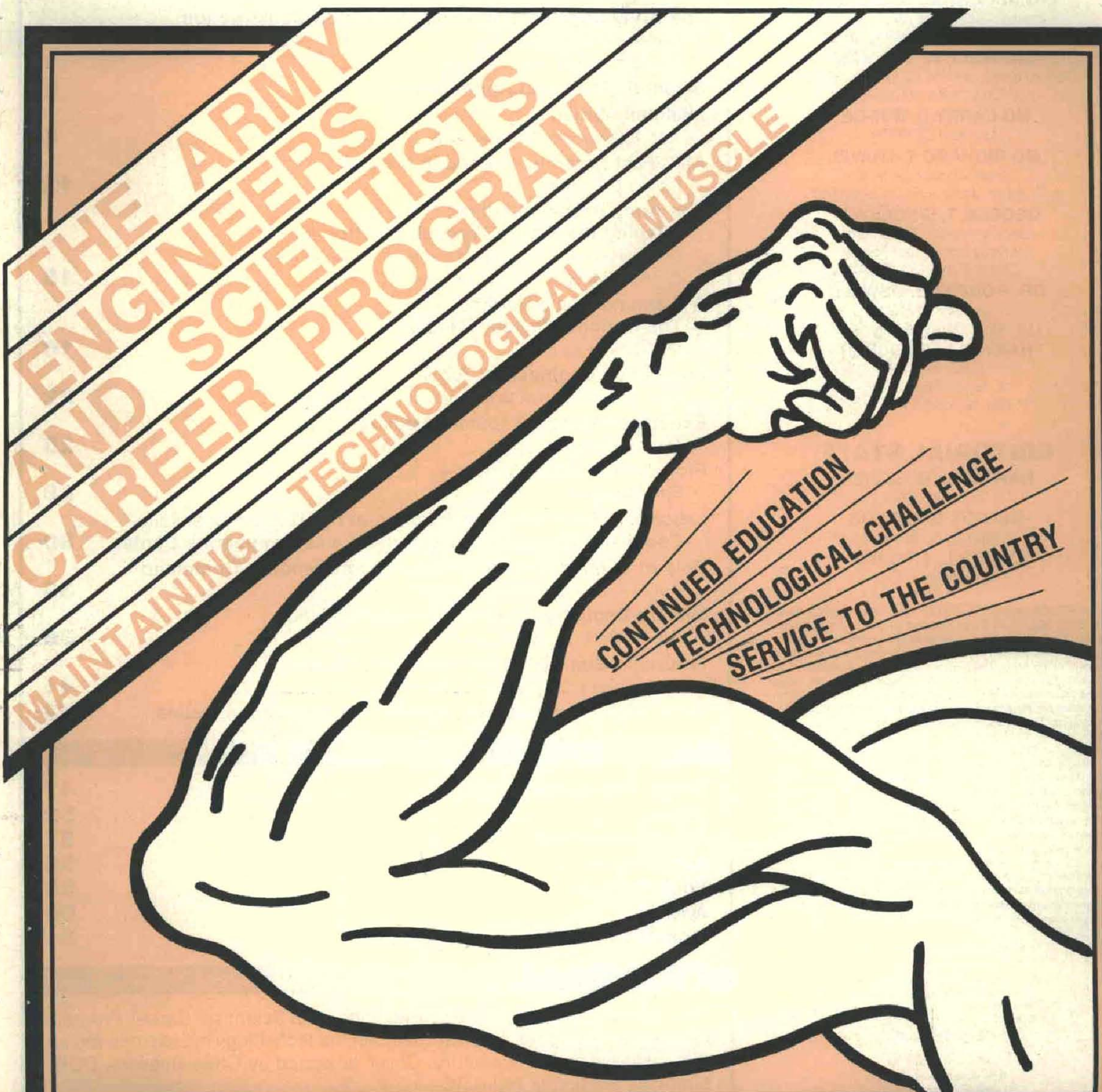
Headquarters Department of the Army
PB 70-92-2

ARMY RD&A BULLETIN

MARCH - APRIL 1992



Approved for Public Release: Distribution is Unlimited

MARCH-APRIL 1992
PB 70-92-2

Assistant Secretary of the Army (Research, Development and Acquisition)
STEPHEN K. CONVER

Commanding General U.S. Army Materiel Command
GEN JIMMY D. ROSS

EDITORIAL ADVISORY BOARD MEMBERS

STEPHEN K. CONVER
Chairman, Editorial Advisory Board

LTG AUGUST M. CIANCIOLO
Director of Acquisition Career Management

LTG BILLY M. THOMAS
Deputy Commanding General for RD&A U.S. Army Materiel Command

MG LARRY D. BUDGE
Assistant DCSPER

MG RICHARD T. TRAVIS
Commanding General U.S. Army Medical R&D Command

GEORGE T. SINGLEY, III
Deputy Assistant Secretary for Research & Technology Office of the ASA (RDA)

DR. ROBERT B. OSWALD
Director of R&D U.S. Army Corps of Engineers

HARVEY L. BLEICHER
Editor-in-Chief Executive Secretary Editorial Advisory Board

EDITORIAL STAFF

HARVEY L. BLEICHER
Editor-in-Chief

MELODY B. RATKUS
Managing Editor

DEBRA L. FISCHER
Assistant Editor

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

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

By order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

Milton H. Hamilton

MILTON H. HAMILTON
Administrative Assistant to the Secretary of the Army
00810

ARMY RD&A BULLETIN

Research Development Acquisition

Professional Bulletin of the RD&A Community

FEATURES

DEPARTMENTS

COVER

This issue addresses the Army Engineers and Scientists Career Program and its role in helping the Army maintain the technology muscle needed for the soldier in the 21st century. Cover designed by Chris Deavers, DOIM Graphics Section at HQ AMC.

THE ARMY ENGINEERS AND SCIENTISTS (NON-CONSTRUCTION) CAREER PROGRAM

By Dr. Lucy B. Hagan and Kay M. Driscoll

Introduction

The complex science and technology of the 1990s offer the Army new capabilities to perform its mission with increased effectiveness and decreased resources. This article describes the Army Engineers and Scientists (Non-Construction) (E&S(NC)) Career Program and the initiatives under way to maintain the science and technology muscle needed for the soldier in the 21st century.

History

In April 1961, Army representatives were requested to develop a career program for Department of the Army (DA) engineers and scientists to assure that Army's continuing requirements for E&S personnel were met. The DA E&S Career Program was first described by Army Regulation in 1965 (Civilian Personnel Regulation 950-18). Several years ago, Career Program 18 (CP 18), which included all DA engineers and scientists, was divided into two career programs, CP-18, E&S (Resources and Construction) (RC) and CP-16, E&S (NC). These career programs are managed by general officer functional chiefs: The E&S(RC) by the chief of engineers, and the E&S(NC) by the commanding general of the U.S. Army Materiel Command (AMC).

Management Structure

The career program management structure is controlled by regulation AR 690-950 which establishes policy and responsibilities. The functional chief is responsible for the overall program while day-to-day activities are delegated to the functional chief's representative (FCR). The FCR for the DA E&S(NC) Career Program is the deputy commanding general for research, development and acquisition at the Army Materiel Command and the FCR for the DA E&S(RC) Career Program is the deputy director for civil works, Corps of Engineers. In addition, each major command has a command career program manager (CCPM), who manages the career program within the headquarters; each major subordinate command (MSC) has an activity career program manager (ACPM), who manages the MSC's program.

Population of Program

There are over 20,000 E&S(NC) Army-wide, of which almost 60 percent are engineers. The program covers approximately 54 civilian occupational series, ranging from very broad series such as general engineer and general physical scientist to highly specialized series such as aerospace engineer and microbiologist. AMC employs about 75 percent of the Army's civilian E&S(NC). Other Department of Army major commands (MACOMS), including the Corps of Engineers, the Office of the Surgeon General, the Strategic Defense Command, and the Training and Doctrine Command, and other Army agencies, employ the remaining 25 percent. There are approximately 12,000 E&S(RC) Army-wide of which about 80 percent are engineers. There are 46 series within the E&S(RC) Program.

Subcareer Areas

Engineers and scientists in the Non-Construction Career Program perform work in nine subcareer program engineering and scientific areas, including research, systems development, production, software, testing and evaluation, logistics, product and quality assurance, and operations research systems analysis, and medical research and development. Engineers in the Resources and Construction Program work in development, design, construction, and maintenance of facilities.

Army Acquisition Corps

Army engineers and scientists may elect to join the Army Acquisition Corps (AAC) and follow the career path to become a program executive officer (PEO) or a project manager (PM). The AAC has been discussed in earlier articles in the *Army RD&A Bulletin* (pages 1-3, May/June 1989; pages 39-41, March/April 1990), and will be summarized here to explain how engineers and scientists will be integrated into the program.

The AAC is a combined military and civilian program which will develop a dedicated pool of highly qualified acquisition specialists to fill designated critical acquisition management positions at levels of GS/GM-14 or lieutenant colonel and above. The goal of the AAC is to provide the Army with a highly qualified group of professionals who are efficient in developing and procuring dependable Army materiel. The AAC will be staffed with qualified military personnel from specified functional areas and civilians from 10 career programs including both of the Army-wide Engineers and Scientists career programs.

The AAC critical positions are established to fulfill requirements mandated by law, DOD directive, or at the direction of the Army acquisition executive (AAE), and require the incumbent to have certain training, education, and experience. These positions include those occupied by general officers assigned to procurement commands, all PEOs, all PMs, deputy PMs, other positions in PEO and PM offices, and other positions in HQ DA and procurement commands.

Careerists in the DA E&S Career Programs working at the bench level and as technical managers may refer to these previous articles on the AAC to learn more specific information on training requirements and staffing of the AAC critical positions.

Training

Training of our engineers and scientists is essential to a high quality, efficient workforce. Training guidance is provided through the recently developed Army Civilian Training, Education and Development System (ACTEDS) Training Plan. (ACTEDS includes special training required for the Army Acquisition Corps). This plan is the framework for effectively blending the management, scientific, and functional training needed by our civilians throughout their careers. It will be published as a DA pamphlet for use by members of the DA E&S(NC) Career Program in designing their Individual Development Plans. The plan reflects training and development guidance specifically geared for each of the nine subcareer programs.

A career program ladder has been established to allow an engineer or scientist to progress from a technical journeyman or specialist to a top management position in the Senior Executive Service (SES), or to a senior scientific and technical (ST) position equivalent to an SES position (see Figure 1). The dual ladder recognizes the value of senior engineers and scientists who possess world class credentials in their technical areas but may not be interested in senior level management positions. ST candidates are selected for their outstanding contributions to research, development, and engineering contributions to their highly specialized technical areas of expertise, as documented in their research publications, international recognition and awards.

The Army historically has had three to seven ST positions but has made a major and successful effort to expand the opportunity for its truly outstanding researchers. As a result, the Army now has 29 authorized ST positions of which 23 are filled (18 in AMC, four in Corps of Engineers, and one in the Medical R&D Command). Additional details are provided in the accompanying article on STs.

Recruitment and Promotions

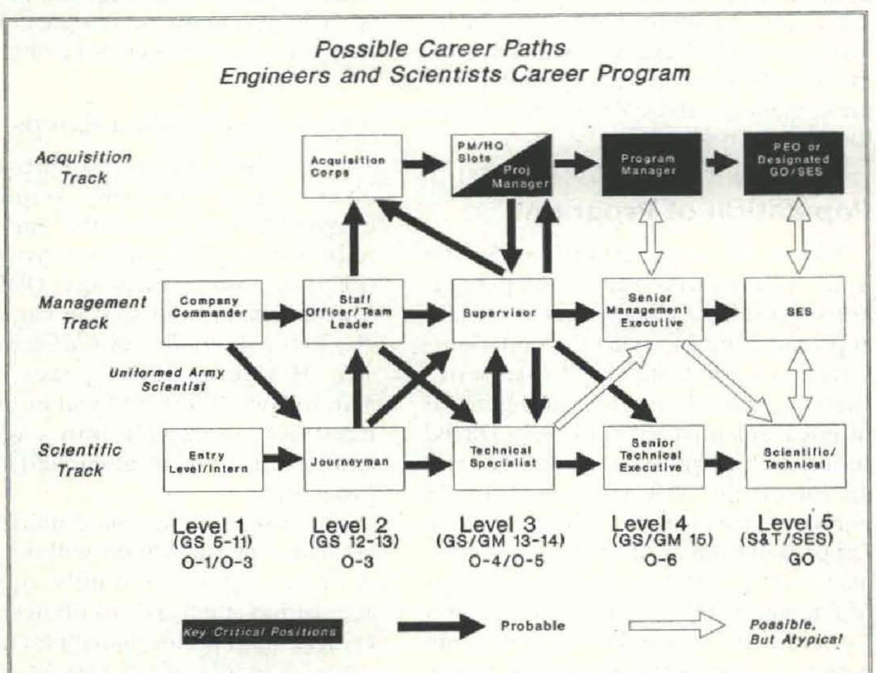
The strength of the nation's defense is inherently dependent on proper and continued input of personnel who possess a high level of adeptness to science and engineering. This career program requires, at the entry level, a B.S. or equivalent degree in an engineering or science discipline from a college or university.

Recruitment, reassignment, and promotions in the DA E&S(NC) Career Program were decentralized to major commands (MACOMs) in 1981, in recognition of the size of the career field and the increased complexity and sophistication of the scientific and engineering work. Now the separate Army activities recruit and promote most of their new personnel locally, using standard merit promotion procedures. Decentralized recruitment provides local, regional, and national career opportunities in consonance with the employees' mobility desires.

Pre-Degree Programs

The intake and retention of bright, young men and women in highly technical engineering and scientific areas remain a prime concern. Dependent upon the interest and personal desires of the individual, there are several innovative methods for recruiting and placing new employees. Assistance is provided to high school students through the Research and Engineering Apprenticeship Program (REAP). The objective of this program is to stimulate interest in science and engineering careers. The program also provides an opportunity to recruit upon graduation from college, candidates from underrepresented groups, including women and minorities.

Another program which puts the "earn-as-you-learn" concept into practice, and continues the learning process begun with REAP, is the Federal Junior Fellowship (FJF) Program. This pro-



gram offers high school graduates of families with financial need the opportunity to earn money for college as well as a chance to learn about their chosen career fields through related work experience. FJFs are eligible to work during school vacations and part-time during the school year. Students who maintain a 3.5 grade point average in a science, engineering, or business administration major and 3.0 average overall, qualify for tuition and book expense assistance. This year 15 FJFs are working in Army laboratories. Nine are majoring in engineering, four in economics/business, and one each in political science and computer science.

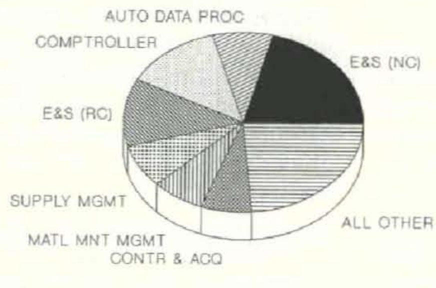
The Cooperative Intern Program is another work/study program in which students obtain hands-on experience in R&D activities at a variety of Army locations. Students in colleges and universities participate by alternating periods of work and study. They receive a salary while working and tuition/books expenses while attending school.

The Department of the Army Engineers and Scientists (Non-Construction) Career Program is strongly supportive of the Department of the Army Scientific and Engineering Reserve Officer's Training Corps Cooperative Program (DASE ROTC CO-OP Program). The goal of the ROTC Program is to prepare college students for careers as Army officers. The purpose of the DASE ROTC CO-OP Program is to support this goal and to meet the Army's military and civilian workforce needs for high quality scientists and engineers through the use of civilian employment opportunities.

Eligibility requirements are that the individual is attending a college or a university full-time in an undergraduate program leading to a degree in either science or engineering; is enrolled in an Army senior ROTC Program; and is recommended by the school and the professor of military science.

Benefits to the DASE ROTC CO-OP student who after graduation serves on active military duty by fulfilling the four-year active duty service obligation, are that they will be eligible for the position which was held at the time of graduation. All promotions, within-grade increases, etc., which would have accrued if the student had remained in the position will be granted upon restoration to duty. The student who remains on active duty beyond the four-year obligation will be eligible for reinstatement to federal civilian service. The active duty military service will be credited towards their civilian service tenure and the military service can be credited toward qualifying experience for promotion.

ARMY CAREER PROGRAMS BY SIZE



Interns

Pre-degree programs are followed by the intern programs where B.S.-degreed students enter the federal service at the GS-5 or GS-7 level and participate in a combination of formal and on-the-job training. Intern programs are administered centrally by the Department of Army and by Army major commands and laboratories. Central interns are given the opportunity to select an engineering specialty that is of particular interest to them and in short supply, such as software, production engineering, maintainability, test and evaluation or product (quality) assurance. In many instances, upon completion of a year of intensive formal training, interns may continue advanced training at a university for another six months. Dependent upon the interns' successful completion of the advanced training, they may be awarded a master's degree. The intern is paid a full salary while in school.

Central internships are also offered in various scientific research areas and in operations research systems analysis. Many laboratories and centers offer local internships in a variety of engineering and scientific areas that match their specialized missions. Details of these programs can be obtained from local Army civilian personnel offices.

Professional and Advanced Development

Professional development is popular with engineers and scientists, and is available to those who have three years consecutive service in career appointments and are at the grade GS-11 or above within the Department of the Army. Army-sponsored, long-term training opportunities are announced annually for military colleges, fellowships, university programs, developmental and training-with-industry assignments. In some instances, the participant must be able to obtain a top secret or secret clearance prior to the beginning of the training program and be willing to sign a mobility agreement that will allow Army to choose a post-training position as appropriate and necessary.

Army civilians may apply for training at the senior service colleges, such as the National War College, the Industrial College of the Armed Forces, the Army War College, and the Army War College Corresponding Studies Course. The Army Management Staff College (AMSC) offers a 13-week resident course designed to provide professional development across functional areas in the Army sustainment base environment. Most of these colleges grant significant credit hours towards an advanced degree.

The Secretary of the Army research and study fellowships range in length from six to 12 months and require that the individual be a Department of Army employee at the GS-12 level or above. Other university training is available locally and is funded by the individual's laboratory or center.

Developmental assignments are designed to provide training that is not possessed by the participant, such as training-with-industry assignments, which are full-time, continuous, and last over 120 days.

Another training opportunity for science and engineering employees is the foreign exchange program, sponsored by the Army's international R&D community. This program is available to interested and qualified scientists and engineers who may participate in career broadening objectives in a number of countries, including Australia, Egypt, France, Germany, Israel, Korea, Norway, Pakistan, and the United Kingdom. Other countries are under consideration. There are no time limits for this program since it is on-going. However, potential candidates should plan six to 12 months in advance before actual placement to allow time for administrative procedures and possible language training prior to assignment.

Although the programs described above are primarily for Army civilian engineers and scientists, military personnel may attend training activities intended mainly for civilians. If their attendance increases costs for a course funded from a civilian program element, payment for military participants is prorated. The civilian training account will be reimbursed or direct payments will be made from the proper military account. Additionally, the Army has long-term training programs focused at the military engineers and scientists. One initiative that is currently underway is the development of a program/career path to develop a soldier scientist.

The Army is establishing an advanced training program to take advantage of recruitment and retention of outstanding college graduates in science and engineering, similar to the U.S. Air Force's "Palace Knight" program. This program will offer recent college graduates with baccalaureate degrees the opportunity to continue education with the possibility of attaining a Ph.D. at government expense.

Retention

Numerous studies in the Department of Defense and Army have noted the importance of recruiting and retaining high quality engineers and scientists in the workforce. By recruiting interns with the agreement to train them and allow them to pursue advanced training, the Army has a potential source of high quality career professionals. Statistics compiled by the Army's School of Engineering and Logistics show that out of almost 5,000 interns trained from 1957 to 1989, 90 percent were placed within the federal service and that 97 percent of the distinguished graduates are retained in the federal government. Also 16 percent have achieved high grade levels of GS-13-15 and SES positions.

Facilities and Environment

Modern facilities are essential to challenging and developing skills and potential of our scientists and engineers. The Army Supercomputer Program has been designed and established to place the Army in the forefront of leading-edge technology. This network of supercomputers allows Army scientists and engineers to have access to the most advanced computer architectures to use in engineering design, weapon systems development, vulnerability modeling, and battlefield wargaming. Professionals can pursue their career interests in numerical algorithm research, applications programming, graphics, expert systems, and artificial intelligence. Availability of such advanced technology assures continued exciting challenges to new graduates seeking career opportunities in computer science and computer applications within the Army.

The Laboratory Demonstration Program (LDP) has been launched by OSD to increase the productivity and effectiveness of DOD laboratories by implementing specific changes in procedures involving personnel management, research-related contracting, facilities refurbishment, and measures to enhance the authority of the labs' technical directors. The Army has participated in this program since its inception in November 1989 to revitalize our labs and centers.

As a result of our response to the Defense Management Review initiatives and the Lab Demo Program, we are instituting in our demonstration labs and Research, Development and Engineering Centers (RDECs) several initiatives to improve our recruitment, development and retention of quality scientists and engineers (S&Es) within the Army, be they military or civilian. For one, lab directors will have the authority to classify and direct-hire all S&E positions. This would eliminate the need for the lengthy permission-granting process now required by the Office of Personnel Management.

Other initiatives developed by the Lab Demo Program seek to streamline research and development contracting practices, accelerate the modernization of our labs and centers, improve the financial management of our R&D organizations, and delegate greater authorities and responsibilities to our lab directors. The Army is working closely with OSD and the sister services to meet the LDP objectives which have been strongly endorsed by Congress.

Summary

The DA E&S(NC) and DA E&S(RC) Career Programs span a wide variety of important technological skills which are critical to the performance of the Army mission. Army scientists and engineers have opportunities for continued education, technological challenge and service to country. New initiatives are in place to introduce exciting research and development programs to Army laboratories and centers and lead the Army into the 21st century.

DR. LUCY B. HAGAN is a physical scientist administrator currently serving in the Department of the Army E&S(NC) Career Program Office. Dr. Hagan's prior hands-on experiences in the science and engineering areas critical to Army contributes to the overall program goals. Dr. Hagan's 26 years of federal science and engineering professional work assures subject matter expertise is a prime factor in each major area of the program.

KAY M. DRISCOLL has served as the Department of the Army E&S(NC) career program specialist in the Army E&S(NC) Career Program Office for over 11 years. Prior to her current assignment, she was employed for over 20 years in the civilian personnel area. During her tenure in the AMC Civilian Personnel Office, she concentrated much of her efforts on servicing the Army E&S(NC) Career Program. Driscoll's professional background provides expertise essential to the career program's careerists.

SCIENTIFIC/TECHNICAL APPOINTMENTS

Recognizing the Army's Best Scientists and Engineers

Some of the best scientists and engineers in the world work for the Department of Army. Infectious diseases, propulsion, optics, terminal ballistics, geosciences, coastal hydrodynamics, electromagnetics, nuclear survivability, and food technology are a few of the areas to which current Department of Army scientists and engineers have made major contributions and earned national and international recognition as leaders and authorities in their fields.

These individuals, whose photos are shown on accompanying pages, have taken a career path to senior researcher and chief scientist/engineer positions by virtue of their "bench" contributions.

Until a few years ago, such positions were almost non-existent and deserving scientists and engineers were unrewarded monetarily for their contributions relative to their peers. A non-supervisory science and engineering career path was virtually non-existent beyond the GS-14 level. Individuals who wished to earn more money were forced to choose between leaving the Department of the Army or entering the management track.

Approximately five years ago, the Department of the Army recognized that it needed to make a commitment to attract and retain outstanding scientists and engineers by providing them with a viable non-managerial career track to SES-equivalency.

The scientific/technical (ST) career path is now one of three career paths available to scientists and engineers in the Department of Army. Progression in the ST career path is contingent on the signficance of the personal scientific or engineering contributions made by the incumbent.

The other two career paths are to management positions as senior executives in engineering and scientific management or to program managers/program executive officers in the Acquisition Corps.

The regulatory authority to appoint individuals to scientific/technical positions is 5 U.S.C. 3104. The authority is used for positions that are concerned with research and development in the physical, biological, medical, or engineering sciences, or a closely related field; exceed the GS-15 level; are nonmanagerial, and require qualifications that resulted in outstanding attainments in the field of research or consultation.

Candidates for ST appointment are measured on their contributions to their field as evidenced by publications, patents, citations, awards, honors, and membership and activity in national and international professional and scientific societies and organizations. Individuals may be appointed to the ST non-competitively, the person truly impacting his or her base pay by earning a "world-class" reputation as a leader and contributor to science or engineering.

