factual content, timeliness, and relevance to our magazine. The following are general guidelines for submissions:**

- *Length.* Articles should be about 2,500 to 3,000 words. 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 or white or color are acceptable. We cannot promise to use all photos or illustrations and they are normally not returned unless requested.
- *Biographical Sketch.* Include a short biographical sketch and photo of the author/s.
- *Clearance.* Article must be cleared by author's security/OPSEC Office prior to submission.

Articles should be addressed to: HQ DARCOM, ATTN: DRCDE-OOM, 5001 Eisenhower Avenue, Alexandria, VA 22333. Telephone: Autovon 284-8977, Commercial 202-274-8978.

## MERADCOM APBI Announced

The U.S. Army Mobility Equipment Research and Development Command (MERADCOM) has announced that a fall 1983 Advanced Planning Briefing for Industry will be held November 9-10 in Springfield, VA.

Cosponsored by MERADCOM and the American Defense Preparedness Association, the meeting is intended to provide an in-depth review of MERADCOM's 5-year R&D Plan relative to mobility/counter-mobility, survivability, logistics, and energy. Current plans call for government and industry individual workshops and open forums. In addition, small business counselors will be available for consultation.

Registration information may be obtained by calling the American Defense Preparedness Association on commercial telephone (703) 522-1820.

# From The Field...

## Fast Burst Reactor Achieves Operational Milestone

White Sands (NM) Missile Range's fast burst nuclear reactor has reached a new milestone in its operational history. The reactor recorded its 10,000th test since it became operational on August 10, 1964.

One of two such facilities within the Department of Defense, the fast burst reactor is used to study, in a laboratory environment, the effects of radiation on weapon systems and their components.

The reactor is operated by the Nuclear Weapon Effects Office (NWEO) in support of nuclear effects test programs of the Army, Navy and Air Force. Each operation represents either a steady-state or burst operation involving transient radiation effects studies, radiobiological experiments or dosimetry studies.

Mr. Armando De La Paz, a nuclear engineer, heads the NWEO, a division of the range's Army Materiel Test and Evaluation Directorate.

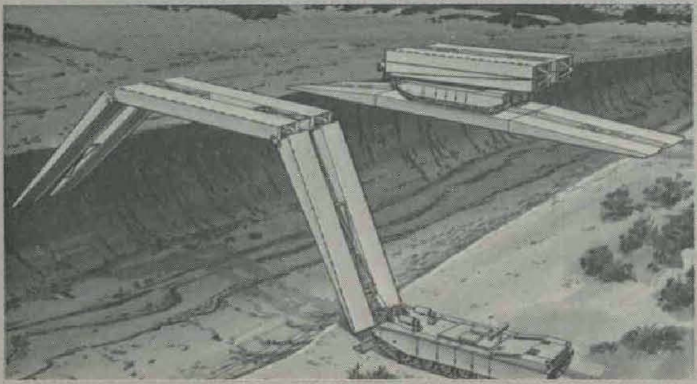
The NWEO also includes the range's thermal radiation facility (or solar furnace), an electromagnetic pulse test array, a linear electron accelerator, gamma radiation facility, neutron generator and a dosimetry laboratory. Collectively, the facilities permit a wide range of laboratory experiments to study phenomena associated with a nuclear burst. In addition, the laboratories are used periodically to conduct studies associated with energy alternatives and weapon systems development.

According to De La Paz, the only nuclear burst studies that cannot be accomplished in a laboratory environment at White Sands are the blast and shock phenomena. To this end, De La Paz says, the facility supports special studies that utilize conventional explosives in the field at White Sands Missile Range.

## Contract Calls for Assault Bridge Fabrication

The U.S. Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA, has awarded a $4.82 million multi-year contract to a York, PA, firm for the design and fabrication of a prototype heavy assault bridge. The experimental system, which will be built by Bowen-McLaughlin-York, will consist of a 100-foot span military load class 70 bridge mounted on an M1 tank chassis. The bridge will be designed utilizing composite materials for key components in order to reduce the system weight and reduce deflections.