The Department of the Army increased its recognition of its "world-class" scientists by increasing the number of its scientific/technical designations from three to seven. In 1991, the Department of the Army obtained authorization from the Office of Personnel Management to increase the number of its STs to 29. The current distribution of STs is: U.S. Army Medical R&D Command (1), U.S. Army Strategic Defense Command (3), U.S. Army Corps of Engineers (6), and U.S. Army Materiel Command (19).

Until 1991, STs were paid on the GS-16/17/18 pay scale. With the passage of the Federal Employees Pay Reform Act (FEPCA), the ST track became even more attractive. Individuals appointed as STs are now paid as part of a senior level system. The GS-16/17/18 pay levels have been abolished and a pay band of 120 percent of a GS-15/1 ($77,080 to level IV of the Executive Schedule ($112,100) established. The 1992 SES pay scale starts at $90,000 for an ES-1 and ends at $112,100 for an ES-6. Under the Senior Level pay system, there are no grades or steps. The SES has fixed pay levels, ES-1 through ES-6. Some of the other differences between the systems are shown in the following chart:

	STs	SES
Awards	Special Acts (up to $25,000)	Performance Awards (Bonuses) of 5 to 20% of salary Sustained
	Superior Performance Awards (up to 20% of salary)	Presidential Rank Awards of Meritorious Executive ($10,000) and Distinguished Executive ($20,000)
Mobility Requirement	No	Yes
Annual Leave	Limited to 240 carry over	Unlimited accumulation
Probationary Period	None	1 year
Status	Competitive Service with same rights and benefits	Senior Executive Service System with separate rights and benefits

The Technology Transfer Act of 1986 has also made remaining in the ST career path more attractive. This act allows scientists and engineers to receive a share of the royalties collected from inventions that have been licensed for commercial use. The Department of the Army pays inventors 20 percent of the income from invention royalties beginning with royalty reviews from fiscal year 1987. The yearly maximum, set by law, is $100,000; payments over that amount require approval of the president. The remaining royalties must go to the inventor's labs.

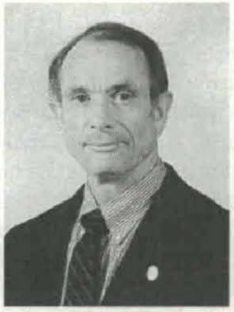
Not all the problems are solved for the ST career track. The Army, the other Services, and OSD, as part of the DOD Laboratory Demonstration Program have undertaken efforts to obtain legislative relief to the 517 limitation on ST positions government-wide.

The department has made a commitment to strengthening the R&D infrastucture. It is determined to build world-class labs and centers and provide the support that its people need to produce. A strong ST career track is part of that commitment.

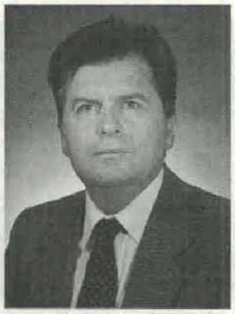
The preceding article was written by Janice M. Lynch, chief, SES/Classification Division, HQ AMC, and Suzanne O'Neill, position classification specialist, CPO, Vint Hill Farms Station, VA.

Department of the Army Scientific/Technical Appointees

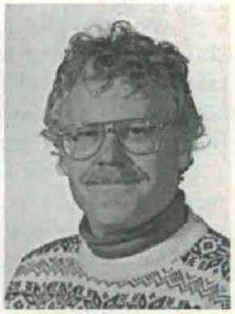
Dr. Arthur D. Ballato
Principal Scientist
Electronics Technology and Devices Laboratory
U.S. Army Laboratory Command
Comm.: (201)544-2773
DSN: 995-2773



Dr. Charles M. Bowden
Senior Research Scientist (Optical Research)
U.S. Army Missile Command
U.S. Army Materiel Command
Comm.: (205)876-2650
DSN: 746-2650



Dr. Walter Bryzik
Senior Research Scientist for Advanced Propulsion
Research, Development and Engineering Center
U.S. Army Tank-Automotive Command
U.S. Army Materiel Command
Comm.: (313)574-6461
DSN: 786-6461



Dr. Samuel C. Colbeck Jr.
Senior Research Scientist (Geophysics)
Cold Regions Research and Engineering Laboratory
U.S. Army Corps of Engineers
Comm.: (603)646-4257

Dr. Joel M. Dalrymple
Senior Research Scientist
U.S. Army Medical Research Institute of Infectious Diseases
U.S. Army Medical Research and Development Command
Office of the Surgeon General
Comm.: (301)663-7241
DSN: 343-7241

Dr. Donald Eccleshall
Chief Scientist
U.S. Army Ballistic Research Laboratory
U.S. Army Laboratory Command
U.S. Army Materiel Command
Comm.: (301)278-4708
DSN: 298-4708

Photo Not Available

Charles F. Freeman
Chief Scientist
U.S. Army Communications-Electronics Command
Night Vision and Electro-Optics Directorate
Fort Belvoir, VA 22060-5677
Comm.: (703) 704-2022

Dr. Thaddeus Gora
Senior Research Scientist (EM/ET Armament Technology)
U.S. Army Armament Research, Development and Engineering Center
U.S. Army Armament, Munitions, and Chemical Command
U.S. Army Materiel Command
Comm.: (201)724-6198
DSN: 880-6198

Dr. Gary L. Hagnauer
Senior Research Scientist
U.S. Army Materials Technology Laboratory
U.S. Army Laboratory Command
U.S. Army Materiel Command
Comm.: (617)923-5121
DSN: 955-5121

Dr. Nicholas C. Kraus
Senior Research Scientist (Coastal Sedimentation)
Waterways Experiment Station
U.S. Army Corps of Engineers
Comm.: (601)634-2018

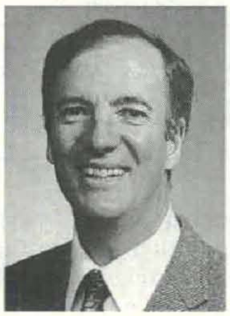
Dr. Ellis L. Krinitsky
Senior Research Scientist (Geoscience)
Waterways Experiment Station
U.S. Army Corps of Engineers
Comm.: (601)634-3329

Dr. William J. McCroskey
Senior Research Scientist for Applied Computational Aerodynamics
U.S. Army Aviation Systems Command
U.S. Army Materiel Command
Comm.: (415)604-6428

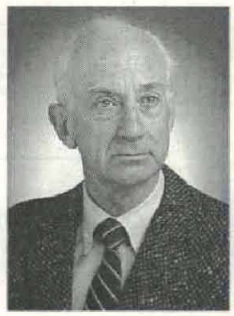
Dr. James M. McGarrity
Senior Research Scientist for Nuclear Survivability
Harry Diamond Laboratories
U.S. Army Laboratory Command
U.S. Army Materiel Command
Comm.: (301)394-3180
DSN: 290-3180

Dr. Herbert L. Meiselman
Senior Research Scientist (Behavior and Performance)
Natick Research, Development and Engineering Center
U.S. Army Troop Support Command
U.S. Army Materiel Command
Comm.: (508)651-4522
DSN: 256-4522

Dr. Edward H. Poindexter
Senior Research Scientist for Physical Sciences
Electronics Technology and Devices Laboratory
U.S. Army Laboratory Command
U.S. Army Materiel Command
Comm.: (908)544-4233
DSN: 995-4233



Dr. Joseph P. Sattler
Chief Scientist
Harry Diamond Laboratories
U.S. Army Laboratory Command
U.S. Army Materiel Command
Comm.: (301)394-2002
DSN: 290-2002



Dr. Felix K. Schwering
Senior Research Scientist for Electromagnetics
U.S. Army Communications-Electronics Command
U.S. Army Materiel Command
Comm.: (201)532-0469
DSN: 992-0469

Dr. Michael A. Stroscio
Senior Research Scientist
U.S. Army Research Office
U.S. Army Laboratory Command
U.S. Army Materiel Command
Comm.: (919)549-4242
DSN: 935-4242

Dr. Irwin A. Taub
Senior Research Scientist (Food Technology)
U.S. Army Natick Research, Development and Engineering Center
U.S. Army Troop Support Command
U.S. Army Materiel Command
Comm.: (508)651-4711
DSN: 256-4711

Dr. James J. Valdes
Scientific Advisor for Biotechnology
U.S. Army Chemical Research, Development and Engineering Center
U.S. Army Armament, Munitions, and Chemical Command
U.S. Army Materiel Command
Comm.: (301)671-3564
DSN: 584-3564

Dr. Charles L. Vincent
Senior Research Scientist (Coastal Hydrodynamics)
Waterways Experiment Station
U.S. Army Corps of Engineers
Comm.: (601)634-2008

Dr. Billy J. Walker
Senior Research Scientist for Computational Fluid Dynamics
U.S. Army Missile Command
U.S. Army Materiel Command
Comm.: (205)876-5216
DSN: 746-5216

Dr. Thomas Wright
Senior Research Scientist (Terminal Ballistics)
Ballistic Research Laboratory
U.S. Army Laboratory Command
U.S. Army Materiel Command
Comm.: (410)278-6046
DSN: 298-6046

LIFELINES ABROAD

Where should we—or can we—draw the line on foreign dependence for critical defense items?

By John T. Correll and Colleen A. Nash

Editor's Note: The following article, the second of two parts on the defense industrial base, was initially published in the October 1991 issue of Air Force Magazine. The first part appeared in the January-February issue of Army RD&A Bulletin. Both were adapted from an Air Force Association study titled "Lifeline Adrift: The Defense Industrial Base in the 1990s." For a complete copy of the study, send $5.00 to the Aerospace Education Foundation, 1501 Lee Highway, Arlington, VA 22209-1198.

Foreign dependence is the defense industrial base issue the American public understands best and to which it reacts the most intensely. In fact, the increasing penetration of defense and other markets by foreign suppliers has provoked such an emotional response that it complicates the task of those seeking sensible solutions to the problem.

Protectionist sentiment runs high in Congress. Part of it, no doubt, is genuine concern about the defense industrial base, but political passions are further driven by the loss of U.S. jobs and business to foreign suppliers.

The Pentagon acknowledged in 1988 that it did not know the extent to which it relied on foreign parts and had no way to identify, much less minimize, such areas of dependence. DOD's data have improved since then, but in the opinions of a Defense Science Board (DSB) task force, the General Accounting Office, members of Congress, and others, many blind spots remain.

Most observers agree, however, that the reliance of U.S. defense on foreign sources is extensive and growing. The classic area of concern is electronics. The problem is evident in other sectors as well.

The nation's armed forces are understandably nervous about their increasing reliance on foreign sources. Of all the problems identified in key sectors by the 1990 Air Force Systems Command Industrial Base Assessment, the dominant concern was foreign dependence.

If foreign sources were unavailable in a crisis, the Joint Chiefs of Staff say, the U.S. would be able to sustain accelerated production for only two months in such systems as the M1 tank, the AIM-7 missile, sonobuoys, and the F/A-18 fighter. It would be six to 14 months before domestic sources could deliver the critical components and materials for continued production.

Controlled, Not Eliminated

It is generally recognized that foreign dependence is a problem that may be controlled but that cannot be eliminated. One key conclusion of Lifeline in Danger, the Air Force Association's 1988 study of the defense industrial base, was that the U.S. cannot have an all-domestic defense industrial base. Even if it were possible, it would be unwise. "Buy American" policies, followed blindly, undermine interoperability and two-way trade with allies. They also drive up costs and jeopardize defense system quality by forcing prime contractors to buy higher-priced and sometimes inferior parts from domestic sources.

Nor can the U.S. cut off access to the best technology, which will be foreign technology in some cases. The proper objective is to identify critical, potentially harmful cases of dependence and concentrate on reducing them.

Acquiring defense products from foreign sources does not necessarily constitute dependence, and even dependence is not automatically crippling. Foreign suppliers may have needed some nudging in the course of Operation Desert Storm, but, in the end, they delivered. (see accompanying sidebar article). Like much else about the defense industrial base, it is a matter of calculating the risks and the realities.

Sooner or later, political and strategic repercussions tend to develop when nations are dependent on foreign suppliers for defense products. History refutes the argument that dependence is of minor consequence.

Professor Theodore H. Moran of Georgetown University points out that "all of the major European powers have experienced the agony of dependence on companies and technologies controlled from abroad." This has been true, he notes, "from the Suez crisis of 1956, for example, when the United States threatened to order its oil companies to cut off supplies if the British and French did not withdraw their military forces from the Canal, through the Johnson Administration's order to IBM and Control Data to withhold critical computer technology from deGaulle's nuclear force de frappe, to the Soviet gas pipeline case of 1982."

During its long period of dominance in weapons production, the U.S. routinely limited the access of other nations, including allies, to systems and technology. The U.S. should expect similar practices by other nations as the direction of dependence shifts.

For example, the DSB report points out that the U.S. had difficulty getting television cameras for missile mounts during the Vietnam War and that Japan's Diet held long debates over whether Kyocera should supply ceramic parts for U.S. cruise missiles. Rep. Helen Delich Bentley (R-MD) cites the case of Mobay Chemical Co., a German firm operating in the U.S. that refused to sell chemicals to the Army for weaponry. When challenged, she says, "they told the Army, 'It is policy—so sue us.'"

Concern about the U.S. reliance on foreign sources inevitably invokes memory of the 1973-74 oil embargo, this nation's most wrenching experience of having supplies withheld by nations that had us in a position of dependence.

Still Saying No

The Japan That Can Say No, by Shintaro Ishihara (a million-copy bestseller in Japan), set off shock waves in the United States with observations that the Pentagon would be "totally helpless" without Japanese chips, that Japan "is in a very strong position," and that when matters of crucial national interest warrant," Japan must "articulate our position and say no to the United States."

The DSB took note of this threat and others, commenting that, "as the leader of the Western alliance, the United States needs the freedom to take actions that our allies may wish to distance themselves from politically. Foreign dependence complicates such actions; it allows others to 'say no' and make it stick."

Mr. Ishihara is back with a new book, *The Japan That Can Definitely Say No.* It argues that Japanese technology made allied victory in the Gulf War possible and suggests that, if conflict occurs again in the Middle East, Japan could withhold financial support and spend it on "Japan's own creation of an international world order."

Politics and ideological disagreement aside, foreign governments may withhold technology for trade advantage. According to a DSB task force, that happens frequently. "Evidence of the willingness on the part of U.S. allies to withhold technology from us is increasing, probably in direct relation to the extent of technology leadership," said the task force's report.

For example, it contends Nikon makes its latest stepper semiconductor manufacturing equipment available in Japan up to twenty-four months before it will sell the devices to non-domestic firms. Nikon claims that this helps get the "bugs" out of the equipment before it is sold abroad. U.S. chip makers complain that this practice allows manufacturers in Japan to remain ahead of U.S. competitors in the production of next-generation semiconductors.

In another, somewhat more disturbing case, the DSB says that a Japanese firm withheld the sale of an advanced microelectronics package for supercomputers to a U.S. firm because the sale would have stripped a Japanese producer of its competitive advantage.

Testifying before Congress earlier this year, Nicholas Torelli, the deputy assistant secretary of defense for production resources, surveyed the situation with optimism.

"With the reduction of the threat comes a plausibility of a longer warning; thus, our previous concern about foreign dependency can be substantially softened," he said. "If the primary threat is perceived to be Third World conflicts, such as Desert Shield and Desert Storm, in which the U.S. is operating in concert with international coalitions, the probability of interdiction or arbitrary cutoff of foreign sources may not be high."

Targeting and Seizing Markets

Considerable effort is expended to make U.S. industry more productive and competitive internationally, but even if those efforts succeed, American firms must still face foreign government-industry cartels that target and seize markets with combined arms tactics. The 1991 report to Congress by SAMATECH, an American consortium working to regain the U.S. position in the computer chip market, provides a short case study in how Japan, Inc., works the drill.

In 1975, says SEMATECH, Tokyo tar-

The Strange Case of Moore Tool Company

Former State Department official Kevin Kearns got full effect with his angry article, "Who Will Build America's Nuclear Arms? The Sale of a Key Supplier Means It May Not Be Americans," in the January 13, 1991, *Washington Post.*

In short order, all hell broke loose. What Mr. Kearns had brought to light was the sale (a forty percent share, as it turned out) of Moore Special Tool Co.—described as a "crown jewel" of the U.S. industrial base—to Japanese investors. To make matters worse, the acquisition had been reviewed and passed by the government's appointed watchdog, the Committee on Foreign Investments in the United States (CFIUS).

Characterizing Moore as "the sole U.S. supplier to the Department of Energy for specific aspects of our nuclear weapons program," ten Congressman wrote to President Bush, imploring him to block the sale, using emergency powers if need be.

Moore Tool was founded in 1924, serving local clock and brass firms from second-floor shop space above a diner in Bridgeport, Conn. It prospered through the Depression and grew into one of the world's leading producers of ultraprecise machine tools. By the 1880s, about ten percent of its sales were to the government, including tooling and other items for the nuclear weapons program.

Like others in the machine tool industry, however, Moore had run into hard times recently. It had laid off seventy of its 400 workers and needed capital to upgrade its plant and equipment to become more competitive in the overseas market.

Unable to find U.S. investors, Moore struck a deal in which Fanuc Ltd. of Japan would buy forty percent of its stock for $10 million. The proposed acquisition passed through the CFIUS review without a ripple.

That changed quickly when Congressmen and others read Mr. Kearns's article. In view of Japan's strong opposition to nuclear weapons and its policies on export of weapons of any sort, there was great concern about Japanese acquisition of a critical Department of Energy machine tool supplier.

The controversy raged for a month, and on February 18, Fanuc dropped its offer to buy. With Japan in retreat, Washington's interest in the Moore Tool case diminished—except for its value in periodic clubbings of CFIUS.

Back in Bridgeport, however, the old realities had not changed. In June, four months after withdrawal of the Japanese offer, Moore Tool Co. was still searching for acceptable investors.

'We Might Have Had Trouble Recovering'

U.S. forces relied on foreign suppliers in many instances during the Persian Gulf War. The Pentagon says that in no instance was there a failure to deliver. The Department of Defense assured Congress that there was trouble only twice in getting items from foreign suppliers and that both cases were resolved amicably.

Nevertheless, according to numerous reports, high-level persuasion may have been required to ensure these deliveries, and a Japanese spokesman confirmed that cooperation was a touchy public issue in Japan, where many of the sources were located. The Congressional Research Service says that, in several cases, foreign reliance complicated the smooth flow of supplies to the Persian Gulf, even when foreign governments were cooperating to the full extent.

In the war, Air Force Logistics Command relied on foreign suppliers for parts and subassemblies forty-two times. Noting that the command was awarding about 12,000 contracts a week during the war, AFLC Commander Gen. Charles C. McDonald called the level of foreign dependence relatively small. However, he added a warning in three of the forty-two cases, no alternative supplier existed and the U.S. was in a sole-source situation.

"Foreign dependency was not a problem, but if the coalition had been different, it might have been," he said. If the foreign suppliers had chosen to cut us off for political reasons in those few cases where they were the sole source, we might have had trouble recovering."

geted semiconductors and provided its industry a wide range of assistance, including subsidized research and development, a protected domestic market, low-cost financing, anti-trust immunity, and cartel-like planning. Japanese producers teamed with the powerful Ministry of International Trade and Industry to attack the U.S. semiconductor market with determination. In the mid-1980s Japan took a two year loss of more than $4 billion, dumping American-designed, reverse engineered dynamic random-access memory (DRAM) chips on the U.S. market below the cost of production in order to gain market share.

It worked. Japanese conglomerates sustained the dumping long enough to drive all but two U.S. firms out of the DRAM business.

In 1986, the U.S. and Japan agreed to a pact that was supposed to stop the sale of chips at less than market rates. As part of the agreement, foreign producers—mainly American firms—were supposed to gain twenty percent of the Japanese chip market by 1991. Since then, and despite a small uptick last year, the U.S. share of the global chip market has declined further. U.S. sales to Japan fell far short of expectations, and the arrangement had a negative side effect. While U.S. computer makers bought chips at the high prices established by the pact, Japanese computer manufacturers bought cheaper chips from domestic suppliers.

In June, the U.S. and Japan agreed to extend the 1986 agreement with some changes. The revised deal eliminates the minimum chip price but again sets a target of twenty percent of the Japanese semiconductor market for foreigners.

The *Economist* plotted on a graph the expectations for sales in Japan under the 1986 agreement (a goal of twenty percent) and the actual experience of the past five years (topping out at thirteen percent, of which twelve percent was American and one percent European) and declared the divergence of the trend lines "the angle of unreality."

Foreign Takeovers

A variation on the straight dependence problem is the one of takeovers and penetrations of U.S. industries by foreign investors.

In response to the Exon-Florio amendment (1988) to the Defense Production Act, the President set up the Committee on Foreign Investment in the United States (CFIUS) to review foreign investments that might impair U.S. national security (which was not defined). Since its creation, the committee has blocked only one of the deals it reviewed, a case in which the government ordered the divestiture of a U.S. airplane parts manufacturer that had been acquired by an arm of the Chinese government immediately after the 1989 Tiananmen Square massacre.

Of the 540 foreign investments reported to CFIUS since 1988, the body has formally investigated twelve and made a negative recommendation on one. In some high-technology areas, says the Economic Strategy Institute (ESI) "CFIUS has even allowed the last remaining firm to be sold, apparently unconcerned that these deals will leave both the U.S. military and the private sector completely reliant on foreign suppliers of many critical goods."

ESI adds that the U.S. government refused to conduct a formal review of the foreign acquisition of Union Carbide Chemicals and Plastics Co., the only U.S. producer of ultra-high-purity polysilicon, despite the fact that the firm developed polysilicon specifically for defense purposes. It was bought by Komatsu Electronic Metals Co. of Japan. Earlier this year, public and congressional outrage stopped Japanese acquisition of a critical machine tool firm, Moore Tool Co. The sale had been passed by CFIUS (see accompanying sidebar article).

A June 1990 DSB report, sharply critical of CFIUS, said that "One problem with CFIUS is that the chairman, a Treasury Department official, has a primary goal of alleviating the overall budget and foreign trade deficits. Foreign investment is not only unavoidable but positively desirable as a means of repatriating U.S. consumer dollars that cause imports to exceed exports. Obviously, the Treasury Department does not want to frustrate the desire of foreign firms to invest capital in the United States."

The DSB task force recognized that some foreign investments in U.S. high technology are beneficial. In 1989, Materials Research Corp. (MRC), a key producer of semiconductor equipment, faced bankruptcy and could not find domestic financing. It stayed afloat with funds from Japan's Sony Corp. The task force reported that "with MRC, the United States now has at least a domestic location and relatively assured access to sixty percent of the world's equipment for sputtering materials [specialized materials used in the production of semiconductors]. If MRC had gone bankrupt, our assured access might have been reduced to roughly two percent."

Some members of Congress believe CFIUS needs new leadership and tougher orders. In her proposed Technology Preservation Act, Rep. Cardiss Collins (D-ILL) suggests amending Exon-Florio to tighten controls and restructure CFIUS. The amendment would specify that impact on the U.S. industrial and technology base be a criterion for review and would require that foreign investors in mergers, acquisitions, and takeovers give written assurance that their plans and intentions would not impair national security.

The level of foreign dependence in the defense technology base varies by industry. In some sectors, such as semiconductors or machine tools, foreign companies hold a majority of the market and control a major share of the technology. In others, like computers and materials, the U.S. still holds a decisive lead in technology but foreign companies are taking an increasing share of the market.

Foreign dependence is not a new problem, and time has softened the psychological shock. The Pentagon and the services now take a practical view of the matter and have adjusted themselves to living with a certain amount of reliance on foreign suppliers.

Machine Tooling is the Cornerstone

Some commodities and some industries, however, remain of special concern. Among these is the machine tool industry, which has been characterized as the "cornerstone of the nation's industrial base." Machine tools cut, grind, shape, and form materials, including metals, into useful products. From 1982 to the present, the import share of the U.S. machine tool market rose from twenty-six percent to about fifty percent.

Defense Department purchases account for some ten percent of the U.S. machine tool market. In 1987-89, DoD made 2,350 machine tool procurements. Of those, 1,550 were from the restricted list, meaning a waiver was required for non-domestic purchase. Foreign-made tools on the restricted list were bought in 108 cases.

Efforts to shore up domestic machine tool industry have had some positive results. One of the most successful projects of the National Center for Manufacturing, a research consortium established in 1986, has been the development of a machine tool that combines tap and drill functions.

Nevertheless, the machine tool industry as a whole is still struggling, and the problem could have some long-range effects. Albert Albrecht, owner of a machine tool consulting firm, says that "what the statistical numbers do not reveal is the loss of engineering and shop floor skills. The loss of manufacturing talent, as a result of the decline in the machine tool industry, is perhaps more serious than the lost volume. It is conceivable that we could reach the point of having to depend upon foreign suppliers to tool up a U.S. Army shell line in a GOCO [government-owned, contractor-operated] plant."

Mr. Albrecht points out that, in 1991, "overall earnings were down significantly, as were shipments. The industry needs help if it is to survive." It is conceivable that, by 2000, "there will not be a U.S. machine tool industry to support our defense needs," he warns.

Meanwhile, the Japanese machine tool builders' backlog (5.7 months) now surpasses that of U.S. firms (5.2 months). The demand is growing in this Japanese industrial sector, already working at capacity.

The "Four/Fifty" Rule

The question is not whether defense will be dependent on foreign sources—that's given—but where we should (and can) draw the line. Professor Moran proposes a "Four/Fifty" rule, in which defense industrial strategists would seek to ensure that no four countries or four companies supply more than fifty percent of the world market. He further stipulates that sources under this rule should meet an "arm's length" standard. That would appear to exclude sources controlled by adversaries or others with interests potentially in conflict with the U.S. defense program.

It is difficult to say how actual circumstances today square with the proposed "Four/Fifty" rule. For some commodities, the armed forces would probably welcome with joy the existence of four reliable sources.

It is no longer as easy as it once was to specify whether a source is foreign or domestic. As the Office of Technology Assessment notes, "Individual companies and entire industries are becoming internationalized. It is becoming increasingly difficult (if not impossible) to define what an American company is."

In any case, the government does not look at U.S. sources alone but all those available in the entire North American industrial base. By long practice, formalized in the Defense Development and Defense Production Sharing Arrangements of 1959 and since reinforced, the U.S. and Canada regard themselves as partners in industrial preparedness.

In today's multinational world, components of a product may be manufactured in several different countries and assembled in yet another. Determination of whether the finished item is foreign or domestic often involves percentages.

For example, the Defense Federal Acquisition Regulation Supplement goes to some length in defining a machine tool as U.S. or Canadian if it is manufactured in the U.S. or Canada and the cost of its components manufactured in the U.S. or Canada exceeds fifty percent of the total cost of its components. "Cost of components" is further defined as including transportation expense and duties.

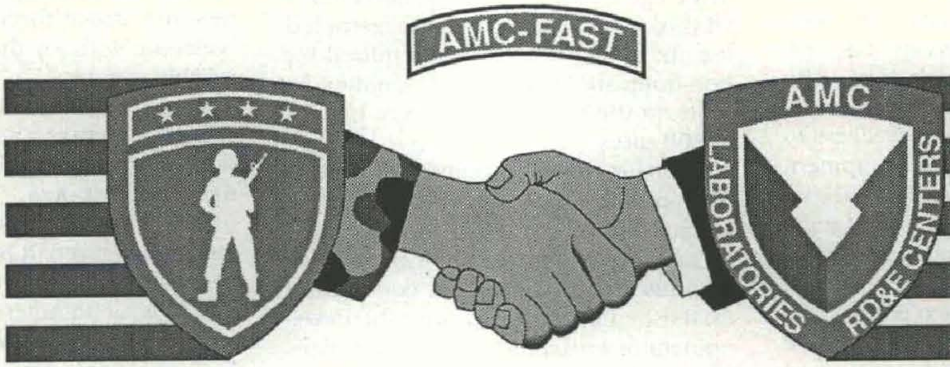
According to the President's Council of Economic Advisors, two-thirds of exports from the United States today are traded by multinational corporations. About twenty-five percent of all U.S. exports and fifteen percent of all U.S. imports are transfers between parent multinationals and their affiliates abroad.

Cyrill Siewert, former chief financial officer of Colgate-Palmolive, says bluntly, "The United States does not have automatic call on our resources. There is no mindset that puts this country first."

Colgate-Palmolive does not loom large in the defense industrial base, but, in time, a U.S.-based multinational with a more critical product line could adopt a similar attitude.

JOHN T. CORRELL is editor-in-chief of Air Force Magazine.

COLLEEN A. NASH is associate editor of Air Force Magazine.



AMC-FAST LESSONS LEARNED IN THE GULF

By Richard E. Franseen

The Army Materiel Command's (AMC) Field Assistance in Science and Technology (FAST) Program lived up to its acronym—FAST—before, during and after Operation Desert Storm. From Sept. 19, 1991 to Oct. 11, 1991, AMC FAST sent 12 teams to Southwest Asia. These teams "hand carried" special equipment to the troops, identified needs, provided instruction on use of equipment and supervised fielding.

Back at their home stations, FAST science advisers assisted in solving problems which needed almost immediate solutions. These ranged from fuel contamination to grounding of electrical equipment to securing tents to sandy soil under windy conditions. Meanwhile, FAST Headquarters was occupied with coordinating the effort, assisting in procurement, organizing teams, and supervising their employment. From all of this, FAST learned many lessons, but there are three which stand out:

- The existence of the FAST Program prior to the war made it much easier to respond to urgent wartime requirements.
- Equipment problems become more apparent under wartime operational use than under any other condition.
- It is far easier to field equipment in wartime than in peacetime.

This article addresses these lessons by describing how FAST became involved in Desert Storm/Shield, what it did, how it did its work and some of the equipment and solutions provided.

Before describing FAST activities in Desert Shield/Storm, it is necessary to make a specific point. AMC-FAST science advisers provide an information collection and dissemination service. They can coordinate efforts, supervise projects and conduct demonstrations. When it comes to actually producing products and providing solutions, AMC laboratories and centers do the work. Whenever a FAST project is mentioned, it should be understood that there is always a lab or center, and often more than one, involved in providing advice and producing the required hardware. Whenever a science adviser responds to a field command need, labs and centers are asked to become involved. The science adviser is not just a member of the FAST Program, he is also a representative of the entire Army Materiel Command.

At the beginning of Desert Shield, the FAST Program consisted of a headquarters, 17 science advisers in the field and designated points of contact at all of AMC's laboratories and centers, the Engineer Topographic Laboratories, and the Training and Doctrine Command. All of these elements became involved at the very beginning of the crisis in the Middle East. Even before units were alerted, there were many urgent meetings between supported commands and their science advisers. These meetings and requests for assistance in terms of equipment, modifications and advice, continued and intensified as units were alerted and moved out.

Some examples of assistance provided by science advisers are extremely instructive. The Forces Command science adviser, Dr. Don Snider, was requested to look into the problem of grounding electrical equipment in desert soil which has insufficient coductivity for normal means of grounding. Dr. Snider contacted the Communications and Electronics Command, identified several potential solutions and advised FORSCOM. One item being worked on at the time of Dr. Snider's initial investigation, the Surface Wire Grounding System (SWGS), has since successfully completed a field test and it appears that it will become standard issue. In addition to the grounding problem, Snider gave assistance in providing available prototype Auxiliary Power Units for Abrams tanks, lithium battery testers and information on anchoring tents in sandy soil. Recent reports indicate that the lithium battery testers proved their worth in ensuring that the batteries of units about to engage in action had sufficient charge to meet their operational needs. A program is underway to field the lithium battery testers throughout the Army.

Just prior to the Middle East crisis, Dr. Pat Easton, III Corps science advisor had identified a fuel contamination problem at Fort Hood. With the impending deployment of III Corps troops to Southwest Asia, the requirement to solve the fuel problem became urgent. Dr. Easton called in fuel experts from the Belvoir Research, Development and Engineering Center (BRDEC). With BRDEC and contractor support, the problem of microbiological contamination was solved.

FAST advisers in Germany had been working on projects to increase the mobility of Tactical Operations Centers (TOCS), and to improve the surveillance capability for Scouts.

A significant delay in setting up and tearing down battalion TOCs was having to assemble, then manhandle into position a 30 foot high antenna mast. Early in 1990, FAST, supported by CECOM, the Signal School, and BRDEC demonstrated several quick erect antenna masts. Following several comparative demonstrations, USAREUR selected a mast. As is often the case, the field knew what it needed and a solution had been identified, but there was no procurement authorization money allocated to purchase and field the item. General Crosbie Saint, CINCUSAREUR, personally directed the use of USAREUR funds to purchase 126 masts. By the time they were delivered to USAREUR, many Seventh Corps units were already in the Middle East.

Todd Stevenson, science adviser to Headquarters, USAREUR and chief of the FAST European Division, went to Saudi Arabia to insure delivery to the troops and the proper installation of the antenna masts on M577 vehicles. In fact, Stevenson was there when Desert Shield became Desert Storm. The extra effort in personally supervising delivery and installation of the masts paid off. The masts proved themselves in combat. Because of them, battalion TOCS could emplace and displace more rapidly. USAREUR is currently continuing the fielding of these masts.

Another USAREUR concern had been the need to improve the surveillance capability of Scouts. Despite advances in night vision devices and optical devices, Scouts still had eight-power binoculars as their only visual aid. General Saint, CINCUSAREUR, stated that given this limitation, Scouts would first learn of an enemy's presence when they received enemy fire. General Saint then described the operational requirement for Scout surveillance in practical terms of what should be seen at specific distances. In an effort to meet this requirement, the Night Vision and Electro-Optics Directorate took two approaches: addition of a two power extender lens to the ANTAS-6 Far Infrared Night Observation System and purchase of a foreign thermal imaging device. As a FAST project, both items were demonstrated in Europe. The requirements were briefed to the Army Commanders Initiatives Program (ARCIP) Board and arrangements for limited fielding in Europe had been accomplished by the beginning of Desert Shield. (The ARCIP Board consists of: the military deputy, Office of the Assistant Secretary of the Army (RDA); deputy commanding general for research development and acquisition, U.S. Army Materiel Command; commander, U.S. Army Laboratory Command; director, force requirements, integration and deep operations, ODCSOPS; assistant deputy chief of staff for personnel, ODCSPER; director, supply and maintenance, ODCSLOG; deputy director, program, analysis and evaluation, OCSA and deputy chief of staff for combat development, TRADOC). Recog-

FAST Shuttle Equipment Provided to Troops in Southwest Asia in Support of Desert Shield/Desert Storm/Operation Provide Comfort

- Sleep Restraint Systems for M1 with Installation & Training
- TW25B™ Dry Lubricant for Weapons
- Cloth Bag Covers for Rifles and Pistols
- Stabilized Binoculars
- AN/TAS-6 FLIRs with 2x Extender Lens
- Desert Clothing and Boots
- QUESTAR™ Telescope Surveillance Systems
- John Deere™ Lightweight Haulers
- Computer Hardware and Software
- Barrett™ .50 Caliber Sniper Rifles and Rufus Rounds
- Voice Amplifiers for M17 Masks & PA
- Anti-Magnetic Mine Probes
- Infrared Chemical Lights
- Hand Held Radios
- Clear Lane Marking Systems
- 5 Gallon Water Cans with Mask Adaptors
- IGLOO™ Water Coolers
- Reinforced Sledge Hammers
- Desert Tires for HMMWVs and 5-ton Trucks
- Sand Dune Avoidance Kits for Helicopters

- 1kw Power Generators
- 50ft Portable Watch Towers
- HMMWV TOC Shelter
- Solar Covers for Tanks and HelicoptersTank Decoys
- Night Vision Pocket Scopes
- High Strength Bolt Cutters
- AN/PVS-7A Goggles and AN/PAQ-4 Aiming Lights
- Visible and IR Chem Lights for ID/IFF
- 10m Quick Erect Antenna Masts, Installation & Training
- Lessons Learned/Materiel Requirements Study
- 6x6 Lightweight Hauler & Spare Parts
- Broco Steel Cutting Torch
- Visual and IR Chemical Light Circle
- Night Vision Pocket Scopes
- Individual and Squad Water Filter Kits
- Individual Camouflage Over Garments
- Thermal Insulating Material
- 1kw Generator

Figure 1.

nizing the greater requirement in Southwest Asia, priorities were shifted and the Scout surveillance devices were sent to Desert Storm. These devices proved their worth in combat and are now being supplied to the forces in Europe.

The first involvement of FAST Headquarters in Desert Storm/Shield resulted from its mission of supervising and directing the science advisers. FAST also received direct tasking from LABCOM and AMC. Responding to a survey conducted by AMC and LABCOM, FAST submitted a list of projects which had the potential to increase the operational capability of the troops in Southwest Asia.

One item which illustrates the increased capability to field items in times of emergency is the Sleep Support System. This device had been developed by the Human Engineering Laboratory (HEL) as a FAST project. It permited crew members of tanks in stand-by type operations to gain recuperative sleep inside the confined space of tanks. The system would allow one or two crew members to sleep while the other crew members stayed alert. The device had proved itself in previous USAREUR tests to be an extremely good idea which addressed the real problem of crew exhaustion. However, the use of the system, ran head-long into a long standing belief that one troop sleeping in a tank would cause the others to fall asleep. The resistance to the Sleep Support System remained strong and there was no impetus to field it until Desert Shield.

It was quickly learned in Southwest Asia that tankers sleeping on the ground were vulnerable to both vehicles moving around and some rather nasty creatures which made their home in the desert. In addition, there was the threat of chemical warfare with the possible requirement to stay buttoned up for the doctrinal 72 hours. In face of these conditions, it was determined that upholding the practice of not sleeping in tanks was not as valuable as providing the tank crew members a means of conserving their energy and maintaining their fighting condition. In short, the Sleep Support System was finally accepted for Desert Shield use.

HEL supervised the purchase and the delivery of more than 1,000 Sleep Support Systems to the forces in Desert Shield. As proof of the combat value of this system, MG Joe Rigby, AMC, DCS for research, development and engineering, on May 31, 1991, requested the Tank-Automotive Command to assume item management of the Sleep Support System and to complete all actions necessary for expeditious type classification.

Key to the ability of FAST to support Desert Shield/Storm were the "shuttle" trips which were initiated on September 19, 1990. The first trip was made by John Hall, retired BRDEC Sergeant Major and BRDEC/AMC-FAST's soldier interface. The shuttle trips were conducted to deliver equipment, demonstrate its use, and to determine additional requirements which would be fulfilled on a following trip. Equipment provided is shown in Figure 1. The shuttle trips provided direct communication between troops in the field and a representative of the AMC development community. The needs of the field which were outside of logistic channels were discussed and available solutions could be quickly supplied directly back to the troops in need. The access of the teams to the operational commands and the responses of AMC labs and centers attested to the value of the shuttle trips.

As a follow on to the shuttle team effort in Desert Shield and Storm, FAST sent John Hall on a support mission to Operation Provide Comfort. On April 22, the 3/325 Airborne Combat Team staff provided the SETAF science adviser, Russ Phelps, a list of special items needed for their mission in Iraq. Forty-seven days after the request (June 9), Hall, the BRDEC/FAST soldier interface, was on his way to Iraq. Within one week, he delivered the material which he had accumulated in response to the 325th request. He also provided information and instructions on how to use the equipment and he identified additional areas in which help could be provided.

Concerning the first lesson learned, it was clear that the already established FAST organization provided AMC a means of responding quickly to problems which suddenly became very important in time of war. The second lesson—in time of war, problems become more apparent and the need to solve them becomes more urgent—was clearly evident in the III Corps fuel contamination problem, in securing tents in high winds, improving electrical grounding and improving scout surveillance capabilities. The third lesson—it is easier to field equipment in wartime—was illustrated by the Sleep Support System, the Quick Erect Antenna Mast and the Lithium Battery Testers.

In response to these lessons, FAST has begun a re-examination of the assignment of its science advisers. As a result, FAST will provide science advisers to the Special Operations Command and USARSO. In addition, FAST is restoring a previously deleted science adviser position to Korea. With a limited number of advisers it is essential that the commands with the greatest needs are supported and the review of needs versus resources will continue. FAST is also emphasizing the need to not just identify problems, but to estimate their wartime impact. As a follow-on, all FAST projects are now prioritized with special consideration given to their application in combat.

During the past two years, FAST has increased its efforts in obtaining the fielding of successful projects. In future efforts to field projects, their wartime benefits will be emphasized. In addition, FAST will examine short cuts used to field equipment in Desert Storm to determine if similar measures can be taken in peace time.

In conclusion, like most of AMC, FAST worked overtime during Desert Shield, Desert Storm and Operation Project Comfort. FAST is indebted for the support provided by the AMC community and appreciates the good reception received from the using forces. FAST will use the lessons learned in the recent crisis to be in an even better position to serve when the occasion arises.

RICHARD E. FRANSEEN is director of the U.S. Army Materiel Command's Field Assistance in Science and Technology Program. He has served as a research and development engineer with the Army Materiel Command for 27 years. He holds a 1963 B.S. degree in mechanical engineering from Rice University and performed post-graduate study in electro-physics at George Washington University. He graduated from the Defense Systems Management College Program Managers Course in 1985.

THE ARMY RESEARCH OFFICE: SHAPING THE FUTURE THROUGH ELECTRONICS

By Dr. James W. Mink, Dr. Gerald J. Iafrate, Dr. Robert W. Shaw, Dr. Michael A. Stroscio and Dr. William A. Sander

Introduction

Electronics is a pervasive technology under-pinning virtually all Army systems; it is the technology upon which all "force multipliers" are derived. Electronics technology is fundamental to the development of new battlefield capabilities which place emphasis on mobility, electronic surveillance, target acquisition, smart weapon systems, and battlefield management for the Army environment.

The principal objectives of the Electronics program at the Army Research Office (ARO) are multifold: to provide technical leadership in meeting unique Army requirements through scientific innovation; to promote Army-unique science and technology to provide quantum leap development opportunities; and to accelerate technology transfer to Army systems developers.

Army "platforms" requiring Army-specific systems include the helicopter, tank, troop carrier, and, most important of all, the soldier. Each of these has unique missions and systems requirements. In some respects, requirements for the soldier are the most challenging—equipment must be compact, lightweight, rugged, maintenance-free during combat, and require little power.

The ARO electronics program of today focuses on new fundamental concepts and opportunities for the Army systems of tomorrow. To accomplish these objectives, the ARO process for developing research priorities includes maintaining knowledge of the Army's mission area deficiencies and strong interaction with Army laboratory and center engineers and scientists.

Background

Modern electronics came to military prominence as a result of research efforts in the World War II era. During that period, there was a tactical imperative placed on RADAR systems, improvements in navigation techniques including electronic methods such as radio direction finding and long-range navigation (LORAN), and improvements in radio communications. Early electronic systems were, by today's standards, primitive and limited in complexity and capability due to the large physical size, high power consumption, and poor reliability of vacuum tubes.

The invention of the transistor in 1947 changed the world of electronics. The transistor's small physical size, low power consumption, and high reliability set into motion miniaturization of electronics systems which continues today. As electronic circuits become smaller, the complexity and capability of the system for a given volume increases greatly. In addition, because of integration, the reliability of electronic systems continues to dramatically improve to where the Army can envision electronic systems which last without repair for the life of the system in which they are embedded. ARO has sponsored research contributing to these developments since its formation in 1951 and continues to sponsor research for the next generation of Army electronics.

Accomplishments

Knowledge gained through electronics research is relevant to a wide variety of developmental efforts and contributes to the solution of technology-related problems in communications, command and control, intelligence, surveillance, electronic and signals warfare, smart weapons, guidance, and fire control. New research areas are added and others dropped as continually changing Army needs, technology maturity, and research opportunities become apparent.

In the early 1970s, the Electronics Division recognized that projected Army systems demanded electronic systems with a level of complexity that could not be achieved through then conventional techniques. The man-hours required to design integrated circuits manually would make the cost prohibitive. Since these components would be critical to future Army electronic systems, a program of research in computer aided design (CAD) was initiated. Research by Professor Dutton at Stanford University and by Professor Pederson at the University of California at Berkeley created the base for all electronic device and integrated circuit computer-aided design tools in the world.

The research of Professor Dutton is focussed upon the device and the physics of the fabrication process and has resulted in codes called SUPREME and PISCES. Research addressing computer simulation of integrated circuits was conducted by Professor Pederson. The simulation he developed is called SPICE. These CAD tools (SPICE, SUPREME, and PISCES) are now the world standards for simulation and are utilized by industry, universities and government world-wide.

Without CAD tools, industry would not be able to design and manufacture today's integrated circuits and microprocessors. Not only have these tools provided the capability to design complex ICs, but they also have provided industry with the capability to design and produce Army electronics compo-

The U.S. industry investment in basic electronics research is declining which makes the Army's investment in basic electronics research critical.

nents at greatly reduced cost. Specific Army applications of these innovations include Very High Speed Integrated Circuits (VHSIC), Microwave and Millimeter Wave Integrated Circuits (MIMIC), infrared sensors, and radiation effects on electronics devices. These applications are also essential for redesign of circuits to solve problems of non-available parts and upgrades for Army systems.

The Army's capability to fight at night is a direct result of the science of infrared detector materials and photoelectronic phenomena for image intensification. The ARO maintains a large program of research in the area of infrared detectors. One aspect of this program has been the investigation of semiconductor interfaces which has resulted in greatly improved yield and uniformity of imaging devices. In addition, this research provided the foundations upon which a broad class of high speed and high frequency devices are built. At Stanford University, Dr. Jim Gibbons' work on the control of electronic properties of gallium arsenide by doping and metal contacts on gallium arsenide has led to higher frequency transistors. Portable Army satellite communications and navigation systems are possible now only because of high frequency, low noise transistors resulting from pioneering research in these areas.

Army systems providing secure communications are of major importance. These systems are a direct result of past research supported by ARO. The ARO electronics program provided leadership in research addressing spread spectrum coding as utilized by the SINCGARS radio system. In a related area, ARO research pioneered techniques in electronic counter-counter measures to counter effects of jamming and the near-far problem for spread spectrum radios. While these techniques were investigated to solve unique Army needs, the civilian sector is now following the Army's lead and is incorporating them into civilian applications such as cellular telephones.

Also, research supported by ARO in adaptive antennas and processing for direction finding and time of arrival estimation has made important contributions to signal intercept development at the Communications-Electronics Command (CECOM) Signals Warfare Directorate. Research of Dr. B. Steinberg at the University of Pennsylvania has led to great improvements in the angular resolution of microwave imaging which are now under review for Army battlefield surveillance. His research enables the Army to obtain optical quality images of targets with radar systems which are not significantly degraded by adverse battlefield conditions.

The Electronics program at ARO supported the pioneering research of Professor Zadeh at the University of California at Berkeley in fuzzy set theory to understand and improve the process by which a computer makes optimum decisions with uncertain or incomplete information. These techniques have unique Army applications that range from aided target recognition to information fusion and command and control. Again, the civilian sector is following the lead of ARO and fuzzy set theory is now being used in other applications such as subway control, automotive transmissions, cameras and heating and air conditioning systems.

These are just a few of the accomplishments of ARO supported research, which indicate the great range and fertility of the program.

Electronics at ARO Today

The ARO research program in electronics is coordinated by the Electronics Coordinating Group (ECOG) which consists of scientists from ARO; Electronics Technology and Devices Laboratory; Harry Diamond Laboratories; CECOM Night Vision and Electro-Optics Directorate; CECOM Command, Control, and Communications Systems Directorate; Missile Command; Belvoir Research, Development and Engineering Center; CECOM Signals Warfare Directorate; Ballistic Research Laboratory; White Sands Missile Range; TRADOC; and Strategic Defense Command. Meetings, held several times each year, enable Army scientists to review and coordinate Army-wide electronics programs, to plan and maintain an electronics research program that is responsive to Army needs identified by the Army labs and centers, and to look forward to identify future enabling electronics technologies.

The current program, as in the past, is driven by the need to generate new fundamental knowledge and understanding of the science of electronics leading to significantly improved capability and performance of U.S. Army systems to provide the technological edge on the battlefield. For example, the Army Tech Base Master Plan indicates there is a need to increase real time signal processing by several orders of magnitude to support future battlefield needs. To achieve these goals, electronics research programs are focused on providing more powerful, more compact, more reliable equipment to give the soldier real-time information to control weapon systems, and to support command, control, communications, and intelligence.

The ARO program supports basic research in signal generation, transmission, reception, and processing. More powerful transmitters and receivers enable improved Army ability for surveillance and target acquisition, communications, and disruption of enemy sensors and communications. Research in signal processing enables faster acquisition and analysis of more information (e.g., continuous location of friendly and hostile forces and analysis of images of possible targets), target identification and tracking, and fire control.

The U.S. industry investment in basic electronics research is declining which makes the Army's investment in basic electronics research critical. In response to this need, ARO seeks to provide the next generation of Army electronics through the exploitation of new electronic materials, fundamental understanding of the behavior of devices, and new concepts for the fabrication of high speed, high frequency circuits.

Research on new electronics materials and device and circuit configurations is leading to faster, smaller computing devices and more sensitive, higher resolution detectors. The value of such devices is illustrated by the global positioning system, communications systems, surveillance systems, smart weapons, and battlefield computers used widely in Desert Storm.

Center of Excellence Programs

During the period when the basic research offices in the Army and Navy were being established, the armed services began the Joint Services Electronics Program (JSEP) to enable continued electronics research at the universities that had made major contributions to the World War II effort. This program began at the Massachusetts Institute of Technology, Harvard, Columbia, and Stanford in 1946 and has been continuous since that time. It is the oldest government funded university research program in the U.S. and is funded and managed by the three services providing tri-service coordination and leveraging of research funds.