A double-fold scissors design, the heavy assault bridge is one of two new bridging systems being developed by MERADCOM for the heavy and light divisions of the future. MERADCOM recently awarded a 4-year, $4.2 million contract to Foster-Miller Associates, Inc., of Waltham, MA, for prototypes for a 30-ton capacity light assault bridge. If the heavy assault bridge is ultimately accepted by the Army, it will replace the armored vehicle launched bridge currently in use. Delivery of the prototype bridge is scheduled for March 1986.



**Artist's concept of 100-foot assault bridge.**

## $6.6 Million Awarded for Aircraft Rotor Designs

Under three Army-NASA contracts worth $6.6 million, Boeing Vertol, Sikorsky Aircraft and Bell Helicopter Textron will perform a preliminary design of an integrated technology rotor, and a flight research rotor including test aircraft modifications.

Contracts will run 17 months and are jointly funded and managed by the Applied Technology Laboratory, and Aeromechanics Laboratory, both facilities of the Army Research & Technology Laboratories (AVRADCOM), and NASA Ames Research Center. The labs and NASA Ames are located at Moffett Field (Mtn. View), CA.

Project Engineer Paul Mirick assigned to the Applied Technology Laboratory, said, "The preliminary design for the integrated technology rotor will involve trade-offs of technical goals and rotor design parameters to obtain a rotor system design with improved reliability, maintainability, survivability, performance, and life cycle cost compared to existing rotors.

"The emphasis for the flight research rotor design will be to develop a rotor system based on the integrated technology rotor design which will be used on the Rotor Systems Research Aircraft to check out ways to reduce vibration, reduce noise and improve performance."

## Nominations Sought for Ordnance Hall of Fame

Nominations for the Ordnance Hall of Fame are now being accepted by the Ordnance Center and School, Aberdeen Proving Ground, MD.

The Ordnance Hall of Fame was established in 1969 to honor both military and civilian persons who have made significant contributions to the Army's ordnance mission and to the ordnance field itself. Induction is open to retired and active duty personnel. Both living and deceased individuals are eligible for nomination. As many as six individuals are inducted into the Hall of Fame annually.

Each nomination must include documented information on the individual and his or her contributions. Nominations should be accompanied by as much background material as possible on the candidate's accomplishments. The nominations are then reviewed by a board of ordnance general officers.

Nominations should be sent to: Commanding General, U.S. Army Ordnance Center and School, ATTN: ATSL-DOSM, Aberdeen Proving Ground, MD 21005. The closing date for 1984 nominations is October 1, 1983.

## Retrofit Effort Provides More Reliable Generators

The DOD's worldwide satellite communication system will have more reliable emergency generators as the result of a retrofit program at the Army's Mobility Equipment R&D Command (MERADCOM), Fort Belvoir, VA.

The 500 kilowatt diesel engine-driven generators, used by the Defense Communications Agency in more than 20 sites operated by the Army, Navy, and Air Force, can also provide backup power for field hospitals and security facilities. They measure 102 inches by 226 inches by 88 inches, weigh 35,000 pounds and are air transportable by a C-130 aircraft. The generators are made by Fermont Division of Dynamics Corp. of America, which also developed the retrofit kit.

Work on upgrading the generators began in 1981 when operational experience and new user requirements justified the need for engineering changes. In order to improve the performance and reliability of the generators, MERADCOM developed a governor actuator that would respond 10 times faster than the old model, modified the synchronizer so that it could synchronize four generators in 12 seconds, redesigned the circuit interrupter, increased the relay rating, reconfigured some of the wiring, developed a siphon heating system and redesigned some of the circuitry to reduce operator errors. Cost of the retrofit contract was more than $330,000.

# From The Proponent Desk...

The Specialty Code 51 (research and development) Proponent Office at HQ DARCOM, which is responsible for managing the Training With Industry Program for Specialty Code 51 officers, is currently determining the positions to be filled by industry trained officers in 1985. These officers will receive a year of training with an appropriate company beginning in the summer of 1984.