Research conducted under the JSEP program continues to be dynamic and at the forefront of electronics science. The focus of JSEP is on those fundamental areas of electronics research with high risk and correspondingly high payoff to the Army.

Important accomplishments during the early years of JSEP include the pioneering work by Professor Charles Townes at Columbia University for which he received a Nobel Prize and which ultimately led to the LASER. The LASER is now an essential component of many Army systems such as ranging, target designation, smart weapons, and optical communications. Also, in 1981, Professor N. Bloembergen received the Nobel Prize for his contribution to laser spectroscopy conducted under JSEP support.

The research of Jerrold Zacharias at MIT, using cesium atoms to measure frequencies with great precision led directly to the development of the atomic clock which is crucial to numerous modern technologies requiring accurate measurement of time. The global positioning satellite system used by our troops during Desert Storm and communications synchronization directly benefit from this research.

For the past five years, ARO has managed the DOD University Research Initiative Center for High-Frequency Microelectronics at the University of Michigan. The Michigan center has a broad range of research, has supported 36 U.S. citizens as graduate fellows, and has collaborated with Army scientists and engineers from the Army's Electronics Technology and Devices Laboratory, Harry Diamond Laboratories and the Missile Command. Among their many accomplishments, Michigan scientists have established the world's leading capabilities in the growth and specialized use of indium-gallium-arsenide, an important new semiconductor material. The Army has unique requirements to make use of this material that has already demonstrated superior characteristics for sensor and receiver applications of the U.S. Army Missile Command.

Additional Army applications of indium-gallium-arsenide technology include specialized millimeter wave integrated circuits and optoelectronic detectors for applications in missile seekers, communications, and smart munitions. Scientists from the University of Michigan are currently coordinating with scientists of the U.S. Army Missile Command to transfer monolithic millimeter wave integrated circuit technology based on indium-gallium-arsenide.

The Future

Current trends in electronics which the Army must capitalize upon to meet future system needs include dimensional scaling of existing device structures to atomic level dimensions (e.g. quantum well and superlattice devices); increased use of optoelectronic, photonic, and electromagnetic device concepts; and the investigation of advanced materials, including engineered and artificially structured materials.

The Army research community must also be diligent in exploiting all opportunities for new, more powerful architectures based on optical interconnections, optical computing and optical signal processing. Future devices for ultra-fast processing of data will rely heavily on the interface of microelectronics and optics which will permit the full utilization of bandwidth and allow novel parallel processing functions to be implemented. Similarly, highly parallel and reconfigurable multiprocessor arrays will find extensive use in computationally intensive applications and in neural networks. These arrays will have many important Army applications.

The electro-optic interface will allow high resolution video data transfer to be realized. Images will be transmitted in real time for subsequent processing, analysis, and decision. Command centers will be able to store libraries of images of friendly and hostile forces and to perform an optical comparison of target images and tactical deployments. Eventually, optics will be introduced into integrated circuits and devices will be controlled by optical and quantum interference phenomenon. This quantum opto-electronics implementation may achieve the ultimate physical limit of performance in terms of minimum size and maximum bandwidth.

Just as the research carried out over a quarter century ago provided the technology base for the global positioning satellite system, so the research carried out today will enable the U.S. Army to make our future soldiers safer and more effectively armed. We at ARO look forward to increasing our effectiveness in accomplishing the Army's mission.

DR. JAMES W. MINK is director of the Electronics Division at the Army Research Office (ARO). He has a Ph.D. in electrical engineering from the University of Wisconsin.

DR. GERALD J. IAFRATE is director of ARO. He has a Ph.D. in physics from Polytechnic Institute of Brooklyn.

DR. ROBERT W. SHAW is associate director of the Chemical and Biological Sciences Division at ARO. He has a Ph.D. in physical chemistry from the University of Washington.

DR. MICHAEL A. STROSCIO is senior research scientist at ARO. He has a Ph.D. in physics from Yale University.

DR. WILLIAM A. SANDER is associate director of the Electronics Division at ARO. He has a Ph.D. in electrical engineering from Duke University.

A DIAMOND IN THE ROUGH: THE NATIONAL TRAINING CENTER

By SPC Galen Wiering

Introduction

"All excellent things are as difficult as they are rare." That quote by Benedict (Baruch) Spinoza sums up the National Training Center (NTC) extremely well. The NTC is one of the finest training facilities anywhere in the world; not because it is easy, but because everything about it is a challenge. The Mojave Desert can be a very unforgiving adversary and it is no mistake that the opposing forces (OPFOR) slogan is "No Slack." Added to this are the brutally honest after action reviews (AARs) that the observer controllers (OCs) give to the player units.

The mission of the NTC is simple: to provide tough, realistic combined arms and services joint training in accordance with air land battle doctrine for brigades and regiments in a mid to high intensity environment while retaining the training feedback and analysis focus at battalion/task force level.

To do this, the NTC hosts a 28-day rotation 12 times a year. NTC began its first rotation in 1982, and has conducted 116 since then. This adds up to close to half a million soldiers, more than 120,000 NCOs and 31,500 officers. This is even more impressive when one considers that these soldiers return to home station and pass on the lessons they learned to other soldiers. Training at the NTC literally affects every CONUS-based soldier.

Rotation

The rotation is the very heart of the NTC. Units come to the NTC from each division, separate brigade and armored cavalry regiment in CONUS. Consisting of 4,000-5,000 soldiers, they represent infantry, armor, artillery, aviation, chemical, logistics, air defense, engineering, MP, electronic warfare, and special operations units.

Realism

The highest priority is placed on realism at the NTC. Almost nothing is simulated. For example, if a commander wants a tank ditch dug, he must send his engineers out and they must dig that ditch. If a soldier is injured in a battle, he must be evacuated properly, and if he dies, a new soldier must be requisitioned. If not, he will not be re-keyed (have his Multiple Integrated Laser Engagement System reset) and he will not be able to participate in the next battle. The same goes for equipment. If orders for spare parts are not filled out properly, the unit won't get any parts. If the food is lost, the unit will go hungry. To add further to the realism, close air support is provided by the Air Force through the Air Warrior Program. These sorties, flown out of Nellis AFB, account for 50 percent of all close air support sorties flown in the United States.

This realism not only adds stress to commanders, simulating combat, but also causes mistakes that would not occur in a less realistic situation. The OPFOR are experts at exploiting mistakes, and learning from mistakes is the name of the game at the NTC.

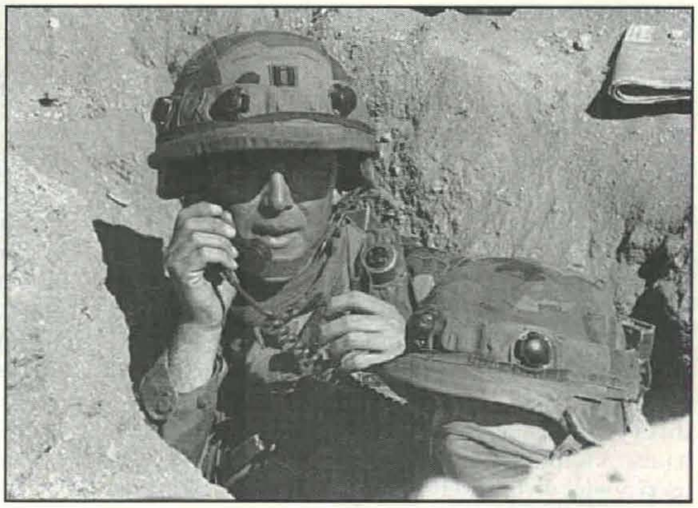
The 28-day cycle includes a 14-day combat cycle in which the unit is completely tactical, and seven days for equipment draw and seven days for equipment turn in. The 14-day combat cycle is broken into two phases. In the first phase, the unit is split into two units; one goes to live fire exercises while the other begins force-on-force training. After five days, the two units switch places for another five days. The final time is spent with the whole unit participating in force-on-force exercises.

During this force-on-force training, a unit will have a variety of missions, including movement to contact, hasty attack, deliberate attack, defend in sector and defend from a battle position. This continuous scenario is created by scenario writers based on the unit's Mission Essential Task List (METL), wartime missions and past missions of the NTC.

It should be stressed that the NTC does not specifically conduct "desert training." In fact, the combat training conducted and battle tactics employed are designed to be applied in any contingency irrespective of geographical location.

To supply all the necessary equipment for rotation and to cut down on transportation costs, the NTC has a prepositioned stockage in which visiting units can draw the vehicles they need. The prepositioned equipment

Troops hit the ground running in this bayonet exercise by the OPFOR's 87th Engineer Company.



A commander from a player unit communicates with his troops. Note the Multiple Integrated Laser Engagement Systems on both helmets.

consists of a battalion set of M1A1 tanks, M2 Bradley Fighting Vehicles and M109 howitzers. The wear and tear on these vehicles is enormous. A single 28-day rotation will put the same amount of wear on a vehicle as six months of war at their home station, according to LTC Ronald Hale, garrison support operations officer.

The unit must bring some of their own vehicles with them to supplement their draw. Those vehicles are brought by railroad to the Yermo Annex of the Marine Corps Logistic Base and then trucked out to Fort Irwin. Of the two to 10 million dollar cost for each rotation, the transportation of vehicles makes up the largest percentage.

Organization

The NTC is organized into five separate groups. Operation Group (Ops Group) is in charge of training and coaching the player units. The 177th Armored Brigade is the opposing force—a highly experienced field unit who takes pride in being a counter training unit for visiting American units. Garrison command is in charge of beans and bullets, insuring that the other groups have the proper resources to complete the mission. The Medical Activity/Dental Activity Department is responsible for the health and welfare of the NTC. Finally, the command group insures that all units are accomplishing their tasks as ordered so that visiting units get the best training possible.

These units, working together, make up the NTC—a post that looks like any number of other posts, but is a post that is like no other.

There are numerous reasons why the NTC is unique in comparison with all Army posts. These reasons include size and location, a sophisticated live-fire exercise, a dedicated OPFOR, full-time OCs, and an instrumented battlefield.

Sophisticated Live Fire

When people think of the NTC, the first thing that pops into their mind is the high-speed force-on-force training. However, there is another less publicized, but just as important aspect to the NTC, and that is the live-fire exercise.

Fort Irwin provides the space for task force offensive and defensive live-fire exercises without the constraints of "barber poles" or other artificial control measures. This realistic battlefield is unique since it gives the task force the opportunity to practice its combat mission using live ammunition.

The Combined Arms Live-Fire Exercise at the NTC is unique since, for the first time, direct fire, artillery, antitank missiles, attack helicopters and Air Force close air support weapons are brought together at the battalion task force level in a realistic scenario.

Commanders and troops have an opportunity to coordinate available firepower and observe its effect against a simulated enemy. This skill is significant since it develops the ability to rapidly shift combined power throughout the battle area.

Size and Location

When the Army began to consider building a national training center, one of the key factors in picking the fort was the location. The area must be large enough to support brigade-size operations, yet be isolated enough so that the instruments of war could be fully implemented. For example, the NTC needed to be in an area where communications jamming equipment could be used without disturbing the local population. An area where airplanes could fly nap-of-the-earth missions at super-sonic speeds—an area where tank ditches and other obstacles could be actually built and torn down over and over.

Added to this, Fort Irwin's desert environment, with temperatures ranging from 12-119 degrees Fahrenheit, adds to the stress which is so important in simulating an actual combat situation.

Of the 636,182 acres (1,000 square miles or the size of Rhode Island), only about 430,000 acres are trafficable. One third of this area is used for live-fire exercises while the rest is used for force-on-force training.

The harsh environment of the desert demands maintenance of equipment. A soldier quickly learns that if he doesn't keep his equipment clean, it will not work properly when needed. This is an extremely important lesson and one that paid off in Southwest Asia.

Dedicated OPFOR

Once the player unit learns how to survive the desert, he is then hit with the real enemy at the NTC, the formidable OPFOR.

The OPFOR is unique in every sense, from their special uniforms to the visually modified vehicles they drive. They are so good at what they do that they win over 90 percent of all battles.

But besides being excellent field soldiers, they are also accomplished tacticians. The OPFOR are proficient in three different foreign military doctrines, including the most commonly used Soviet style and the most recently added Iraqi style.

To insure that Fort Irwin has the latest intelligence, there is a Foreign Material Intelligence Detachment based here. This is the only place outside of Aberdeen Proving Ground to have such a unit.

Full-Time Observer Controllers

If units came to the NTC, got waxed by the OPFOR, and then went back home, the learning curve would be minimal. Fortunately, there is a group of soldiers who are dedicated to helping the player units learn from their mistakes, which is a lot different from simply pointing out their mistakes.

These are the OCs (observer controllers) who use a Socratic method of probing questions so that soldiers will discover their own strengths and weaknesses. This discovery learning is brought about in daily after action reviews (AAR) which are held at the platoon, company and task force level.

The OCs in the field work closely with the computer analysts in the Death Star Building so that player units are watched from all angles so that all their mistakes are caught. It is the high-tech instrumentation that adds the coup de grace to the uniqueness of the NTC.

High-Tech Instrumentation

Technology used at the NTC is something straight out of George Orwell's *1984*. A battlefield analyst can watch the battle as it progresses, not only on his computer screen, but also by monitoring 90 radio channels with the ability to record 80 of those. Added to this high-tech observation are two video cameras mounted on strategic mountain tops with 4,000mm lenses. These cameras can be operated from the Death Star Building, the headquarters for all high-tech equipment. Added to these two fixed cameras are a fleet of

An OPFOR soldier prepares to move out.

An OPFOR soldier in gear that adds to NTC realism—full uniform, MILES gear, and AK47.

eight mobile camera units which can be positioned by analysts in strategic spots to catch the action on video.

But it is the computer instrumentation that holds the key to the NTC. Each vehicle is mounted with a special transponder which sends out a signal every few seconds. Throughout Fort Irwin's vast training area are 44 solar-powered "interrogator" relay stations. The signal sent from the vehicles' transponder is triangulated by these relay stations and then sent back the exact location of that vehicle to the Death Star Building where it shows up as a symbol on a computer screen.

These symbols vary so that a Bradley fighting vehicle can be distinguished from an MIAI tank, for example, and are color coded so that the OPFOR can be distinguished from the player units. The computer is also hooked up to the vehicles Multiple Integrated Laser Engagement System.

This computer provides a tremendous amount of information. For example, a computer analyst can watch the battle as a whole, or he can pick a single tank, find his exact location, find out how many rounds he fired, where those rounds went, if he killed anyone, and if someone killed him (and who that someone was, be it friend or foe).

The learning potential for this is incredible. The analysts will watch the battle, catching key moments via video and audio medium as well as on computer graphics. Video crews operate two AAR vans which seat 25 persons. They receive, by microwave, edited video tapes and computer graphics so that they can deliver an "instrumented AAR" to the commanders and staffs in the field.

This is an extremely helpful learning tool because commanders can watch a battle, seeing the "big picture." With all this information, commanders can see exactly what they did, regardless of whether it was right or wrong, and what they might have done differently.

All this information helps the OC and computer analyst develop the take-home package with which a commander can review his unit's activities and integrate the valuable NTC training feedback into his training plan at home station. This take home package, which includes approximately 40 hours of video-taped AARs and 500 pages of written material, means that a rotation at the NTC continues to teach a unit long after they have left Fort Irwin.

A newly modified M551 Sheridan is one of 11 new T-80's fielded by the OPFOR to keep up with current Soviet technology.

Conclusion

As the title of this article states, "the National Training Center is a diamond in the rough." This is not to say that there isn't room for improvement. The NTC is always looking for a way to increase the realism of training. For example, CATIES (Combined Arms Training Integrated Evaluation System) is currently being field tested at the NTC. This is a box with shotgun shells mounted on the rear of the vehicle that can be set off from the Death Star Building to simulate artillery. Another recent improvement is the fielding of the ll newly modified T-80s.

The NTC is also pushing for future improvements that include Multiple Integrated Laser Engagement System-type instrumentation on the close air support planes and acquiring another 240,000 acres of land. This land would allow the NTC to train a whole brigade at one time.

The result of all these things adds up to one very important result—learning. Units who come to the NTC get beat up, kicked around, dirty, dusty, hungry and sleepy, but they learn.

COL Pat O'Neal, OPFOR commander, describes it as an exponential learning curve, like a snowball effect. Player units will usually get beat quite badly at the beginning of a rotation, but do better and better as the rotation proceeds, even beating the OPFOR towards the end of the rotation.

Historically, it is the first major battle of any war that creates the most casualties. People at the NTC are fond of saying that battle will be fought here, where the lessons can be learned, yet the soldiers walk away afterwards. As stated in the introduction, everything about NTC is a challenge, but that's what makes it what it is. As BG Wesley K. Clark, former commanding general said, "I guess in the public mind soldiers still appear in parades, but out here, their aren't any parades, and the battlefield is a very lonely place." That is the NTC experience, a unique one to say the least.

SPC GALEN WIERING is the media relations officer and editor of the newspaper, Leader Trainer, at Fort Irwin, CA. He joined the Minnesota National Guard as an infantryman in 1986 while attending Saint Cloud University. After graduating with honors in 1990, he enlisted in the Army as a journalist. He was third place winner as overall print journalist and received honorable mention as overall photo-journalist in the 1991 FORSCOM Keith L. Ware competition.

PRODUCTION ENGINEERING TOOLS

By Gary A. Maddux, John Montgomery and Alan Wyskida

Introduction

The economical design, development, and manufacture of weapon systems and their associated components are of primary concern to the Production Engineering Division (PED) of the Systems Engineering and Production Directorate at the U.S. Army Missile Command (MICOM), Redstone Arsenal, Alabama. As budgetary and resource constraints continue to require production engineers to strive for greater levels of efficiency, the demand for knowledge-based tools, computer-aided engineering technologies, advanced statistical analysis, simulation models, and other progressive technologies becomes even greater.

To provide the engineer with the most current advances in the production and manufacturing discipline, MICOM Production Engineers, in cooperation with the Manufacturing Technology and Producibility Division of the Design and Manufacturing Directorate, U.S. Army Tank-Automotive Command (TACOM), have initiated a research program called Production Engineering (PE) Tools.

PE Tools is sponsored by the Army Manufacturing Technology Program at HQ, AMC, with oversight by the Office of the Deputy Chief of Staff for Concurrent Engineering (CE). The intent of the program is to facilitate the development and transfer of CE technology throughout the Department of Defense, thus enabling the production engineering function to be performed in a more cost effective and efficient manner. This transfer will provide for both the increased probability of development project success and the dissemination of advanced knowledge. By providing an arena for the development and application of new technologies, the Manufacturing Technology Program strengthens the nation's defense through more reliable weapon systems and the nation's industrial base in the form of the knowledge and technologies required to remain globally competitive. This combination of crucial benefits is a testament to the multidimensional concerns of many current Army initiatives.

Concurrent Engineering

The driving force behind the establishment of PE Tools is the emergence of the concurrent engineering concept as a viable approach for controlling weapon system costs. As the complexity of weapon systems manufacture grows, it becomes increasingly important to incorporate concurrent engineering into the design process. The design team must take a proactive approach in the producibility, quality, reliability, and maintainability design from the initial stages of the system's life-cycle. To achieve these attributes, it is essential that manufacturing knowledge be developed in a form that can be applied during early life-cycle phases. The availability of this knowledge is often dependent on either the in-house knowledge of human experts or through the use of a variety of "expert systems," which have stored similar knowledge in a machine retrievable form. As the design evolves, concurrent engineering principles ensure that elements of the design/manufacture team are communicating. This integration /communication process can be divided into two major subtopics: people and tools.

While the human elements of the design process must communicate, it is also imperative that the design process domain-specific tools be integrated, enabling portability of engineering data from tool to tool.

People

To ensure proper design, information must flow among and between the various groups of engineers. Design engineers must receive continuous feedback from production engineers, maintenance engineers, and the end-user regarding the manufacturability, maintainability, and functionality of the ultimate end-product. Without this open exchange of ideas/knowledge, the likelihood for success is greatly lessened.

The Production Engineering Tools program seeks to transfer technology to those production engineers who would benefit from new tools and technologies.

Tools

While the human elements of the design process must communicate, it is also imperative that the design process domain-specific tools be integrated, enabling portability of engineering data from tool to tool. For example, data created in the initial design must either be transportable to or interact with any concurrent analysis or other process tools, such as numerical control mills, lathes, stereolithography, etc.

Because the production of a weapon system is a large and complex task, a considerable amount of time and resources must be utilized to realize success. Therefore, to maximize the benefits of past expenditures, leveraging of related research is essential to the development of viable tools. The tendency to reinvent the wheel by funding near identical research and development of production related tools and technologies is not a practical approach as dollars for R&D projects continue to shrink. By sharing the resources available, the Army can more readily adapt to the changing economic environment.

Objectives

The PE Tools program has a four-fold objective:

• **Establish a single Army-wide center for the integration and dissemination of tools to support the concurrent engineering process.** The PE Tools program seeks to minimize the effort required by production engineers to investigate developments in the areas of manufacturing and production technology. Because of continuous change in the concurrent engineering arena, a single source of information must exist and can be easily accessed. The PE Tools program will serve as a clearinghouse for this information by monitoring developments throughout not only the Army but also throughout the Department of Defense. Information will be disseminated in a manner that facilitates easy access for the production engineers throughout the Army.

• **Develop and validate analytical tools which increase the quality and quantity of information available to support the development of Army systems.** The PE Tools program will obtain, evaluate, and distribute analytical tools of benefit to the production engineer. These tools are often the product of research performed through sole or leveraged Army funding. This funding transpires through either the Production Engineering Division of MICOM, similar directorates or divisions at other major subordinate commands, and the Army "corporate" laboratories.

• **Reduce the time and effort required to develop and transition Army systems into production.** The ultimate goal of streamlining the production engineering function is to reduce the time and effort required to design and develop a system or component, then make the transition from design to a manufactured output. The PE Tools program supports that same objective by providing the tools, technology, and information required in a more accessible manner.

• **Broaden the industrial base by providing the ability to rapidly produce critical items for test, evaluation, and fielding.** As geopolitical and global economic trends redefine many of the traditional views of the role of the military, Army program objectives must increasingly reflect a benefit beyond military applications. The PE Tools program provides an opportunity for the Army to be in the forefront of developing, validating, and transferring manufacturing technology not only within the DOD, but also within the private sector. As the nation strives to retain its global manufacturing superiority, the PE Tools program can play a major part by broadening the U.S. industrial base.

Summary of Research to Date

The PE Tools program seeks to transfer technology to those production engineers who would benefit from new tools and technologies. While one function of the PE Tools program is to locate, obtain, and validate previously developed technology, another is concerned with the in-house development of supporting technologies. To that end, several research activities have been undertaken either with PED as the lead organization or through leveraged funding programs with universities, industries, and/or their agencies.

The following summarizes several projects that have either recently been completed at PED or are currently under development. The project objective, a progress report, its status, and notable technological advantages are emphasized.

Quick Turnaround Cell

The Quick Turnaround Cell (QTC) was developed by the Engineering Research Center for Intelligent Manufacturing Systems, Purdue University. The importance of QTC is evident in several crucial areas. First, there is a general lack of available computerized tools that address the geometric reasoning problem. In this regard, geometric reasoning can be defined as the ability to examine a geometric design and determine what processes are applicable to produce the part. To rapidly transition a design into a part, computer-based tools with this ability are essential.

Secondly, there is a lack of systems that provide a very tight integration of the design, manufacturing, and inspection processes. The next generation of advances in computer-aided design/computer-aided manufacturing (CAD/CAM) will hinge not on the individual merits of each tool, but on the ability of the individual tools to work as a unit. QTC seeks to alleviate the manufacturing problems by facilitating pre-production planning, thus smoothing the transition from conceptual design to physical product.

Designer's Aid

The Designer's Aid for Manufacturing Processing Selection (DAMPS) is being developed by the Ohio State University Research Center for Net Shape Manufacturing. The DAMPS objective is to provide an expert system to assist designers in selecting possible near net-shape processes for a candidate design. It can be used by the experienced engineer for reference or by the less experienced engineer for assistance in training for net-shape processes.

Knowledge-Based Producibility Decision Maker

The Knowledge-Based Producibility Decision-Maker (KPD) is being developed by CIM Systems, a private-sector organization based in Richardson, TX, specializing in productivity technologies. KPD and a sister product, the Intelligent Planning Assistant, are each the result of a TACOM managed Small Business Innovative Research program. The basic objective of the KPD project is to develop a knowledge-based system that evaluates the producibility of a proposed prismatic part with respect to a typical reduction (machining) process.

Composite Materials

The Concurrent Engineering for Composites Materials (CECM) program is being developed through joint efforts by the University of Delaware Center for Composite Materials and the University of Tulsa Department of Mechanical Engineering. The objective of CECM is to develop techniques and methodologies that implement a concurrent engineering approach to the design of products utilizing composite materials and process technologies. The research conducted during the development of CECM should prove to be of increasing importance as the use of fiber-reinforced composite materials continues to proliferate.

Prototyping Work Cell

Prototyping is an important step in the manufacturing process since it allows an engineer to determine the feasibility of a design and uncover manufacturing problems early in the part's life cycle. It is also important that the production time for the prototype part be short in order to minimize the total development time. An engineer designs a part, determines the sequence of operations needed to manufacture the part, and sends these operations to a prototype cell where a part will be produced. Ideally, this process could be as short as a few hours, depending on the complexity of the part. The objective of the Rapid Prototyping Workcell is to assist production engineers in implementing and integrating advanced manufacturing technologies. A primary concern is the ability to verify a part design in a timely manner.

Statistical Process Control Tools

The growing emphasis on the use of statistical process control (SPC) in regard to the management of all activities within an organization has created a demand for easy-to-use, computer-based SPC tools. Since manufacturing is usually the most logical application of SPC, it is no surprise that one of the chief areas of concern is the creation and transfer of technologies utilizing the principles of SPC. The PE Tools program has responded to this challenge with an in-house developed product: the Statistical Process Control Toolbox (SPCT).

The chief objective of SPCT was to develop SPC software utilities that can assist engineering personnel in applying SPC techniques to the management and control of manufacturing processes. The compiled software of SPCT can be executed on any IBM PC with a VGA or EGA monitor, and is currently available for distribution upon request.

Conclusion

By sharing both the combined expertise of its in-house staff and the outputs of a variety of research efforts, MICOM engineers are creating a "win-win" relationship with other organizations throughout DOD. Rather than relying on a fragmented approach to research, the Army can create a synergy of coordinated efforts through networks formulated as a result of the PE Tools program. The Army is not the only benefactor of PE Tools. The PE Tools program has joined forces with defense, academic, and industrial organizations, thereby maximizing the return on the Army's investments through leveraged funding and enhanced technology transfer.

The analytical tools that have been demonstrated under the support of PE Tools, along with those yet to be developed, will help the production engineer of the future meet the challenge of concurrent engineering. By providing the needed tools, these engineers are empowered to more easily fulfill the request to "get it right the first time." The tools and methodologies promoted via PE Tools all have the common theme of allowing the engineer to "do the right thing right." While this may seem a simple credo, the results from its adherence ensure that the design and manufacture of weapon systems and their components are on time, within budget, producible, maintainable, and reliable.

GARY A. MADDUX is a research scientist for the Research Institute at the University of Alabama. A co-director of the university's Quality Improvement Techniques Laboratory, he has B.S. degrees in management, accounting, and management information systems, and an M.B.A. from the University of North Alabama.

JOHN MONTGOMERY is a lead producibility engineer at the U.S. Army Missile Command, and is the program manager for production engineering tools. He has an M.S. E. in industrial engineering at the University of Alabama in Tuscaloosa.

DR. ALAN R. WYSKIDA is a lead producibility engineer at the Army Missile Command. He has a B.E. degree in mechanical engineering from Vanderbilt University, and an M.S.E. in industrial and systems engineering from the University of Alabama where he is a Ph.D. candidate.

Introduction

"U.S. Army Outgunned by Iraqi Artillery." During the build-up preceding Operation Desert Storm, headlines like this were common in the media. Indeed, on paper, the artillery assets deployed by Iraq were formidable. Particularly worrisome were guns like the South African G5 with its 40-kilometer range capability. Fortunately for the coalition forces, the Iraqi's ineffective target acquisition and command and control caused by the intense aerial bombardment and the "Schwartzkrieg" style ground assault, did much to negate the numerical advantage.

But what about next time? What if there are no friendly airbases and port facilities to support a Desert Storm-type operation, and the Army must fight with what it brings? The fact that many armies around the world are currently in possession of long range artillery is a source of serious concern that raises some questions.

The first is, "Can the U.S. develop and field extended range tube artillery?" The answer is "yes." The second is, "should we?" Again, I believe the answer is "yes." However, these two simple answers are not the complete answer. An effective tube artillery weapon is a complex system requiring the integration of a number of components. When these systems are dealt with in a piecemeal fashion, as has often been the case in the past, much of their potential performance is lost.

Let's take a look at the major components that comprise an artillery system and their contributions to range performance. We'll then look at how they combine to form a total system. The items will include the cannon, propellant, projectile/fuze, platform and fire control.

EXTENDED RANGE FOR 155MM ARTILLERY

By Terrence Ringwood

The Cannon

A cannon assembly is a thick wall pressure vessel with a fixed end seal (the breech) and a movable end seal (the projectile). The volume between the seals is the chamber. Propellant is burned in the chamber to create the high pressure gas needed to accelerate the projectile down the tube. Therefore, the cannon possesses two principal influences on range. One is chamber volume, which dictates the maximum propellant load. The other is tube length, or shot travel, which controls the time the gas can act on the projectile. So the bigger the gun, the longer the range. But there are drawbacks to this approach, such as increased system weight, decreased mobility and transportability, projectile rotating band wear, increased propellant usage, and effects of tube droop and whip on accuracy and precision.

The Propellant

There are two major categories of propellant to be considered for modern artillery applications. The first is solid propellant. There are three general families of solid propellant, called single-, double-and triple-base. Single base propellant consists primarily of nitrocellulose (NC). Double base adds nitroglycerine (NG) or other nitrate esters to the NC. Triple base makes a further addition of nitroguanadine (NQ). The propellant energy rises as each constituent is added. Energetic plasticizers, or binders, are also considered to increase energy levels. For this increased energy, a price is paid in terms of increased wear and erosion from the higher flame temperatures and the risk of increased sensitivity.

Another aspect of solid propellant is the shape of the propellant grain. The size, length-to-diameter ratio, and the number of perforations, or holes, greatly influences the loading density and the rate at which gas is produced. It is critical to properly balance these two elements to insure that chamber pressures are neither too high nor too low. Also, the generation of negative differential pressures, a potentially damaging phenomenon of traveling pressure waves, must be controlled. Also, the length-to-diameter ratio of the chamber will influence the magnitude of negative differential pressures, i.e., the greater the ratio the greater the risk of high differentials. A number of grain shapes have been tested to increase performance, and the final choice usually rests on what works best in the particular sys-

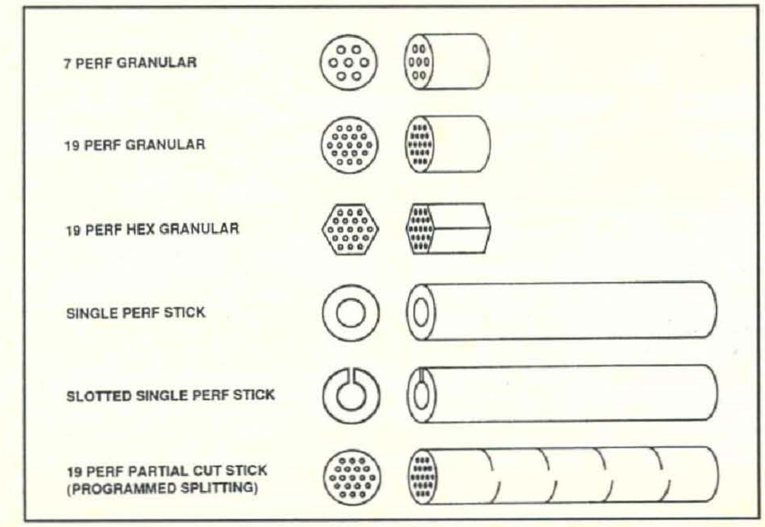


Figure 1. Various propellant grains.

tem under consideration. (See Figure 1.)

Another active area of research is less sensitive propellant formulations. One approach is the replacement of the nitroglycerine with new energetic plasticizers. Several very promising formulations are currently under development and have demonstrated reaction levels 50 percent less than current propellants when struck by a shape charge jet.

The second major category of propellants is liquid propellant (LP). Pursued with varying levels of intensity since the late 1940s, LP can be categorized as either mono-propellant, bi-propellant, or liquid/metal solutions. LP gun systems fall into two types, bulk loaded or injected. The simpler approach, bulk, is also the least reliable. The mass of liquid defies consistent ignition and the guns have had an unfortunate tendency to spontaneously disassemble. The second method, injection, has proven to be more controllable and consistent.

An ongoing development program for an injected gun focuses on the regenerative injection process. As Figure 2 illustrates, a two-piece differential piston uses primary ignition gases to pressurize the LP reservoir, injecting fluid into the hot gases. This increases chamber pressure and sustains the event until all the LP is consumed.

This system requires a higher degree of mechanical complexity in exchange for its more benign behavior. It has the potential to alter the conventional pressure-time curve to provide higher muzzle velocity at lower peak chamber pressures. This could have a significant impact on G sensitive projectiles.

The Projectile/Fuze

The next item for consideration is the projectile/fuze combination. These two items are combined as they see the same environment of accelerations, velocities and spin rates, which are critical factors in extended range design efforts. In fact, some of the current projectiles, fuzes and submunitions may be inappropriate for the extended range role, due to design limits for these parameters.

Three principal techniques can be applied to projectiles to enhance range performance. These are rocket assistance, base-bleed, and body streamlining. Rocket assistance, as the name would imply, uses a rocket motor, usually at the base of the projectile, to increase and sustain velocity. This higher, longer lasting velocity dictates the maximum attainable range. The M549A1 HE is such a projectile.

The second technique is called base bleed, which utilizes a gas generator in the base of the projectile. The gas produced is just enough to fill the void created at the back of the projectile as it passes through the air. This produces an artificial streamlining which significantly reduces drag. This allows for a lessening of the projectile deceleration, but does not provide any boost. The M864 ER DPICM, is a base bleed type of projectile.

The last technique mentioned was actual streamlining of the projectile body to reduce drag. An extreme example of this methodology is the Extended Range Full Bore family of projectiles used with the GHN 45 and South African G5/G6 guns. This type of projectile limits payload volume and precludes, for the most part, the use of smart submunitions.

The use of all three of these techniques to produce a projectile capable of ranges in excess of 45 kilometers is under consideration at the U.S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.

Any fuze that is used for extended range missions must be capable of withstanding the high launch loads, air friction heating and the longer flight times that any long range gun will inflict.

Another consideration in the projectile/fuze discussion is the use of some form of terminal guidance. Currently, the only 155mm projectile with such a capability is the Copperhead. This projectile requires the use of laser designation of the target. Future rounds need to incorporate on-board guidance, usually called fire-and-forget, in order to be effective at long ranges.

The Platforms

The platform from which the round is fired must provide strength and stability in order to dissipate the firing loads without excessive movement. It must also provide sufficient mobility commensurate with its mission, i.e., direct support, general support, heavy- or light-division. The platform consists of a gun mount and some form of carriage, either towed or self-propelled.

Fire Control

Now that we have the pieces to send the projectile on its way, we must be able to send it in the right direction. With an accuracy of +/- 1 mil, conventional optical fire control would have an error margin of 45 or more meters at the ranges we are discussing. Add in survey

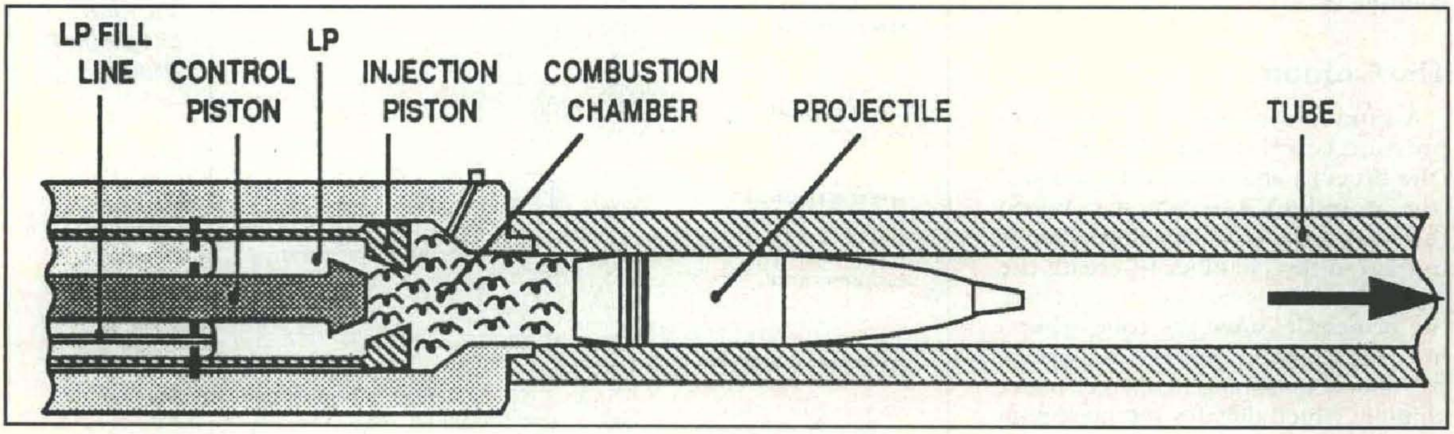


Figure 2.

errors, weather effects, and munition variations and the cumulative error could be greater than the effective radius of the projectile. To reduce this error, something other than optics is required. Here again, the use of terminal guidance would help alleviate this problem.

Modern fire control systems include an array of sensors to collect data, and use powerful computers to assimilate and reduce the data into fire quality data, particularly weather data, becomes imperative. An extended range system would need to make use of sensors for muzzle position and projectile velocity, propellant temperature and projectile/fuze weight, weapon system location and cannon azimuth.

How Does It All Fit Together?

We have looked at the individual pieces needed to assemble an extended range artillery system. The next step, and most critical, is the integration of these pieces into a system. Based on the mission need, performance parameters are established. This will tell us how far the gun will need to shoot, what types of rounds will be needed, mobility and armor requirements, etc.

Essential to our discussion is max range and the type and weight of projectile to be fired. This will dictate the muzzle velocity needed, as well as any acceleration limits. Around this number the variables of cannon size and propellant energy can be manipulated, to achieve the most efficient gun system. The type and configuration of the propellant to be used is then established, usually in an iterative process, to arrive at the *practical* optimum. What works best on paper may not translate to reality.

We must also determine if currently available projectiles and/or fuzes are suited to this mission. If not, a reduction in performance expectations or a new projectile will be required.

The anticipated mission will also determine the type of carriage to be used and whether a new or retrofitted system is required. Added to this will be the fire control system. The type of carriage will greatly influence the type and complexity of automated fire control that can be used.

After the selection of the individual pieces is complete, each must be fitted to the others until the final product meets the requirements as closely as possible. This is a complex, years-long process.

Figure 3.

Trade Offs

It has been said that there is no such thing as a free lunch. That is certainly true here. A system designed to provide 40-50 kilometer range will almost certainly have to sacrifice minimum range performance. The larger chamber will increase the likelihood of stickers and muzzle velocity uniformity with minimum charges. In days past, minimum range for 155mm was provided by short tube weapons such as the M114 or the original M109. Longer ranges were handled by the old "Long Tom" or more recently by the M107 175mm gun. This short tube/long tube mix provided greater range coverage than any single weapon could have. Trying to do it all with a single weapon may not be the best solution, and providing a dedicated long range shooter may prove the best overall solution.

Conclusion

An extended range artillery system for the U.S. Army is certainly doable. At no time in recent memory has there been so much attention given to the need to modernize the field artillery. It is the task of the entire FA community, user and developer alike, to seize the opportunity and provide our troops with the fire support they need and deserve.

TERENCE RINGWOOD is the development project officer for the XM 230 Unicharge System at the U.S. Army Armament RDE Center, Picatinny Arsenal, NJ. He has a B.S. degree in mechanical engineering from the New Jersey Institute of Technology.

PEO-FIRE SUPPORT

George G. Williams

George G. Williams holds a B.S. degree in industrial engineering from North Carolina State University. His previous positions include: industrial engineer, PERSHING Project Office, U.S. Army Missile Command (MICOM); general engineer, PERSHING Project Office, MICOM; general engineer, U.S. Army SAFEGUARD Systems Command; chief, Systems Engineering Branch, ROLAND Project Office; chief, Product Assurance, Manufacturing and Test Division, ROLAND Project Office; deputy project manager, TOW Project Office; chief, Provisional FOG-M Management Office, Systems Development Office, Research, Development, and Engineering Center; deputy project manager, Non Line-of-Sight Project Management Office; and deputy PEO - Fire Support.

Missions and Organization

The PEO-Fire Support reports to the Army Acquisition Executive relative to technical, cost, and schedule aspects for assigned programs and supervises assigned project and product managers. Williams provides the planning, guidance, direction, control and support necessary to field systems within cost, schedule, and performance baselines. The PEO-Fire Support has an authorized technical staff of 48, comprised of military and civilians who provide expertise in business management, contracting, cost analysis, engineering and logistics. The project management offices' personnel bring the strength of the PEO-Fire Support to 872.

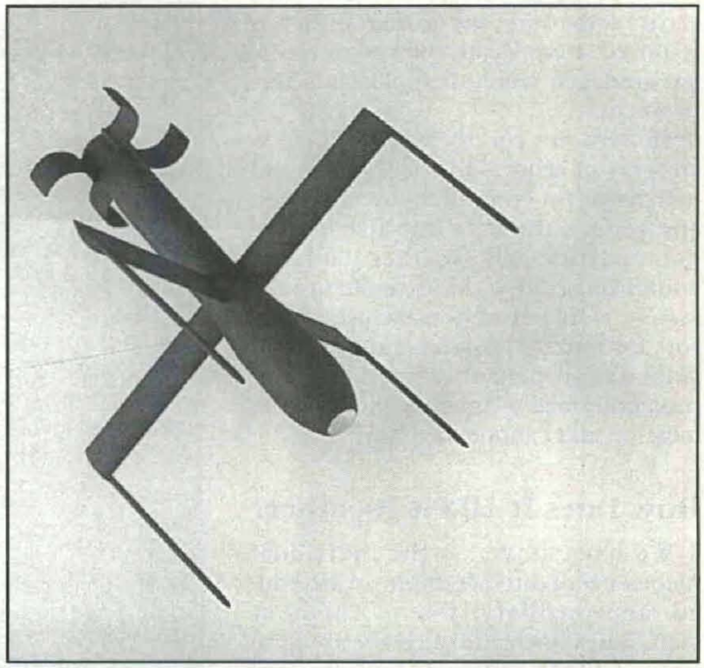
Project management offices, which are located at Redstone Arsenal, AL, include: PM, Multiple Launch Rocket System (MLRS); PM, Tube-Launched, Optically Tracked, Wire Command-Link Guided (TOW) Missile System; PM, Air to Ground Missile System (AGMS); PM, JAVELIN; PM, Army Tactical Missile System (ATACMS); and PM, Brilliant Anti-Armor Submunition (BAT).

PEO-FIRE SUPPORT HEADQUARTERS GROUP

PEO	George G. Williams	Redstone Arsenal, AL
	DSN 746-0714	Comm. (205)876-0714
Deputy PEO	COL Thomas M. Devanney	Redstone Arsenal, AL
	DSN 746-0871	Comm. (205)876-0871

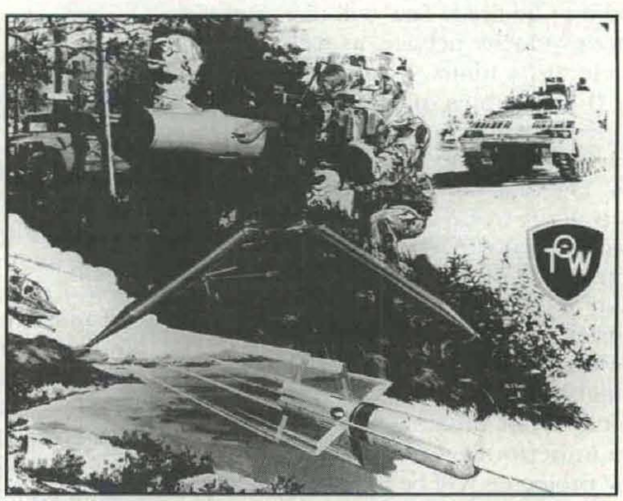
FIRE SUPPORT MANAGERS

PM MLRS	COL William S. Taylor	Redstone Arsenal, AL
	DSN 746-1195	Comm. (205)876-1195
PM TOW	COL Jack D. Conway	Redstone Arsenal, AL
	DSN 746-7194	Comm. (205)876-7194
PM AGMS	COL Robert E. Huston	Redstone Arsenal, AL
	DSN 746-1365	Comm. (205)876-1365
PM JAVELIN	COL Earl W. Finley	Redstone Arsenal, AL
	DSN 746-4266	Comm. (205)876-4266
PM ATACMS	COL David F. Matthews	Redstone Arsenal, AL
	DSN 746-1141	Comm. (205)876-1141
PM BAT	COL David T. Jones	Redstone Arsenal, AL
	DSN 788-0307	Comm. (205)842-0307



BRILLIANT ANTI- ARMOR SUBMUNITION (BAT)

BAT is a dual sensor (acoustic and infrared) "smart" munition that autonomously seeks, identifies and kills armored vehicles. BATs will be carried deep into enemy territory by the Tri-Service Standoff Attack Missile and/or Block II of Army TACMS. BATs will be dispensed from the carrier missile in the vicinity of an enemy armored vehicle column and will use its acoustic and infrared sensors to detect and guide the gliding submunition toward the vehicle column where individual targets will be attacked and destroyed. BAT is in Engineering and Manufacturing Development and is expected to be in production in the mid to late 1990s.



TUBE-LAUNCHED, OPTICALLY-TRACKED, WIRE-GUIDED WEAPON SYSTEM – (TOW)

TOW consists mainly of a launcher and any of five missile versions. The launcher consists of a launch tube, traversing unit, optical sight, night sight, missile guidance set, battery assembly, tripod, overpack, shroud and carrying strap. The missile is encased in a disposable launch container. In addition to the ground-emplaced launcher, the TOW system has been incorporated into the M113 armored personnel carrier, the M151 jeep, the high mobility multipurpose wheeled vehicle (HMMWV), the improved TOW vehicle, COBRA aircraft and the Bradley Fighting Vehicle Systems (BFVS). Basic TOW launcher production is complete for U.S. forces as well as the TOW 2 upgrade for ground and vehicle applications, except BFVS which will continue through FY94. In addition to these platforms for the Army, there are many others which utilize the TOW launcher system, such as the U.S. Marine Corps light armored vehicle.

PROGRAM EXECUTIVE OFFICER —FIRE SUPPORT

MULTIPLE LAUNCH ROCKET SYSTEM (MLRS)

The MLRS is a free-flight, area fire, artillery rocket system being fielded to fill an existing void in conventional fire support. The primary missions of MLRS are counterfire and suppression of enemy air defenses. MLRS supplements cannon artillery fires by delivering large volumes of firepower in a short time against critical, time-sensitive targets. The basic warhead carries dual purpose conventional submunitions. A growth program is underway to add a Sense and Destroy Armor (SADARM) warhead to improve counterbattery fires. The MLRS M270 launcher is being updated to accommodate launching a family of new munitions, including the Army Tactical Missile System (ATACMS). The U.S. Initial Operational Capability for MLRS was achieved in 1983. Starting in FY 89, MLRS has been co-produced by the United States, United Kingdom, Germany, France and Italy. The second multi-year procurement contract for FY 89-93 was awarded in July 1989.

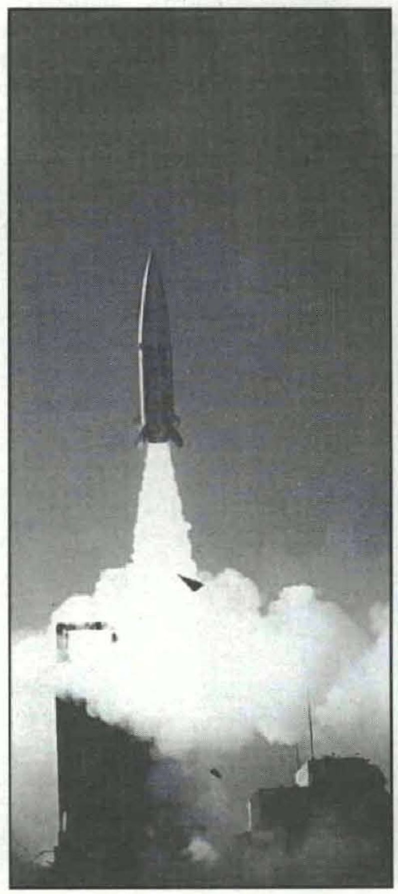
MLRS performed extremely well in Operation Desert Storm, where it was deployed in significant numbers. All operational requirements were met and in most cases exceeded for readiness, reliability, accuracy and maintainability. MLRS units from the United Kingdom were also involved in Operation Desert Storm and proved the value of the successful operation of this multi-national system. The new upgraded MLRS (Deep Attack Launcher) also demonstrated its enormous capability during the first operational firings of the longer-range ATACMS.