Officers may apply for the Training With Industry Program at any time. However, those officers who will be available during the 1984 to 1987 period (one year of training plus a 3-year utilization assignment) should submit their applications now.

Application may be made by submitting a DA Form 1618R, with a resume, to your career management division at the U.S. Army Military Personnel Center. The governing regulation is AR 621-1, Training of Military Personnel at Civilian Institutions. APPLICATIONS RECEIVED AFTER 1 DECEMBER 1983 MAY BE INELIGIBLE FOR NOMINATION CONSIDERATION BY MILPERCEN FOR THE TRAINING CYCLE BEGINNING IN 1984.

Additional information regarding the Specialty Code 51 Training With Industry Program may be obtained from: Commander, U.S. Army Materiel Development and Readiness Command, DRCDE-O, 5001 Eisenhower Avenue, Alexandria, VA 22333. The point of contact, Mrs. Kay Black, may be reached on AUTOVON 284-9587/5872 or commercial (202) 274-9587/5872.

# Awards...

## Army Selects 24 Winners for Top Awards

Albuquerque, NM, was the site of the 34th International Science and Engineering Fair, where 24 top student scientists were chosen from among 560 finalists to receive Department of the Army Superior and Meritorious Achievement Awards. From among the Superior Achievement Award winners, the Army chose three students and two alternates to receive the Operation Cherry Blossom and the London International Youth Science Fortnight Awards.

The International Science and Engineering Fair is sponsored by Science Service, a non-profit institution dedicated to the public understanding of science. This fair culminates competition among high school students in over 300 regional, city, county, state or national science fairs held in 44 of the 50 United States and the District of Columbia. This year's competition also included representation from Australia, Canada, Ireland, Japan, Panama, Puerto Rico, the Republic of China, Sweden, the United Kingdom and the West Indies.

The 12 categories in which the students competed were: behavior and social sciences, biochemistry, botany, chemistry, earth and space sciences, engineering, environmental sciences, mathematics and computers, medicine and health, microbiology, physics, and zoology.

### *Operation Cherry Blossom*

**Operation Cherry Blossom winners Timothy A. Thrailkill (center) and Ann R. Davis pose with alternate recipient James E. Tornes.**

The Army presented two Operation Cherry Blossom Awards consisting of an expense-paid trip to Tokyo, Japan, to attend the 27th Annual Japan Student Science Awards program in January 1984.

Timothy A. Thrailkill, 17, a junior at Melbourne H.S., Melbourne, FL, received the award for his project, "Development of a Vaccine to Immunize Against Infection by Herpesvirus-1." Thrailkill's exhibit captured four Federal, industrial, and professional awards in addition to the Army's OCB and Superior Achievement Awards.

Ann R. Davis, 16, a junior at Mather H.S., Chicago, IL, was selected as an OCB and Superior Achievement Award winner for her project, "New Developmental Changes in Neonatal Rat Plasma Lipoprotein-Cholesterol." Davis, a finalist in two prior ISEFs, also won a second award in the category of Medicine and Health for her exhibit.

Army alternate for the Japan trip is James E. Tornes, 18, a senior at Bishop Watterson H.S., Columbus, OH. His project, "Developing and Analyzing a Home Computer Monitoring and Control System," won three Federal and professional awards as well as the Army's Superior Achievement Award. Tornes was a finalist in one previous ISEF.

The Army has been participating in Operation Cherry Blossom since 1963 when it was initiated in cooperation with the Japanese newspaper *Yomiuri Shimbun.*

### *London International Youth Science Fortnight*

**London Youth Science Fortnight winner William J. Evans (right) and alternate Vincent A. DePasquale flank WSMR Commander MG Niles J. Fulwyler.**

William J. Evans, 17, a senior at Huron H.S., Ann Arbor, MI, was selected to receive an expense-paid trip to London to attend the London International Youth Science Fortnight. His project, "Synthesis of Heteroaromaticimidazoles: New Chemotherapeutic Agents in the Fight Against Filariasis," also won the Army's Superior Achievement Award. Evans was a finalist in one previous ISEF.