JAVELIN – ADVANCED ANTITANK WEAPON SYSTEM

The JAVELIN is a one-man portable antitank weapon system designed to provide high lethality against advanced armor and is envisioned as a simple-to-operate, easily and economically maintained, rugged and reliable infantry system for the U.S. Army and U.S. Marine Corps. It is comprised of two major components: a reuseable Command and Launch Unit and a missile sealed in a disposable launcher container. The JAVELIN will have a range of more than a mile and quarter and more lethality than the Dragon missile which it will replace. The key feature of the JAVELIN is the use of fire-and-forget technology which allows the gunner to fire and immediately take cover.

HELLFIRE

The Laser HELLFIRE Modular Missile System is the primary anti-armor weapon system for Army aviation. HELLFIRE is currently employed on the AH-64 Apache helicopter as the primary point target weapon. It can be employed in day or night operations in a wide variety of firing modes, including autonomous, ground or airborne remote target designation with direct or indirect fire, and rapid or ripple fire. The Longbow HELLFIRE Modular Missile System development/production proveout program was initiated with the objective of providing the Army with a "fire and forget" missile with adverse weather capability. The Longbow system will locate, classify and prioritize targets for the Longbow HELLFIRE missile.



ARMY TACTICAL MISSILE SYSTEM (ATACMS)

ATACMS Block I is an inertially-guided missile with a range of more than 100 kilometers which is fielded with Multiple Launch Rocket System units and fired from the same launcher. ATACMS will destroy tactical missile launchers; suppress air defense; attack command, control and communication sites; and disrupt logistics. Initial fielding occurred in August 1990 during Desert Shield and the system was combat proven during Desert Storm. ATACMS Block II, with a warhead containing smart submunitions, is a candidate system to fill the requirement to destroy enemy armored combat vehicles at long ranges.

LABORATORY MODERNIZATION PROGRAM AT THE U.S. ARMY MISSILE COMMAND RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

Introduction

The U.S. Army Missile Command (MICOM) has received approval from DOD to embark on the final project in a program that has given MICOM's Research, Development and Engineering (RD&E) Center the modern facilities to complement the high technology already achieved by this premier weapons research facility.

Background

In the late 1970s, it became apparent that MICOM's physical structures, mostly of World War II vintage, could not support the new requirements of advancing technology. As technology increased at a dizzying pace, laboratory facilities became obsolete with equal speed. Engineers and scientists were working in overcrowded, uncomfortable and, in come cases, unsafe conditions. The Lab Modernization Program was conceived to upgrade facilities to a level commensurate with the technology they supported.

Figure 1.
Measurement of solid propellant structural behavior at the Propulsion Aging and Mechanical Properties Facility.

Lab Modernization

Spanning more than a decade in planning and implementation, the Lab Modernization Program will produce eight new facilities or renovations. With the completion of this program, MICOM stands poised to undertake new missions resulting from the pending reorganization set out by the Base Realignment and Closure Commission. When the Missile, Armaments and Chemical Command is established here, the RD&E Center will be ready to provide strong support.

Three of the projects are completed and four are under construction. Construction of the final project should begin in early 1992. Costs for completed, contracted and planned construction currently total $70 million.

Chronological Listing of Projects

Hangar Missile Test Facility. Completed in the spring of 1988, this facility, located at the Redstone Army Airfield, houses the test aircraft and shops that support missile seeker captive flight development. MICOM's ability to respond to R&D initiatives or technical investigations involving fielded systems is significantly enhanced by the presence of a drawing board-to-aircraft quick turnaround capability.

Propulsion Aging and Mechanical Properties Facility. This facility includes five laboratories and nine bays for hazardous specimen fabrication and testing of propellant materials, and six laboratories and one bay for inert material and component experimentation (See Figure 1). Completed in 1988, the facility is the most modern of its kind in the world. Activities in the facility provide the thermal, mechanical and statistical data required to estimate the structural service life of Army solid rocket motors. The cost of the facility has been many times surpassed by the savings resulting from avoiding replacing aging motors in the Army inventory.

Target and Seeker Measurement Facility. The Robert F. Russell Measurement Facility consists of a 329-foot tower with a laboratory at the 300-foot level, and a test platform elevator, the height of which can be varied over a 300-foot distance (See Figure 2). It was completed in September 1988 and placed into service immediately. The facility is used for development and testing of seekers and sensors in the millimeter wave, microwave, radio frequency, infrared and electro-optic spectral domains. The facility provides capability for target signature measurements, variable clutter, atmospheric evaluation, target tracking and countermeasures effects. The facility is also used to characterize and integrate sensors and seekers as they progress from the laboratory to the field test environment.

Test Facilities Modernization. Recently completed construction at the Missile Flight Test Range has provided additional engineering and data acquisition floor space and additional temporary explosive storage. The Environmental Test facilities were also expanded in the areas of missile assembly/disassembly and mechanical measurements. Possibly the most important feature of the construction program is the RF Anechoic Chamber in the Electro-Magnetic Test Branch which permits discrete frequency or broad band investigations on small missiles or complete systems including tracked vehicles on which the systems are mounted.

Millimeter and Microwave Simulation Facility. This facility, consisting of four levels, was constructed within an existing high bay area in the RD&E Center (See Figure 3). It provides hardware-loop simulation (high-frequency test chambers) and associated laboratory, control and administrative space in support of research and development missions. Simulators/test chambers include imaging infrared, weapon system simulators, millimeterwave chamber and microwave chamber. Occupancy is anticipated during 1992.

Redstone Scientific Information Center Addition. Ground was broken Oct. 30, 1991, for a 10,000 square foot addition to the massive technical library controlled by the RD&E Center. The

MICOM RD&E CENTER

Dr. William C. McCorkle Jr. Technical Director, MICOM, and Director, MICOM RD&E Center

Dr. William C. McCorkle Jr. holds a B.S. degree in physics from the University of Richmond, VA and a Ph.D. degree in physics from the University of Tennessee. As MICOM technical director, Dr. McCorkle serves as the senior technical advisor to the commander on all R&D matters. As director of the RD&E Center (formerly the U.S. Army Missile Laboratory), he is responsible for providing major research, development, production, field engineering, and software support to more than 20 MICOM project- and product-managed systems. In addition, he is responsible for planning and executing MICOM's programs in research, exploratory and advanced development of missiles, and high energy lasers.

Dr. McCorkle came to MICOM in 1957 from a position at Tulane University, and has since served in a number of increasingly responsible scientific and engineering positions, including an 18-month rotational assignment on the Department of Army Staff as science advisor to the director of weapons systems. He has worked on missile-related R&D problems and projects associated with virtually every missile and rocket system under MICOM cognizance. His contributions include numerous papers and patents in guidance and control, such as the complete guidance system used in the LANCE missile, and major improvements to the HAWK missile system, including the most recent improvement permitting multiple simultaneous engagements. He has achieved national recognition for initiating and guiding the center's highly successful pioneering work in fiber optic guidance links for missiles, providing revolutionary new countermeasure-resistant capability for finding and engaging both rotary wing and armored targets out of the gunner's line of sight.

Dr. McCorkle has long effectively championed the use of simulation techniques for missile design and analysis, and initiated the effort which led to MICOM's Advanced Simulation Center, a major national facility and key to a number of successful missile development and improvement programs.

In November 1980, Dr. McCorkle was selected for the dual role of MICOM technical director and director of the RD&E Center. Since then, the center has been formally recognized each year as a Laboratory of Excellence and was also recognized in 1985 and 1990 as the Army R&D Organization of the Year.

Mission of MICOM RD&E Center

MICOM's RD&E Center provides scientific, engineering and technical support for weapon systems to program executive officers, project managers, and other DOD and AMC elements. The center is the MICOM interface with the Training and Doctrine Command in determining weapon system cognizance of current and future threats.

Selective research and component development is ongoing to generate new technology, reduce missile development lead time and improve reliability.

The center provides management, direction and serves as a focal point for the following programs: manufacturing technology, production engineering, command/DOD international standardization, configuration management, data management, system engineering, human factors engineering, value engineering, software engineering, and materiel change management.

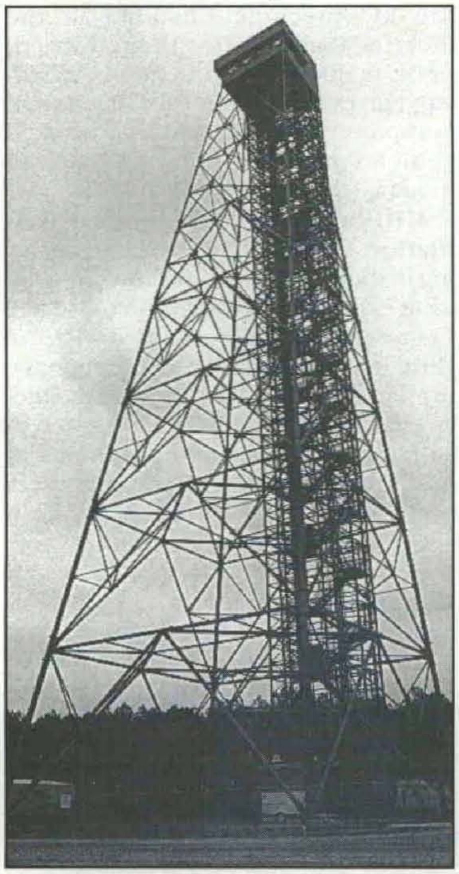


Figure 2.
Target and seeker measurement facility.

addition is an interim measure designed to give much-needed space to the facility until a new library can be built. The existing collection of technical books, documents and journals has exceeded available storage capacity. Reference material has been stored in temporary warehouses and ammunition bunkers from two to seven miles away from the existing facility, making it difficult for researchers to utilize. Scheduled completion of the facility is August 1992.

Systems Engineering Laboratory Addition. This project will add 156,000 square feet of laboratory space to the RD&E building, which was constructed in 1965. The addition will provide the capability to conduct laboratory investigations and experiments, under proper environmental controls, for such critical technology areas as composite structures, manufacturing research, missile guidance components and air defense command and control components. Additionally, the facility will provide the capability to integrate activities of the RD&E Center that currently give systems engineering support to missile systems that are in the field and out of production status. The addition will also provide integrated laboratory facilities for missile technology in support of the acquisition process for all Army developmental missile systems and those with major product improvements. See Figure 4.

Physical Sciences Research Laboratory. DOD has just approved the construction of this facility, which will be used to conduct basic and applied research in the area of physical sciences and to coordinate the Army research efforts with the Air Force and Navy missile programs. The facility will provide modern laboratory capabilities in a two-story, 88,000-square-foot building. Areas of research will include machine intelligence, photonics, passive sensors, signal processing, signature control and data fusion. The facility will also support the future expansion of the emerging technology areas of electro-optic correlation, photonics and optical computers, sensor fusion, integrated optics and neuroscience as related to artificial intelligence.

The preceding article was compiled and submitted by the MICOM Public Affairs Office.

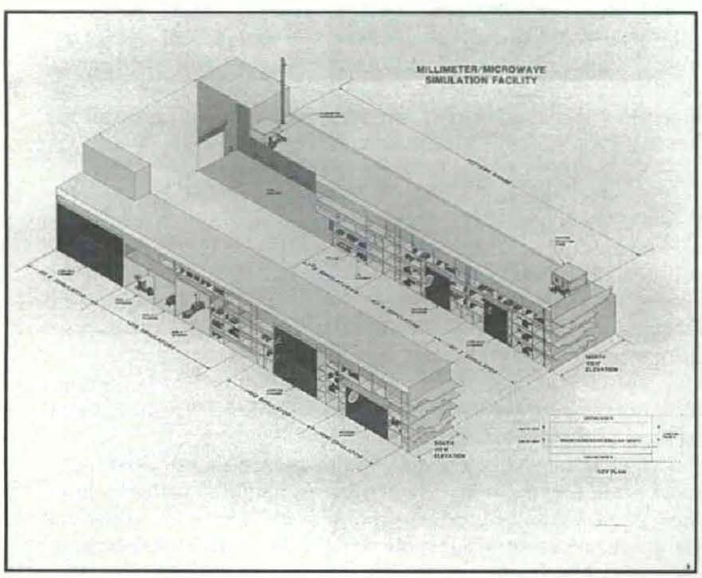


Figure 3.

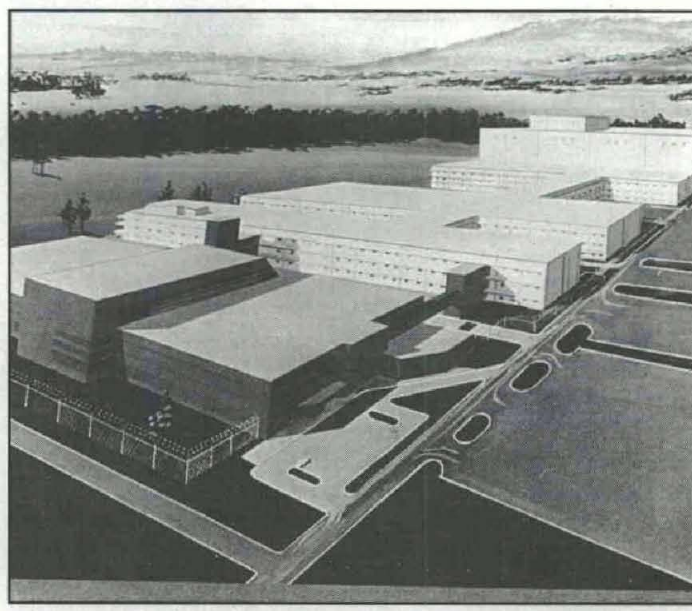


Figure 4.
An artist's concept of the Systems Engineering Laboratory addition.

ROLE OF SIMULATION AT THE ARMY TANK-AUTOMOTIVE COMMAND

By Ronald R. Beck and John C. Schmuhl

Introduction

Simulation of total vehicle and vehicle system performance characteristics has steadily gained acceptance over the past 10 years. Army leadership and the Program Executive Offices (PEOs) have recognized the value of simulation as a tool for reducing the costs and time associated with traditional approaches to vehicle development. At the U.S. Army Tank-Automotive Command (TACOM), in particular, a commanding general's policy memorandum states that simulation and modeling will be used to the maximum extent in support of military vehicle research, design, development, and acquisition.

TACOM has demonstrated that simulation and modeling leads to significant time and cost savings compared to traditional "build-test-break-fix" approaches. Simulation allows analysis of concepts and scenarios which cannot be replicated economically (or not at all) with test beds.

As a result of 10 years of simulation experience in supporting vehicle acquisition projects, TACOM has identified significant factors which, if incorporated when developing performance specifications and used during the source selection and evaluation activity, will make simulation successful. First, it is essential that the vehicle system proponent (e.g., PEO), the user, and vehicle simulation specialists work together to define the vehicle system mission and to develop sets of representative, realistic use scenarios. Paramount to this process is knowledge of the detailed engineering characteristics and quantitative performance levels of existing fleets. This forms the basis for developing comparable quantitative performance specifications for new systems or for establishing product improvement goals for new systems.

Second, with respect to source selections, quantitative performance specifications must be clearly defined in solicitation packages so that prospective bidders can provide the information necessary for useful simulations. This point cannot be overemphasized. Manufacturers, in TACOM's experience, sometimes fail to support their bids with sound design data. Requiring detailed data packages as part of bids, besides aiding simulation, can help iden-

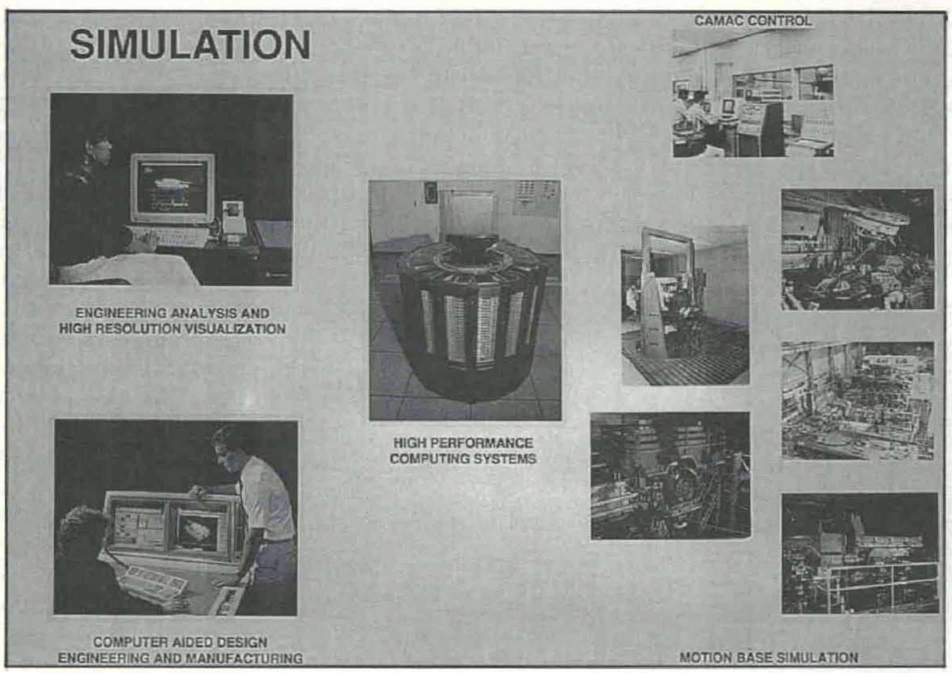


Figure 1.
TACOM's Simulation System.

tify those bidders exhibiting competent engineering capabilities.

Finally, the use of high-resolution simulation models and realistic vehicle input characteristics ensures that source selection and evaluation boards can perform detailed, discriminating, and objective technical evaluations of proposed systems.

Having stated and explained TACOM's simulation-based acquisition strategy and its commitment to simulation, it is appropriate to define "simulation." At TACOM, simulation is the coordinated use of analytical and laboratory testing techniques to evaluate off-road mobility, dynamic stability, structural integrity (or other performance aspects of vehicle systems and subsystems) under repeatable, controlled conditions. Simulation is also a tool for screening new technologies or new or modified components prior to building expensive prototypes.

Most significantly, simulation is a precise and efficient mechanism for evaluating new systems or troubleshooting fielded vehicle problems without having to resort to expensive and time-consuming field tests. It is TACOM's conviction that simulation saves time and affords more extensive evaluation than does field testing alone.

Simulation at TACOM is concentrated in two areas: analytical and physical. A state-of-the-art supercomputer-based analytical and physical simulation capability has been created by TACOM (Fig. I) to reduce the time and high cost of conventional military vehicle prototype-based design and development. These distinct activities encompass a wide-ranging field of tasks in the vehicle development process from analysis of conceptual vehicle systems prior to "bending metal" to evaluation of actual hardware.

Analytical simulation involves mathematically modeling vehicle systems and subsystems for the design and engineering analysis of most aspects of combat and tactical vehicle performance. The most significant component of this capability is the Army Regional Supercomputer at TACOM. TACOM is one of a handful of Army sites having this high-performance computing workhorse (a Cray Research, Inc. Cray-2 computer).

In addition to serving TACOM's simulation requirements, the supercomputer site is used by other Army organizations throughout the country. Augmenting the supercomputer is a growing system of advanced high-performance workstations and networking to perform associated pre- and post-processing and computer-aided design.

TACOM simulation specialists have developed and implemented the basic methodologies and software tools used to perform analytical simulation. At the same time, TACOM is placing increased emphasis on integration of commercially available analysis software packages. Specifically, TACOM uses simulation codes such as: the NATO Reference Mobility Model for cross-country mobility performance analyses (in- house developed); the Dynamic Analysis and Design System methodology for high-resolution, three-dimensional dynamic analyses for determining vehicle ride, stability and duty-cycle load histories (jointly developed with TACOM and, now, commercially available; various finite element analysis/structural integrity tools (commercially developed); and signature assessment models in support of ground vehicle stealth technology research and vehicle survivability (in-house developed).

Physical simulation involves emulating real-time physical motions of actual vehicle systems and subsystems in a computer-controlled laboratory environment to approximate a vehicle's field performance. At TACOM, physical simulation is centered around man- and hardware-in-the-loop motion base simulators. Physical simulation is used to evaluate various issues associated with man and machine interaction dynamics and adaptable motion base simulators capable of "shaking" complete combat and tactical vehicle systems weighing up to 45 tons.

Physical simulation offers accelerated test schedules, repeatable test conditions, and allows collection of data otherwise difficult or impossible to obtain. Physical simulation is used to validate analytical simulation models, address man-in-the-loop issues, and determine failure points of a vehicle system or subsystems.

The most significant component of TACOM's physical simulation capability is its six-degrees-of-motion-freedom Crew Station/Turret Motion Base Simulator (Figure 2), which can accomodate heavy combat vehicle turrets weighing up to 25 tons. It is used for studying soldier-machine interface problems, gun turret drive stabilization systems and addressing issues related to the operation of turrets and their components.

Other full-scale motion simulators are available at TACOM. These consist of sets of digitally controlled hydraulic actuators, which attach to the wheel spindles of tactical vehicles or support tracked vehicle road wheels and tracks to simulate the effect of running over specific rough terrain segments. These simulators can be reconfigured and instrumented to isolate and test specific vehicle components.

The ideal integration of analytical and physical simulation involves each supplying data for, analyzing the results of, and validating each other. For example, detailed analytical evaluations and trade-off analyses of design alternatives are conducted early on to create performance specifications and evaluation criteria to be used later in source selection.

As concepts and designs take on definition, analytical simulation can be coupled with laboratory physical simulation for proof-of-principle and man-and hardware-in-the-loop testing. Laboratory

Figure 2. Crew Station/Turret Motion Base Simulator (CS/TMBS).

tests are conducted under controlled, repeatable, dynamic conditions at the complete system level. Other military vehicle simulation technical areas include advanced suspension, compliant systems dynamics, optimal control and estimation, advanced propulsion, and vehicle electronics crew displays.

If properly applied, simulation can effectively augment the test planning and validation process. For example, a critical part of vehicle system acquisition is developmental testing and operational testing. Through modeling and simulation during the development phases, test environments and instrumentation requirements for field testing can be determined in advance with better certainty. Also, simulation results can identify potential vehicle problems that may arise during field tests which, therefore, should be addressed in advance of testing. Doing this affords the potential for substantially reducing test costs and time.

TACOM's RDE Center and the U.S. Army Test and Evaluation Command (TECOM) are jointly developing procedures to use physical simulation in lieu of field testing in certain cases. For example, structural integrity testing of truck and trailer frames and components in support of comparison production tests and production quality tests is an area where physical simulation has demonstrated cost and time savings of up to 50 percent. A specific example of this is the suspension, frame and lunette durability testing of the M101 trailer (Fig.3) in TACOM's physical simulation laboratory. In addition, carefully planned test scenarios, vehicle and terrain characteristics, as well as detailed test data enhances the ability to validate the simulation models. This permits the creation of simulation database libraries, which can be used for future applications.

Relying on simulation during the test-planning process and validating simulation results against carefully controlled tests will greatly enhance the simulation database libraries and increase confidence in simulation.

TACOM is firmly convinced that simulation technology should be shared, particularly with industry. To enhance the development and transfer of simulation technologies, TACOM, with the National Science Foundation (NSF) and the NASA Goddard Space Flight Center, has established the National Research Center for Simulation and Design Optimization of Mechanical Systems. This is part of the NSF Industry/University Cooperative Research Center program. The center is located at the University of Iowa and was formed in September 1987 with the objective of developing and distributing advanced analytical simulation software to government and industrial participants.

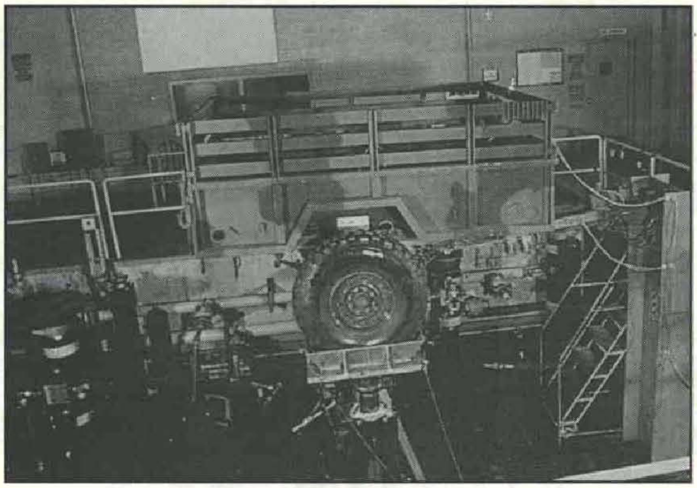


Figure 3. TACOM's Physical Simulation Laboratory.

The center is currently sponsored by 24 companies and federal laboratories. Because of TACOM's commitment to this activity, in May 1988, it received a Federal Laboratory Consortium Technology Transfer Award for the unique nature and potential offered by this technology transfer thrust. This success has led to the involvement of the center in the DOD Computer-Aided Logistics Reliability and Maintainability program and to recent support from the Department of Transportation to adapt simulation tools, under development by the center, for the commercial trucking industry.

TACOM views this consortium as an excellent opportunity for the Army and industry to leverage limited research and development funds and create simulation tools that meet joint requirements. In addition, TACOM encourages industry to share its unique analytic and physical simulation resources and facilities in support of Army weapon systems development programs. TACOM believes that the transferring of its simulation technology to other government and industrial users is as important as applying it itself.

Conclusion

The achievements of simulation—in both military and industrial applications—requires dedication of resources and manpower to constantly explore new methodologies and to refine current ones. TACOM has various ongoing simulation research thrusts with one objective in mind—simplifying the simulation process and putting simulation tools in the hands of journeymen engineers. Combined with the ever-expanding proliferation of high-performance computing capabilities, the implementation of complex, theoretical techniques—impractical or impossible before—is now making the engineer's job easier and—most significantly—more productive.

DR. RONALD R. BECK is chief of the System Simulation and Technology Division at the U.S. Army Tank-Automotive Command. He manages and oversees the TACOM RDE Center's supercomputer-based simulation system. Dr. Beck holds B.S., M.S. and Ph.D. degrees in mechanical engineering from the University of Iowa, and is a member of several professional societies.

MR. JOHN C. SCHMUHL is chief of the Time Share Computing Branch at the U.S. Army Tank-Automotive Command. He manages and oversees the TACOM RDE Center's scientific and engineering computing activities. This includes the Army regional supercomputer at TACOM. He holds B.S. and M.S. degrees in industrial engineering from Wayne State University and is a senior member of the Institute of Industrial Engineers.

Providing Quality Care...

MILITARY DENTISTRY FOR THE '90'S— AND BEYOND

By COL William R. Posey, DC, and Dr. Jean A. Setterstrom

Introduction

A crystal ball is not needed to know that the practice of dentistry in the '90s and beyond will be very different from that of the past—for both the military and the civilian sectors. There are, however, important additional requirements for the military that are not applicable to the civilian community. The military is responsible for providing high quality care anywhere in the world and to do so within an extremely short time period.

Thus, there are unique requirements for the military that are not addressed by research performed in the civilian community. It is incumbent upon the military to develop specialized care or treatment modalities, and materials or equipment to meet those requirements. Within the Department of Defense (DOD), these issues are addressed by the U.S. Army Institute of Dental Research (USAIDR).

The USAIDR is joined in these efforts by the U.S. Army Health Care Studies and Clinical Investigation Activity (HCSCIA) and the Naval Dental Research Institute (NDRI). Both the HCSCIA and the NDRI address issues that complement dental readiness, but their specific research arenas are different from and outside of the USAIDR mission.

For the scientific staff at the USAIDR, there are two major areas of concern: the prevention of dental emergencies in the field and the treatment of combat casualties with trauma to the maxillofacial area. If dental emergencies and/or pain can be expediently treated far-forward, then this type of care and treatment becomes a combat multiplier—personnel losses to units for these reasons are diminished.

The last available statistics for dental emergencies for a long-term deployment are from Vietnam where the rate was in excess of 140 thousand a year. Reducing this incidence through research efforts will both decrease lost duty time and significantly improve return to duty rates.

The USAIDR is the lead agent for the DOD in combat dentistry and the Army's only research laboratory dedicated to research for dentistry. This mission includes a specific emphasis on research to enhance the care and reconstruction of soldiers who suffer trauma to the maxillofacial complex. Other research areas of dental concern are the responsibility of the U. S. Navy Dental Research Institute at Great Lakes, IL. Close coordination between these two DOD laboratories precludes duplication of research efforts.

The USAIDR is one of nine laboratories of the U.S. Army Medical Research and Development Command (USAMRDC). The USAIDR laboratories are located at the Walter Reed Army Medical Center, Washington, DC, Forest Glen and Fort George G. Meade, MD. All of the research conducted by the USAIDR is included in one of three research program thrusts: maxillofacial wound repair and healing; maxillofacial wound infections; and field dental patient management.

The research component of the institute, the Division of Research (chaired by a civilian Ph.D.), contains six functional branches within which all research is conducted: Applied Dental Sciences (with Bioengineering, Dental Materials, Epidemiology, and Laser Anthropometry Sections), Chemistry, Microbiology, Pathology, and Surgery, each of which is headed by a research-trained officer, Dental or Medical Service Corps. Other investigators are civilians and officers of the Dental and Medical Service Corps.

The majority of the investigators in the basic science areas are trained to the doctorate level, while those in the physical sciences area trained to the master's level. Most of the enlisted research assistants are college graduates with training in one of the basic sciences.

Administrative and logistical requirements for the institute are accomplished by the Division of Research Support (chaired by a Medical Service Corps officer). It is composed of Administration, Personnel and Automation, Logistics, and Resource Management Branches. These branches are headed by Medical Service Corps officers and one civilian. They are supported by enlisted personnel and civilians.

USAIDR laboratories are equipped with state-of-the-art equipment for highly sophisticated instrumental analyses. This equipment includes various types of chromatographs, a tandem mass spectrometer, electron microscopes, a nuclear mangnetic resonance spectrometer, and histomorphometric imaging capability. When appropriate, teams are formed by combining personnel from the different branches and sections to investigate a particular project to assure the most effective and efficient utilization of all resources.

Program Objectives

Current investigative thrusts are directed toward a number of different areas. Some are dental specific, some are dental with major medical applications, and only one, which is in advanced development, is medically specific. The descriptions which follow provide an overview of the major programs.

Field Dental X-Ray System

This project consists of two components—a hand-held dental X-ray unit (HDX) and filmless dental imager (FDI). The FDI is a preplanned product improvement.

Ultimate goals of this project are to provide an alternative to the current Army field dental X-ray system by reducing its weight, cube and power requirements and improving the military dentist's ability to diagnose and treat dental patients in far forward remote areas under a wide variety of adverse conditions.

The recently completed pre-production prototype HDX consists of an X-ray source, a 24-volt rechargeable battery, a battery recharger and a shock resistant case. This entire unit weighs 30 pounds (X-ray source alone is 10 pounds), with a volume of 1.6 cubic feet (the current system weighs approximately 218 pounds and has a cube of approximately 11.2 cubic feet). It uses a high frequency inverter to step up the voltage of the 24-volt power supply to maximum operating voltage of 70kV, direct current.

The HDX has undergone laboratory testing, health hazard evaluation, user testing on dental phantoms and environmental testing. The radiograph quality produced by the prototype was found to be equivalent to or better than those taken with current systems.

Although it was not a primary goal of the development process, the medical uses of the HDX have been shown to offer advantages to medical officers also in far forward, remote areas since it is capable, with minor adjustments, of producing medical radiographs up to the size of chest films using conventional medical film.

The HDX pre-production prototype is currently in procurement with initial purchase for testing due in FY 92. Upon successful completion of the field tests, the DOD will have the option to purchase a significant number of the units for fielding.

The FDI is being designed to integrate with the HDX to provide instantaneous capturing and viewing of an X-ray image on a monitor without film. The FDI will eliminate the continual resupply burden for chemicals, film and water in the area of operations.

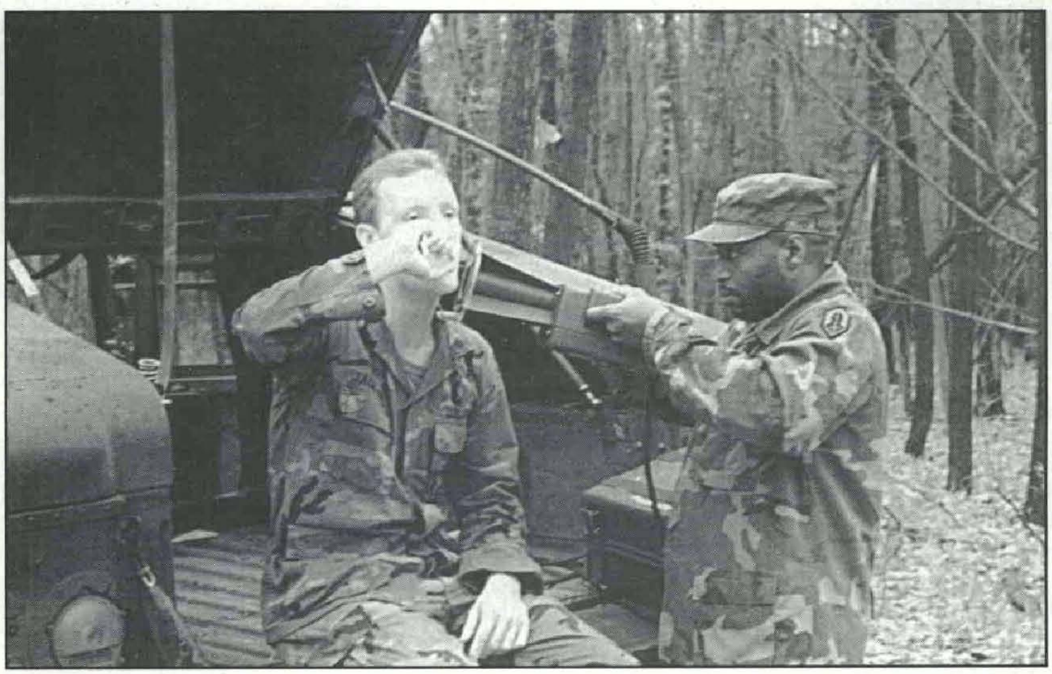
Instantaneous imaging will permit the dentist to proceed with diagnosis and treatment without waiting for film development. Images can be stored locally or transmitted to other sites. The process is not environmentally sensitive and radiation exposure is 10 times less than for a conventional radiograph using Ektaspeed film.

The tech base development of each of these items was conducted by the USAIDR. The advanced development effort resides with the U.S. Army Medical Materiel Development Agency (USAMMDA). The USAMMDA is responsible for advanced development of all products developed in USAMRDC laboratories.

Postmortem Identification System

This project consists of a computer program that has been developed to speed the identification process of human remains following mass disasters. It works by providing a most likely identities list after rapidly comparing dental and physical characteristics obtained from antemortem and postmortem records.

Identification of human remains is an



The miniature dental X-ray can use either its own battery or a vehicle battery as a power source. Portable and lightweight, the hand-held unit can be used for dental and small medical diagnostic X-rays.

obligation of the U.S. military to the families of service members who give the ultimate sacrifice defending freedom. The CAPMI program will run on any MS-DOS computer (including laptop computers), any type of monitor and printer, and requires only 640K RAM.

Because of its minimal equipment needs, CAPMI is ideal for on-site utilization. With its menu based program, it is extremely user friendly. Its algorithm compares 1,200-5,000 records per second, thereby drastically reducing professional manhours and dollars required to identify human remains.

CAPMI (Beta version) continues to be evaluated by more than 300 military and civilian medical examiners and forensic scientists (to include international agencies). This version of the system should be completed in FY92, to include conversion to Ada (the DOD software programming language), and transfer to HCSCIA as the proponent agency.

The Computer Assisted Post Mortem Identification System can be used anywhere in the world. It drastically reduces the time required to identify human remains resulting from mass casualty disasters.

Microencapsulated Antibiotics

Wounds sustained in combat from high-velocity projectiles are characterized by devitalized tissue (soft tissue and bone), damaged vasculature, foreign debris and bacterial contamination—all factors that encourage wound infection.

Improved methods to prevent and treat infection in maxillofacial combat casualties are required. In response to this deficiency, the USAIDR, in collaboration with Southern Research Institute, Birmingham, AL, has developed a novel sustained-release biodegradable antibiotic delivery system which has shown enhanced efficacy for the control of infection.

Pre-clinical studies conducted to test the efficacy of this novel antibiotic dosage form have provided opportunities to study and document the numerous advantages of this form of treatment. The novel aspect of the microencapsulated antibiotic dosage form is that it actually provides drug targeting directly into the site of injury. Specific advantages include: the ability to achieve high concentrations of antibiotic in a wound without the toxic side effects that occur when antibiotics are administered by conventional means; sustained, controlled release of therapeutic levels of antibiotic at the wound site in spite of vascular compromise; and the control of infection via single-dose therapy with a concomitant reduction in medical manpower that is normally required to maintain long-term antibiotic coverage in the critically injured. Thus, the advantages observed have both military and medical relevance.

Microencapsulated ampicillin, the original prototype, has transitioned into advanced development with USAMMDA. Presently, an Investigative New Drug (IND) application is under preparation for submission to the Food and Drug Administration with clinical trials expected to begin in 1993.

Tech base efforts are now focusing on the encapsulation of additional drugs to provide the capability of mixing different encapsulated antibiotics that are selected to function synergistically (a type of antibiotic "cocktail"). The envisioned outcome is a targeted antibiotic dosage form with an extremely broad spectrum of antimicrobial activity that will successfully treat wounds contaminated by any microorganism. This modality of treatment, along with surgical debridement, offers exciting new advantages for effective wound management in both military and civilian sectors.

Antimicrobial Dermal Dressing

In any area of operations, combat or training, many troops acquire superficial dermal injuries such as cuts, blisters, scratches or abrasions. Under combat conditions in warm, humid climates, these seemingly minor injuries develop into debilitating skin infections that are well documented as a serious cause of performance decrement.

The USAIDR, through a Small Business Independent Research (SBIR) tech base initiative, successfully developed a membrane that served the dual function of providing an optimal physiologic covering for the wound while simultaneously sustain-releasing antimicrobials to prevent infection. Several iterations of this original prototype have been formulated to obtain antifungal as well as antibacterial activity. Presently, progress is being made through Cooperative R&D agreements with private industry.

Synthetic Bone Repair Material

Another important research thrust at the USAIDR is the development of a biodegradable synthetic bone repair material for reconstruction of large bony defects in the craniofacial complex. When developed, such a bone regenerative material will also be applicable for the repair of large bone defects in other parts of the body. Currently, an optimal synthetic bone repair material does not exist for the surgeon.

Such a material requires three major components: an initiator, to begin the process; an enhancer, to speed the process; and a carrier, to maintain the active materials in the proper location and to prevent soft tissue prolapse into the bony defect. Stated simply, the process of embryogenesis must be replicated. Obviously, such a system is complex and requires a biocompatible material be developed to sustain-release appropriate quantities of stimulatory proteins in consonance with biodegradation of the carrier material to allow the ingrowth of healthy bone into a bony defect to restore both form and function.

Recent results using cloned human morphogenic protein (through a Cooperative R&D agreement with private industry) have shown excellent promise in developing a critical component of the desired regenerative material.

Pulpal Capping Agents

Acute dental pain due to decay or trauma is documented as a significant cause of lost duty time for military personnel that impacts on combat readiness. Development of a non-steriodal anti-inflammatory pulp capping agent will allow far forward treatment of teeth by controlling pain and potentially reversing some of the damage to the pulp. The outcome will be better control of dental emergencies and the saving of teeth from extraction.

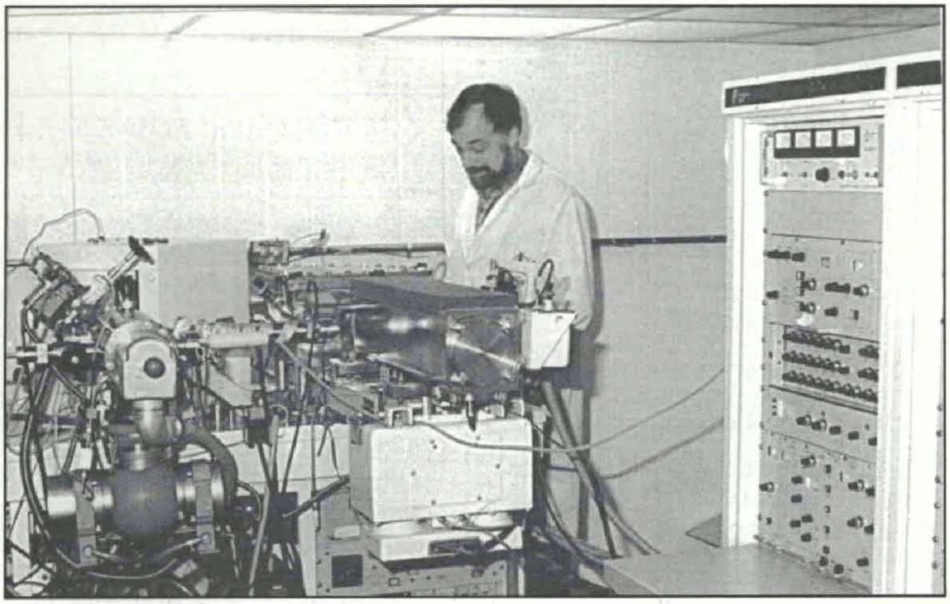
The benefit for a deployed unit is that fewer personnel will be lost because of dental emergencies—a personnel combat multiplier.

Local Anesthetics

There are situations in areas of operations where certain individuals who have been injured can be an asset to their unit, if it were not for the pain caused by their injury. Current medications can control such pain. However, the patient's ability to act or react is compromised because of the effects of the available medications on sensory and motor functions.

One of the significant thrusts of the USAIDR is to develop a highly selective local anesthetic for dental indications that will function by negating the effect of potassium ionophores; this action will provide long lasting selective relief of post injury/treatment ("C" fibers) pain while having no effect on motor or sensory functions (to include the protective Injury-Occurring-Now "A" fibers).

Pain control, without incapacitation or loss of protective "A" pain, should allow the service member functionality without additional injury. Also, maintenance of functionality can be life saving in some evacuation scenarios and should result in reduced manpower required to evacuate mass casualties. In certain critical combat scenarios, such a pain control capability will serve as a combat multiplier.



The mass spectrometer is used to determine the chemical structure of newly synthesized anesthetic drugs.

Surgical Reconstruction Through CAD/CAM

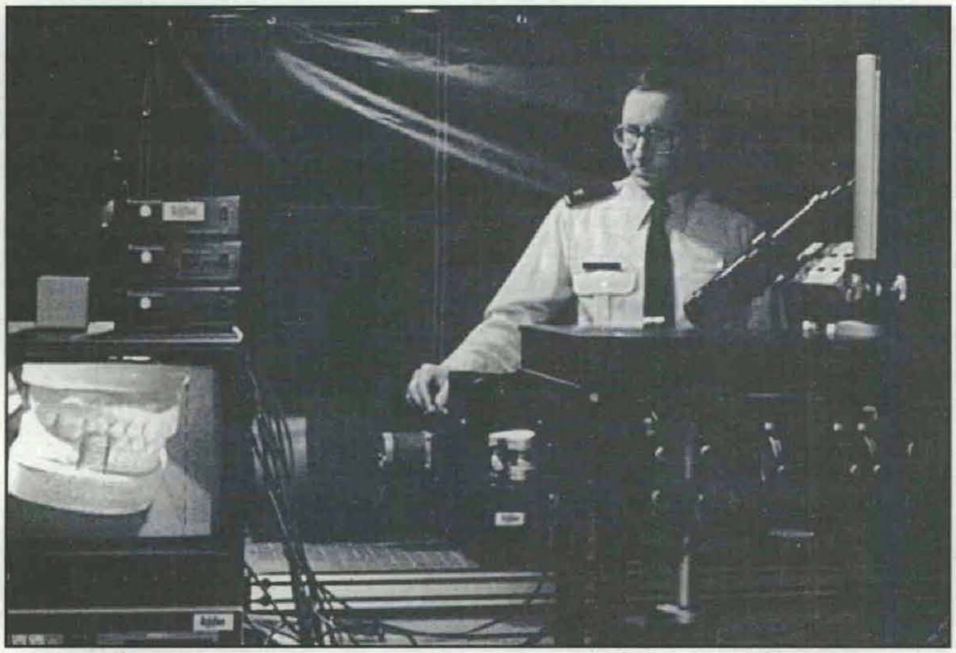
Maxillofacial injury stabilization, treatment and reconstruction is a very time-consuming, labor-intensive process for the medical and dental staff. It involves, as a minimum, an oral/maxillofacial surgeon, a prosthodontist, and numerous ancillary personnel to perform a wide range of preparation and treatment modalities.

A major project of the Laser Anthropometric Section is to develop ways to rapidly map the three-dimensional structure of the oromaxillofacial anatomy and apply 3-D data to computer aided dental design to develop emergency surgical treatment stabilization methods. This includes custom surgical splints. Development of the science of computer aided fabrication of dental devices includes the capability for remote site diagnosis of the injury and remote site fabrication capability.

The success of this project will permit more effective treatment of higher numbers of combat casualties by reducing diagnostic laboratory time from hours to minutes for the oromaxillofacial surgeon and the prosthodontist. It will also reduce the vital time for non-hands-on patient-required procedures during combat casualty surgeries, as well as providing new surgical techniques in diagnosis and treatment.

Development of this system includes battery operable lasers, custom optics, unique spatially programmable light modulators, miniature videocameras and other electronics. Together, this equipment will collect over 75,000 x,y,z data points and create a 3-D volume space coordinate system for the appropriate anatomical target.

The efforts in this area are being achieved through a combined effort of in-house research and a number of



COL B.R. Altschuler, Air Force liaison officer and expert in optics studies, devises new ways to conduct imaging and image analysis of jaws and related structures.

Cooperative R&D agreements with industry and academia.

Perishable Dental Biomaterials

There are more than 20 perishable dental biomaterials used by the military which are located in sets, kits and outfits that are stored in numerous environmentally different areas of the world. Due to the need for pre-positioned stockage in environmental extremes, the military services requirement for the procurement, shipment, storage and use of these materials is unique. No similar requirement occurs in the civilian sector.

Materials which are resistant to degradation under normal storage conditions may deteriorate rapidly when exposed to arid, arctic-like, humid or high temperature conditions. The extent to which the mechanical and physical properties of these biomaterials may be affected under these conditions is unknown, and the requirement for this type of information is important to the military.

Materials used for patient care which have degraded and changed their mechanical and/or physical properties can not be used. This situation presents an unnecessary expense to the military in two major areas—loss of materials and loss of manpower because of insufficient supplies to perform their mission.

The information generated from USAIDR studies on dental biomaterials will impact on the procurement, shipment, storage and use of these perishable materials. Additionally, those materials which cannot meet stringent military requirements will be replaced with an acceptable alternative. If an acceptable substitute cannot be procured, then new materials must be developed to enable the military patient in any global area of operations to receive the high quality of care to which he or she is entitled.

Technology Transfer

In the major programs at the U.S. Army Institute of Dental Research, technology transfer is playing an increasingly important role. Through technology transfer, the institute has expanded development of technology developed in-house into new avenues, enrich its in-house capability through the exchange of ideas with experts in the private sector, and contribute achievements in military research that have either enhanced or driven research in the civilian sector.

Technology transfer has allowed creation of a "win-win" series of Cooperative R&D Agreements (CRDAs) with universities and small businesses. These CRDAs serve to increase both the capabilities and the creativity of principal investigators on both sides of the agreement. The USAIDR has actively pursued and benefited from the Technology Transfer Act of 1986.

Summary

Today, the USAIDR continues to forge ahead, keeping pace with the latest developments in dental science and pioneering new developments. This year, final work is being completed on an experiment designed to encapsulate antibiotics in microgravity aboard the U.S. Space Shuttle and efforts are being expended to expand the role of USAIDR in research on the oral manifestation of AIDS. However, the primary purpose of the research conducted by the USAIDR is to develop techniques, materials and equipment to provide the best health care available for the men and women of this country's armed forces—anything less is unacceptable.

COL WILLIAM R. POSEY, DC, is the commander of the USAIDR. He holds a B.S. degree in biology from the University of South Carolina, a DDS from the University of Tennessee School of Dentistry, a master's in adminstration from Central Michigan University and is a graduate of the U.S. Army Command and General Staff College.

DR. JEAN A. SETTERSTROM is the deputy for research at USAIDR. She holds a B.S degree in zoology from Marshall University, a master's in microbiology from West Virginia University and a doctorate from the Catholic University of America.

FUTURISTIC GUN SLATED FOR YUMA TEST FIRINGS

By LTC Anthony J. Sommer and Dr. Thaddeus Gora

The world's first fully self-contained electric gun—the 9 Megajoule (MJ) Range Railgun—is scheduled for test firings at the U.S. Army Yuma Proving Ground (YPG) this summer. It is the Army's first step at taking this exciting new technology out of laboratories that require "a building's worth of power supply," according to the gun's developers at the Armament Research, Development and Engineering Center (ARDEC), Dover, NJ.

The gun is based on a concept that could end the dependence of tank guns, artillery pieces and air defense and naval guns on explosive gunpowder or other chemical propellants. It relies instead on an intense magnetic field created by a pulse of electrical energy to accelerate projectiles. This railgun is the simplest form of so-called "electromagnetic" (EM) guns.