Selected as alternate for the London trip was Vincent A. DePasquale, Jr., 17, a senior at Lincoln Jr.-Sr. H.S., Lincoln, RI, for his exhibit "Beta Numbers." DePasquale, a finalist at one prior ISEF, captured a total of four Federal, industrial and professional awards at this year's fair.

Winners and alternates of both the Operation Cherry Blossom and London International Youth Science Fortnight Awards received congratulatory letters from the Secretary of the Army and $100 from the Association of the United States Army.

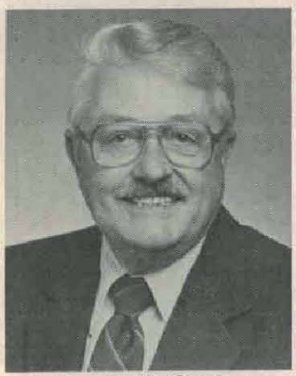
MG Niles J. Fulwyler, commander, U.S. Army White Sands Missile Range, NM, presented the awards for the Department of the Army.

*Army Superior Awards,* consisting of a certificate of achievement, a gold medallion, and a one-week, expense paid orientation visit to an Army R&D facility, also went to Jill M. Conway, 16, Warren Central H.S., Bowling Green, KY, for "Radiation: How Much Is Too Much?"; Stevie R. Council, 16, Benjamin E. Mays H.S., Atlanta, GA, for "Effect of Substrate and AMP on the Reversal of the ZN++ Inhibition of the Avian Embryo Liver FDPase by Chelators"; David A. Burns, 17, Lexington Catholic H.S., Lexington, KY, for "Organic and Chemical Amelioration of Copper Toxicity"; Darin Day, 18, Roy H.S., Roy, UT, for "Implications of Barn Owl Pole Box Placement in the Northern Wasatch Front Area"; Theresa Treep, 17, S.W. Springstead H.S., Spring Hill, FL, for "Virus Inactivation in Aerobic Digestion of Waste Water Sludge"; Stacey RaNae Frost, 18, Weber H.S., Ogden, UT, for "Salinity Effects and Solutions to Controlling Bacteriological Activity in Farmington Bay"; and Michael F. Webb, 18, Omaha Northwest H.S., Omaha, NE, for "Comparison of Stroke Patterns Using a Swimming Device."

*Meritorious Awards*, consisting of certificates of achievement and silver medallions went to Meera Krishnamurthy, 16, Muskogee H.S., Muskogee, OK, for "Interrelationships Between Creativity, Visual Perception, and Cerebral Preference"; Sharon LuAnne Ladson, 18, Denbigh H.S., Newport News, VA, for "Role in Photosynthesis of the Carotenoids"; Dawn L. Bickerstaff, 17, Warren Central H.S., Vicksburg, MS, for "Sulfur Requirements on *Chlorella vulgaris*"; Agnelli S. Quinones, 17, University of Puerto Rico Secondary School, Rio Piedras, PR, for "A New Natural Substitute for the Chemical Preservative, Sodium Nitrate"; Marcelo Colon, 17, Antonio S. Pedreira H.S., Caguas, PR, for "New Antimicrobial Natural Products Found in the Fruits of *Solanum mammosum*"; Nanette J. Latchaw, 18, East Noble H.S., Kendallville, IN, for "Effects of Volcanic Ash on the Mammalian Respiratory System"; Timothy E. Shirley, 18, Palo Verde H.S., Tucson, AZ, for "Hydrogen: A Possible Synthetic Fuel"; Laura L. Huckabee, 17, Huntsville H.S., Huntsville, AL, for "Determination of Parameters for 73.8 Mhz Interferometer System"; Fred R. Siver, 16, Lane Technical H.S., Chicago, IL, for "Developing a New Method of Constructing Integrated Radio Circuits"; Stephen J. Shanabrook, 18, Calvert H.S., Tiffin, OH, for "Construction of a Parabot for the Basic Manipulation of Objects"; Michael Tai-ju Lin, 15, La Jolla H.S., La Jolla, CA, for "Cubik Math: A Computer Tutorial in Group Theory"; and Jonathan Santos, 17, Bowie H.S., Bowie, MD, for "Tip Vortex Propulsion: A New Approach." Santos won a total of 12 Federal, industrial and professional awards for his exhibit in addition to the Glenn T. Seaborg Nobel Prize Award, presented by General Motors, which involves an all-expense-paid visit to Stockholm, Sweden, in December to attend the Nobel Prize Ceremonies.

Anne G. Taylor, U.S. Army Research Office, Research Triangle Park, NC, was Army project officer for the ISEF program.

## Aeronautics Institute Elects Carlson as Fellow



**Dr. R. M. Carlson**

Dr. Richard M. Carlson, director of the U.S. Army Research and Technology Laboratories, (AVRADCOM), has been elected to the grade of Fellow by the officers and directors of the American Institute of Aeronautics and Astronautics. He was cited for his "pioneering technical contributions to the commerical certification of helicopters, and leadership in rotary wing structures, dynamics and aeronautical systems design in industry, academe, and government."

According to the AIAA, Fellows are persons of distinction in aeronautics or astronautics who have made notable and valuable contributions to the arts, sciences, or technology thereof. A Special Fellow Guide Committee reviews Associate Fellow nominees from the membership and makes recommendations to the Board of Directors, which makes the final selections. One Fellow for every 1,000 voting members is elected each year.

Dr. Carlson, who holds a PhD in engineering mechanics from Stanford University, is a Fellow of the Royal Aeronautical Society, and Honorary Fellow of the American Helicopter Society, and is the first foreign member of the Swedish Society of Aeronautics and Astronautics. He is also a member of Sigma Xi and is a registered mechanical engineer in California.

## 4 APG Employees Cited for Outstanding Performance

Four employees in the Materiel Testing Directorate (MTD), Aberdeen Proving Ground, MD, have been recognized for outstanding job performance which significantly contributed to MTD's successful mission accomplishment.

COL Charles W. Binney, director of MTD, presented awards to Mary E. Viars, Measurements and Analysis Division; Mr. Norman T. Hopkins, Technical Support Division; SSGT Robert S. Stull, Military Support Division and Betty B. Fritter, Technical Support Division.

Viars received the Director's Award which is presented to an individual whose performance on a special technical project or study resulted in significant progress or achievements in testing technology or reflected outstanding project management ability.

A computer programmer analyst in the Analytical Branch, Viars was commended for developing and implementing new procedures which make use of the most modern computer technology to reduce the time required to make test results available to MTD's and equipment developers.

Hopkins was the recipient of the George Groak Award which is named for a former general foreman of facilities support at MTD. This award is intended to highlight the contributions of the large body of support personnel who make much of the MTD mission accomplishment possible.

Hopkins, who is an engineering technician in the Nondestructive Test Section, serves as senior technician of the Inspection Evaluation Facility. He is credited with being the guiding force behind the inspection of more than 8,000 components in the past two years, including gun systems, automotive systems and small arms. Additionally, Hopkins has authorized or reviewed more than 1,500 data sheets and 34 laboratory reports.

Stull, employed in the Field Support Branch, was the recipient of the Crozier Award, named after the late MG William Crozier, Chief of Ordnance for the Army from 1901 to 1918.

Stull served as the test NCOIC during developmental testing of the M1 Abrams tank; Micro-Climate Crew Cooling System; Barrier Mine Test, Driver's Thermal Viewer and test and evaluation of the M1E1 tank, non-firing Ammunition Robustness Phase.

He was praised for identifying potential operational problems during the non-firing M1E1 120mm Ammunition Robustness Test and his demonstrated technical competence in the M-60 and M-1 testing programs.

Fritter received the Administrative Award, which is presented for outstanding administrative support. A facilities support assistant in the Engineering Services Branch, she was cited for consistent high quality job performance demonstrated by outstanding effectiveness attained in achieving expedited response to emergency work requests.

# Career Programs...

## ALMC Establishes Force Modernization Course

The U.S. Army Logistics Management Center, Fort Lee, VA, has developed a 15-day Force Modernization Management Course in an effort to provide logistical managers with the knowledge required to approach the variety of problems faced as the Army modernizes. The course provides an in-depth understanding of various processes and techniques required in the management of the force modernization effort. These include force development, materiel acquisition, distribution/redistribution of equipment and the programming and budgeting cycle.

Guest speakers from the Corps of Engineers; HQ, Department of the Army; U.S. Army Training and Doctrine Command; U.S. Army Materiel Development and Readiness Command; and U.S. Army Forces Command are an integral part of the course and provide candid discussions on the force modernization process.

The first class (83-01) was composed of 40 students from the U.S. Army Training and Doctrine Command, the U.S. Army Materiel Development and Readiness Command and U.S. Army Forces Command.

Commissioned and warrant officers, enlisted personnel in grades E-7 and above, and civilians in grades GS-09 and above are eligible to attend. They should be holding or be moving to positions in force modernization, project or product management, U.S. Army Training and Doctrine Command system management, or integrated logistic support.

Additional information may be obtained by writing to: Commandant, U.S. Army Logistics Management Center, ATTN: DRXMC-ACM, Fort Lee, VA 23801.

## Lawhorne Chosen for Executive Training Program

Mr. Stephen E. Lawhorne, a chemical engineer, is the 48th civilian employee selected to participate in the 6-month technical executive training program at the Army's Chemical R&D Center (CRDC), Aberdeen Proving Ground, MD.

The specialized training includes a 3-month assignment in the Office of the Deputy Chief of Staff for Research, Development and Acquisition at the Pentagon, following a similar period of training with the CRDC command group.

Established in 1971, the executive training program is designed to give participants practical experience in the essentials of staff work relating to managerial decisions. Lawhorne holds a bachelor of science degree in engineering science from the Johns Hopkins University.

He came to Edgewood (Arsenal) in 1972 and was assigned, as a soldier, to the Army's Technical Escort Unit. Following military service, he remained in Edgewood and entered Federal Service as a chemical engineer with the Army's Demilitarization/Disposal Office. He transferred to CRDC's Environmental Technology Division in 1975 where he is assigned as a group leader in the Installation Restoration Branch.

# Personnel . . .

## Oblinger Takes Over as DARCOM DE&A Director


**MG J. B. Oblinger**

MG John B. Oblinger, former deputy chief of staff for Combat Developments, U.S. Army Training and Doctrine Command, has assumed new duties as director of Development, Engineering and Acquisition, HQ U.S. Army Materiel Development and Readiness Command, Alexandria, VA.

MG Oblinger was graduated with a BS degree in engineering from the U.S. Military Academy. He also holds an MS degree in nuclear physics from Tulane University, and has completed the Army War College, Army Command and General Staff College, and the Artillery School Basic and Advanced Courses.

Prior to his tour at TRADOC, he served as commander, U.S. Army Air Defense Center and commandant, U.S. Army Air Defense School, Fort Bliss, TX. Previous to that assignment he was the assistant commandant of the Army Air Defense School.

Other key assignments have included commander, 38th Air Defense Brigade Artillery, Eighth U.S. Army, Korea; chief, Missiles and Air Defense Systems Division, Office, Deputy Chief of Staff for Research, Development and Acquisition, Department of the Army; and commander, 94th Air Defense Artillery Group, U.S. Army Europe.

MG Oblinger is a recipient of the Meritorious Service Medal with two Oak Leaf Clusters, Joint Service Commendation Medal, Army Commendation Medal, and the Parachutist Badge.

## Huxsoll Commands Infectious Disease Institute


**COL D. L. Huxsoll**

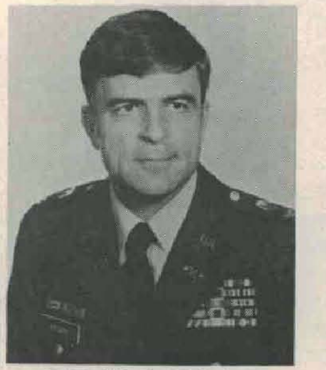
COL David L. Huxsoll has succeeded COL Richard R. Barquist as commander of the U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, Fredrick, MD. COL Barquist is now special assistant to the commander of the U.S. Army Medical R&D Command.

The first Veterinary Corps officer to command the Medical Research Institute of Infectious Diseases, COL Huxsoll has served since August 1979 as a research area manager with the U.S. Army Medical R&D Command and was the senior staff officer for all infectious disease research in the Army.

COL Huxsoll's other career assignments have included commander, U.S. Army Medical Research Unit, Institute for Medical Research, Kuala Lumpur, Malaysia; chief, Department of Veterinary Medicine, Walter Reed Army Institute of Research (WRAIR); virologist, 9th Army Medical Laboratory, Vietnam; and separate assignments at WRAIR as assistant chief of Microbiology and veterinary virologist.

COL Huxsoll holds a doctorate in veterinary medicine from the University of Illinois and a PhD in microbiology from Notre Dame. In addition, he has authored numerous articles on veterinary microbiology, and holds an academic appointment of associate professor in the Department of Veterinary Pathology and Hygiene in the College of Veterinary Medicine, University of Illinois.

## Brisker Succeeds Eure as PM Smoke


**COL M. S. Brisker**

Project manager for Smoke/Obscurants is the new title of COL Morton S. Brisker, following completion of a tour as a development project officer at the U.S. Army Tank-Automotive Command, Warren, MI. He succeeds COL Samuel L. Eure who is now chief of staff of the U.S. Army Test and Evaluation Command.

COL Brisker earned a BS degree in chemistry and a master of science degree in organic chemistry from the University of Miami. He has also completed the Army War College and the Army Command and General Staff College.

His career assignments have included command staff services in Washington, DC, and tours in Iowa, Alabama, Colorado, Germany, and Vietnam. COL Brisker served previously in the Office of PM Smoke as an assistant project manager from 1973 to 1976.

Included among his military decorations are the Bronze Star Medal with Oak Leaf Cluster (OLC), Air Medal (second award), Joint Service Commendation Medal, and the Army Commendation Medal with second OLC.

# From the Editor:

Even though I have served for only a short-time as editor of this magazine, I am certain it will be a rewarding assignment. Under the auspices of Mr. Naisawald and his very able staff the magazine has gained an excellent reputation. Our challenge — not an easy one — is to maintain the magazine as a quality product and, where possible, continue to improve it. I anticipate no significant changes: if it works, don't fix it.

For some time this magazine has focused on management interests, particularly those of the materiel acquisition careerist in the field. We will continue to do so, making our contribution to the active interchange of ideas that is essential to progress in this complex and rapidly changing business. We seek to act as a multi-directional conduit through which information and ideas will freely flow.

The ideas are certainly out there. Originally, I was concerned that good material would be in short supply. It seems we often worry about the wrong things. During this past month it has become clear that the RDA community is alive and writing. Now I am concerned with how to deal with the abundance of material we receive. We would like to use it all, but unfortunately our budget will not permit it. However, dear reader, don't let our constraints deter you from submitting your article. It might well be exactly what we need for the next issue.

Although the thrust of the magazine is toward management, we will continue to cover hardware. In that vein, if the discerning reader has detected a slight bias toward small arms in past issues of the magazine, then he might notice a comparable bias toward missiles in future issues. Readers can curb any such tendencies by providing us with feedback.

So let us hear your views on the magazine's operation and content as they relate to your RDA concerns. Our address is HQ DARCOM, DRCDE-OOM, 5001 Eisenhower Ave., Alexandria, VA 22333. The AUTOVON phone number is 284-8977, and the commercial phone is (202) 274-8978.

DAVID G. KIRKPATRICK
Editor

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I certify that this statement made above by me is correct and complete: LTC David G. Kirkpatrick, Editor, 1 September 1983.

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