"We've reached the outer edge of speeds at which rounds can be fired using chemical propellants," according to Wade Porter, electric gun project engineer at YPG. EM guns can fire at velocities well above those of any other guns. Velocities up to six kilometers per second (12,000 miles per hour) have been routinely achieved in laboratories in this country and abroad, and there is no theoretical reason they should top out there. Such speeds are referred to as "hypervelocity." They compare to the top speed of about 1.7 kilometers per second of conventional tank guns, 1.1 kilometers per second for the M-16 rifle, and well under one kilometer per second for long-range artillery pieces.

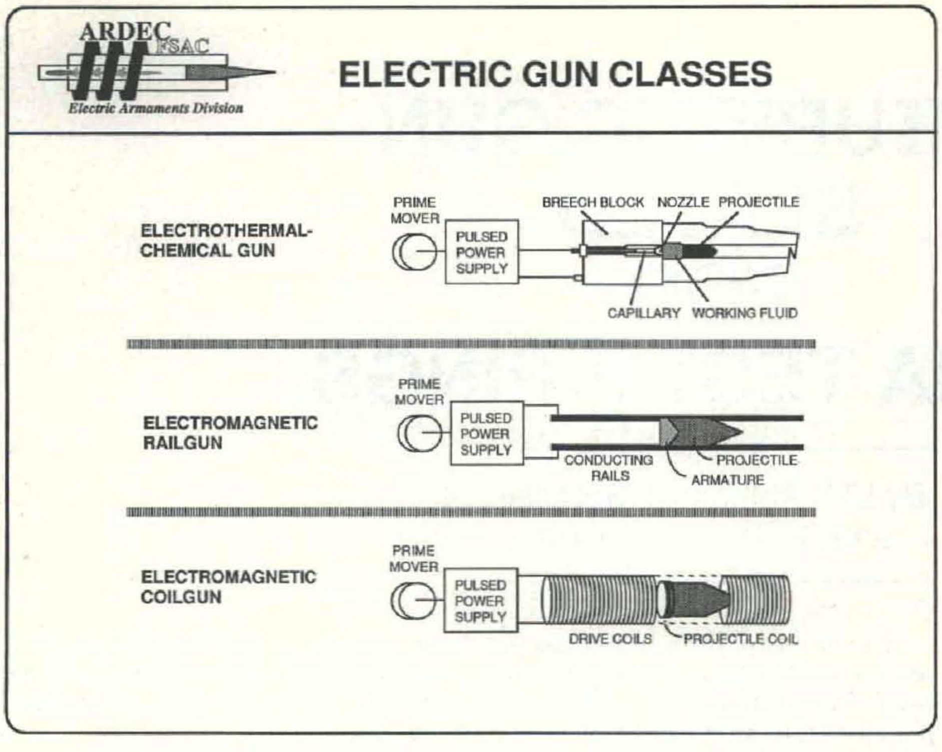
At a velocity of three kilometers per second, the kinetic energy of anything, even foam rubber, has the energy punch of the same weight of TNT. A critical problem for developers is to understand and optimize the effects of hypervelocity for real weapon systems. Developers expect EM tank guns to operate best somewhere between 2.5 and four kilometers per second, with air defense and theater missile defense systems wanting the mid- to higher end of this range.

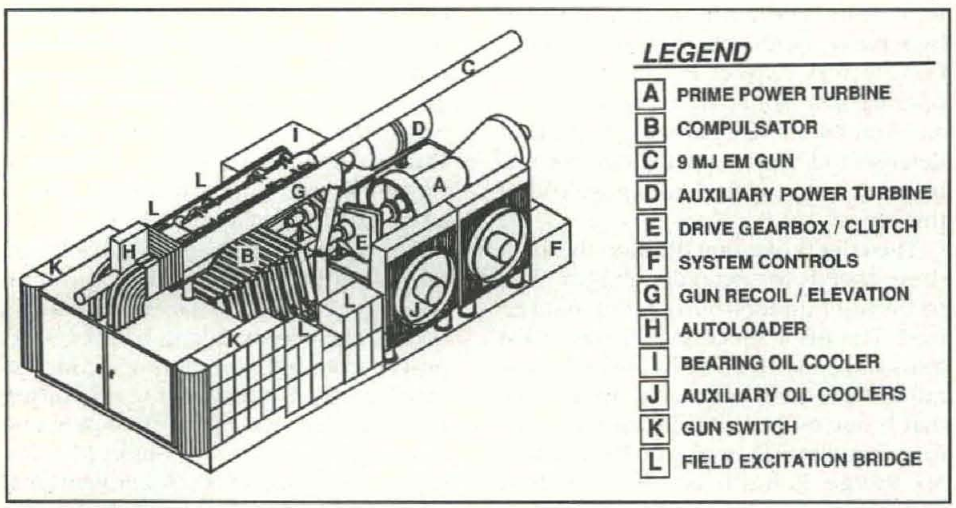
The effects of going through the air at these speeds for extended ranges need to be fully understood and characterized. The prior successful firings of EM guns have involved only tens of yards rather than the thousands required, and that is one of the critical reasons to perform exploratory testing at YPG. The 9 MJ Range Railgun is only the first demonstrator scheduled for testing at YPG, if the Army's decision to make YPG the electric gun national range test facility is fully implemented. The Yuma site would also make an excellent choice for other Defense range-scale testing, such as potential missile defense demonstrators planned by the Strategic Defense Initiative Organization.

The way that the railgun system works is not difficult to explain in principle. It uses a pulse of electrical current which travels down one conducting copper rail embedded down the length of the barrel's support and insulation structure. The current passes across an "armature" at the base of the projectile, in order to return through the other copper rail. The resulting magnetic field in this "U"-shaped path provides the force on the armature needed to accelerate the projectile. The hard thing to comprehend is the power of the more than three million ampere electrical current involved. The system's power supply would be able to light up one 100 watt light bulb for every person in the United States. It should be noted that the whole experiment would be over in a small fraction of a second.

The 9 MJ Range Railgun is a self-contained, multiple shot railgun system weighing 25 metric tons, mounted on a "skid." The 90mm railgun barrel gets its power from a "compulsator" (compensated pulsed alternator), a rotating machine that gets spun up slowly and discharged in several thousandths of a second (milliseconds). A conventional gas turbine spins this machine up. The system design and fabrication efforts have been performed under Army contract by the University of Texas Center for Electromechanics in Austin. The compulsator will deliver 30 MJ to the railgun breech, a factor-of-10 advance over any prior machine of its size.

Assessment of EM gun weaponization potential may take up to five years, according to YPG and ARDEC officials. Low energy firings of the Range Railgun system will commence this year, using "dummy" projectiles. YPG technicians will also be evaluating and improving new tracking equipment. Although they believe existing technology will be sufficient to track projectiles at speeds never





Electromagnetic Gun Prototype

before encountered at test ranges, YPG engineers say they may have to modify their test equipment to deal with the electromagnetic fields generated when the railgun is fired.

In 1993, the railgun system will employ higher electrical power, increasing both velocity and effective range considerably. Realistic armor-piercing projectiles will be used for the first time, and their effects at distances up to about a mile and a half will be assessed.

Plans for 1994 involve increasing the testing range to about two miles, and continued firings of the Range Railgun in support of hypervelocity anti-armor projectile development. In 1995 the anti-armor range will be extended to three miles. Further requirements may involve much longer ranges for artillery and air defense scale testing, as well as installation of new power supplies and EM guns capable of launching "smart" hypervelocity projectiles.

Other EM gun types are also under development, and may wind up as demonstrators for testing at YPG. The "coilgun" also uses magnetic fields for its driving forces, and has the potential for greater energy efficiency than simple railguns. Coilguns have received less attention, partly because of their great conceptual and geometrical complexity.

Another family of electric guns is called "electrothermal" (ET), because electrical energy is used to heat and control the vaporization of a "working fluid" to provide the driving hot pressurized gas. If the working fluid is energetic, far less electric energy is required. This approach is called "electrothermal-chemical," or ETC. Comparisons between EM and ETC guns involve very detailed technical and system requirement arguments. YPG officials believe that the results of their planned extended range atmospheric testing will be vital to final Army assessments.

Prospects for these new technologies are revolutionary, according to major Defense Department officials. No other approach has comparable armament system performance potential, meaning very high velocities without the danger of carrying explosive gun propellant. In addition, very significant space and weight reduction are possible if and when the necessary power supply downsizing has been achieved. Developing, integrating and weaponizing these new technologies will certainly be a large challenge to the developers at ARDEC. YPG will play a vital role as the technology continues to mature.

LTC ANTHONY J. SOMMER is a U.S. Army Reservist employed at the Phoenix Arizona Gazette and is a member of the Command and General Staff College ajunct faculty. He has a B.A. degree in journalism from Central Michigan University and a master's degree from Ohio University.

DR. THADDEUS GORA is employed at the U.S. Army Armaments RD&E Center. An internationally recognized expert on electric armaments technology, he has a B.S. degree in physics from Rensselaer Polytechnic Institute and a Ph.D. in theoretical solid state physics from the University of Delaware.

ARMY PM CONFEREES DISCUSS KEY ACQUISITION ISSUES

More than 200 attendees exchanged information on major subjects of interest to the Army's research, development and acquisition community at the 1992 Program Manager (PM) Conference, Jan. 15-17, in Orlando, FL. Topics of discussion included, but were not limited to, modernization strategy, resource allocation, the acquisition process, and the Army Acquisition Corps.

Assistant Secretary of the Army (Research, Development, and Acquisition)/Army Acquisition Executive Stephen K. Conver opened the conference by providing a brief overview on the four topics of discussion cited above. Some of Conver's suggestions include: correcting current development overruns and avoiding future ones, better matching of requirements between the user and the developer, insuring that schedule requirements are not unrealistic and arbitrary, reducing government contributions to overhead costs, and reducing the time and cost involved in weapon system production. Conver encouraged the conferees to provide specific suggestions, during work group sessions, on how to accomplish the modernization strategies, how to address the resource allocation issues, and how to streamline the acquisition process so that the Army gets equipment into the hands of the soldier much faster and cheaper.

Dr. John Hamre, a congressional staff member on the Senate Armed Services Committee, gave a congressional perspective on the way recent world events are shaping the Army's acquisition strategies. According to Hamre, in these "startling times," we must substitute the notion of "what threats we may face" with "what capabilities we want." Do we still want military capabilities ...to deter nuclear war? ...to perform as we did in Desert Storm? ...to rescue Americans caught in dangerous situations? ...to counter terrorism? ...to win conflicts quickly with few casualties? Hamre stated that the Army leadership must make sure that the average American understands what needs exist. He called on the Army leadership to convey to the average person what the needs are in clear, simple and believable terms.

The keynote speaker was Robert N. Parker, executive vice-president, LTV Aerospace and Defense Company. Parker spoke on the opportunities to get more fighting capability with available funds and personnel. According to Parker, without taking some risk, there won't be much progress. He added that the current acquisition process is both costly and time consuming. Innovative acquisition programs, which are necessary if the Army is to get "more for less," are unlikely to occur unless the senior leadership assumes the risk and makes the necessary compromises. Parker suggested the following actions for consideration: a senior HQ DA review system is needed to rationalize requirements and the acquisition strategy early; require more participation from the acquisition people in the acquisition process and the requirements people in the RFP process; establish an RFP review system; supplement requirements documents with unit and development cost ceilings; and focus on systems requiring less manpower. According to Parker, "The key is risk management at the senior levels of the Army."

Daniel R. Gill, director of the Army's Small and Disadvantaged Business Utilization (SADBU) Program, gave a presentation in which he called for PEO/PM support to meet the Army's SADBU and Historically Black Colleges and Universities (HBCU) Program goals. Gill emphasized that in order for

We must substitute the notion of "what threats we may face" with "what capabilities we want."

the Army to reach its goals, PEOs and PMs should provide greater manufacturing opportunities for small and disadvantaged businesses.

MG Donald M. Lionetti, chief of staff, Headquarters, U.S. Army Training and Doctrine Command (TRADOC), spoke on TRADOC's role in the acquisition process. According to Lionetti, the TRADOC combat development process is absolutely essential. Lionetti stressed the need for the user and developer to work together to stimulate thinking and to insure that the soldier has the best, most modernized equipment.

MG Charles R. Henry, commander, Defense Contracts Management Command, and deputy director, acquisition management, Defense Logistics Agency, discussed defense contracting and the role his command plays in supporting the PEOs and PMs. Henry's presentation included overviews on In-Plant Quality Evaluation (IPQE), Manufacturing System Reviews and Subcontracting Management, and the Defense Business Operations Fund. In discussing IPQE, Henry suggested working more closely with the contractor to better understand, measure, analyze and reduce variability of processes, focusing more on continuous improvement, and greater use of statistical techniques.

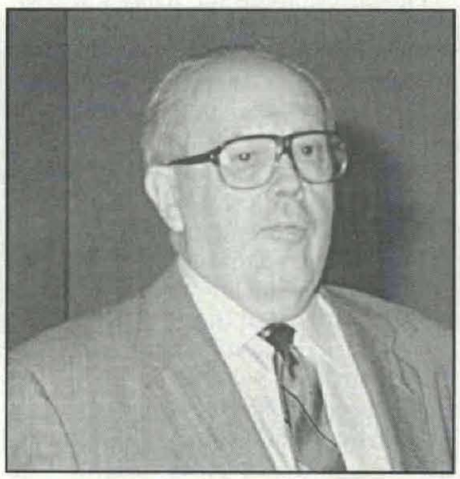
Dr. John Hamre ...a congressional perspective

Frank Kendall III, deputy director, Tactical Warfare Programs, Office of the Under Secretary of Defense for Acquisition, provided a DOD perspective on acquisition. Kendall said that OSD's view of a good PM is one that has credibility. His list of criteria that contribute to building a PM's credibility includes: knowledge and understanding of the details of the program's contracts; objectivity; candor; and providing presentations in a business-like manner without "selling" his program. In describing acquisition trends for the future, Kendall stated that the Army should not expect many new systems, but should look closely at upgrading existing ones.

William Gregory, author of *The Defense Procurement Mess,* presented the luncheon address. He predicted that the PM's life will get more difficult during the next 10 or so years, because of the absolute uncertainty about future threats. Gregory said, "I'd hate to be a requirements guy right now. How do you write a requirement when the old threat is gone, and the new one's not here yet?" He noted that commercial processes will become part of acquisition, that the military will begin to think more like commercial managers, and that this is a time for taking a little more risk than we normally do. According to Gregory, the defense draw-down will cause technology to fall out from military programs and this will not be a casual, easy transition. In closing, Gregory indicated that he believes that in view of the time and talent that we've invested in defense R&D, we should be very cautious as we wind down defense.

One of the conference highlights was presentation of PM of the Year

Robert N. Parker, executive vice president, LTV Aerospace and Defense Company was the keynote speaker.



Innovative acquisition programs, which are necessary if the Army is to get "more for less," are unlikely to occur unless the senior leadership assumes the risk and makes the necessary compromises.

William Gregory, author of <u>The Defense Procurement Mess</u>, was the luncheon speaker.

ment. "Our challenge is to build a balance of force capabilities, and also a balance between upgrading today's capabilities and investing in future systems," Garner said.

Conferees attended work group sessions to exchange ideas and make suggestions on how to address such topics as: modernization strategy, resource allocation, the acquisition process, and the Army acquisition workforce.

The objective of the Modernization Strategy Work Group, chaired by MG Richard D. Beltson, deputy for systems management, Office of the ASA(RDA), was to determine what our general approach is to modernizing the Army—an Army that is not only "trained and ready," but is "trained, ready, and well-equipped." The Modernization Strategy Work Group focused on issues such as:

• How do we develop a policy of "continuous modernization" to replace the current policy of "accepting near-term risk?" How do we generate and capture O&S savings that can be plowed back into procurement funding?

• How and to what extent should we protect the Army's industrial base in a time of economic downturn and constrained defense resources? How do we improve the efficiency of our suppliers in the face of a declining business base?

• How do we expedite our technology into the hands of the soldier?

• What is the best way to handle international cooperation?

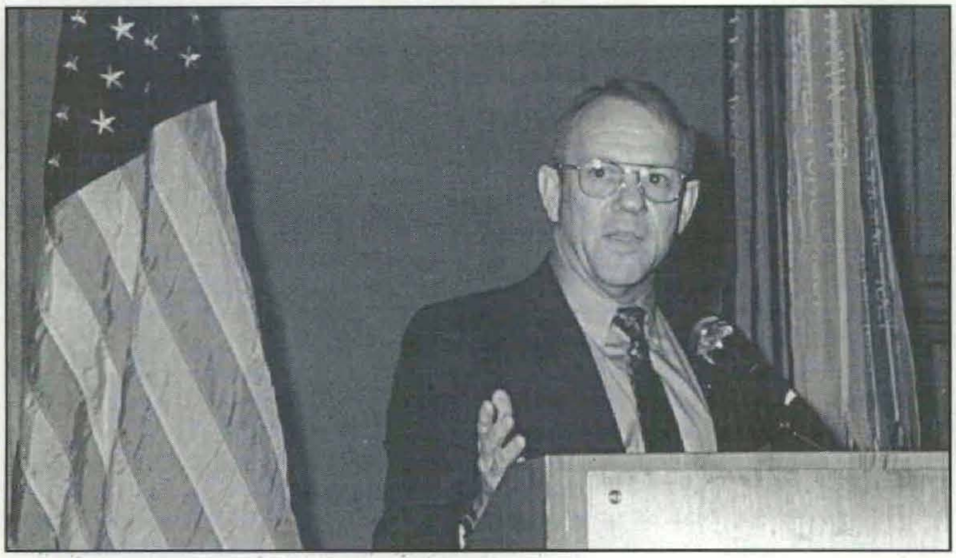
Subchairmen of the work groups that addressed each of these issues were, respectively: MG Peter M. McVey, PEO, Armored Systems Modernization; BG William Schumacher, deputy chief of staff for ammunition, U.S. Army Materiel Command; George T. Singley III, deputy assistant

Awards. Five PMs were selected for the awards—two product managers, and three project managers. Recipients were: LTC August C. Manguso, product manager, Strategic Target System; LTC William R. Hertel, product manager, Paladin; COL Richard A. Grube, project manager, Clothing and Individual Equipment; COL David R. Gust, project manager, Mobile Subscriber Equipment; and COL David F. Matthews, project manager, Army Tactical Missile System. As commendation for their achievements, the recipients were presented with plaques.

The speaker at the awards presentation dinner was MG Jay M. Garner, assistant deputy chief of staff for operations and plans, force development, Office of the DCSOPS. Garner noted that because of decreasing resources and decreased threats, the Army now must face the tough decision of whether to upgrade the existing arsenal or develop new systems. Garner stressed the importance of the partnership between the user and the developer. He described this relationship as that of the "dynamic duo that produces just the right edge." Garner emphasized keeping this partnership intact so that our forces are continuously modernized, and that when our Army—America's Army—is called on to perform, it does so resourcefully, and it does so with the world's best equip-

PM of the Year Awards Presentation

ASA(RDA) Stephen K. Conver (far left), assisted by LTG August M. Cianciolo, director of Army Acquisition Career Management (far right), presented the PM of the Year Award to five PMs this year. Recipients, shown left to right, are: COL David F. Matthews, PM, Army Tactical Missile System; COL Richard A. Grube, PM, Clothing and Individual Equipment; LTC William R. Hertel, PM, Paladin; COL David R. Gust, PM, Mobile Subscriber Equipment; and LTC August C. Manguso, PM, Strategic Target System.



MG Jay M. Garner, assistant deputy chief of staff for operations for force development, Office of the DCSOPS, was the speaker at the awards presentation dinner.

secretary for research and technology, Office of the ASA(RDA); and MG Joseph Raffiani Jr., deputy for program assessment and international cooperation, Office of the ASA(RDA).

The objective of the Resource Allocation Work Group, which was chaired by Keith Charles, deputy assistant secretary for plans and programs, Office of the ASA(RDA), was to determine how we should invest our Army dollars to support our resource allocation strategy. This work group covered such topics as:

- How do we improve planning and programming phases of the Planning, Programming Budget Execution System (PPBES)?
- How do we improve budget and execution phases of PPBES?
- How do we implement Integrated Program Assessment policy?

"We need a major commitment to upgrades because it is the quickest, easiest and cheapest way to get new technology in the hands of the solider."

Subchairmen for the work groups which addressed these issues were, respectively: BG William H. Campbell, PEO, Intelligence and Electronic Warfare; BG Anthony C. Trifiletti, deputy PEO, Armored Systems Modernization; and BG John Longhouser, assistant deputy for system management, Office of the ASA(RDA).

The Acquisition Process Work Group was chaired by George E. Dausman, deputy assistant secretary for procurement, Office of the ASA(RDA). This work group's objective was to determine how (in a time when the Army has the smallest budget it has had in a decade) to develop, produce and field superior equipment. Topics addressed by this work group were:

- Headquarters' role;
- Avoiding Cost Growth and;
- Execution

Subchairmen of the workgroups addressing these topics were, respectively: Joseph Varady Jr., director procurement policy, Office of the ASA(RDA); Robert Young, deputy for cost analysis, Office of the ASA (Financial Management) and director, Army Cost and Economic Analysis Center; and BG Otto J. Guenther, PEO, Communications Systems.

The Army Acquisition Workforce Work Group focused on ways to create the "high performing team" required in the acquisition workforce to accomplish the ASA(RDA) modernization agenda. This work group was chaired by LTG August M. Cianciolo, military deputy to the ASA(RDA) and director, Army acquisition career management. The acquisition workforce group addressed the following issues:

- How do we improve Army Acquisition Corps (AAC) management?
- Standardized PEO/PM Structure and;
- Military and civilian workforce management

Subchairmen for the work groups addressing these issues were, respectively: MG Dewitt T. Irby Jr., PEO, Aviation, and BG Orlin L. Mullen, PM, Light Helicopter (co-chairmen); BG Robert A. Drolet, PEO, Air Defense; and George G. Williams, PEO, Fire Support, and MG Leo J. Pigaty, commanding general, TACOM (co-chairmen).

COL Al Greenhouse, deputy director, Army acquisition career management, gave the presentation for the work group on improving AAC management.

Each chairman presented a brief overview of what his work group objectives were. Following each chairman's presentation, each subchairman presented the issues addressed by his group, and the recommendations for dealing with these issues.

Following the work group brief outs, ASA(RDA) Stephen K. Conver concluded the conference by re-emphasizing three recurring conference themes: the general notion of streamlining and reducing the bureaucracy and doing our business more efficiently; creating harmony in the external relationships that we have with the policy people, the budget people, and with the requirements community and; how we might do a better job of getting equipment into the hands of the soldiers—our main purpose in life—and doing that better, cheaper, and faster.

Conver also identified two ways the Army could expedite technology to the soldier—upgrades and proper resource allocation. Relative to technology insertions, or upgrades, Conver said, "We need a major commitment to upgrades because it is the quickest, easiest and cheapest way to get new technology in the hands of the soldier."

Conver concluded by stressing that the time has never been better for cultural change...for the kind of bold leadership that we can apply to do business quicker, to do it more cheaply, and to put good equipment in the hands of the soldier.

Acquisition Accession Board Results

Officers selected for membership in the Army Acquisition Corps by an Acquisition Accession Board in October 1991 are:

Name	Rank	FA	BR
ALFORD, Dewayne	CPT	51	FA
ALVAREZ, Joseph Henry	CPT	97	AR
ANDERSON, Elijah	CPT	97	IN
ANDERSON, Mark Dunn	MAJ	97	IN
ATWOOD, Henry Jefferson Jr.	LTC	51	AV
AUSTIN, Stanley Fletcher	CPT	97	FA
BAILEY, Christopher Allen	CPT	51	AD
BAKER, Charles Lee	CPT	97	MP
BARBER, Jesse Lee	MAJ	53	FA
BARTON, Christine Marie	MAJ	53	MI
BELL, Jonathan Anthony	CPT	97	FA
BRANCH, Frank James	MAJ	51	QM
BREEDEN, Harry McKinley III	MAJ	97	AR
BREJDA, Andrew Henry	CPT	53	SC
BUCK, Stephen Duane	MAJ	53	AR
BUGGY, Robert John	LTC	97	IN
BUHIDAR, Randy Alan	CPT	97	AD
BURNS, Robert Thomas	CPT	53	AD
BURTNETT, Richard Joseph III	CPT	97	IN
BUTLER, Preston Albert Jr.	CPT	51	OD
CAMPS, David Christopher	CPT	53	IN
CARLEY, Patrick Joseph	CPT	51	IN
CARPENTER, Robert Cameron	CPT	51	IN
CLAGETT, David Clark Jr.	LTC	97	QM
CLARK, David Allan	MAJ	97	FA
COGOSSI, Bruce Richard	MAJ	97	FA
COLEMAN, Gifford	MAJ	97	AD
CONEY, Jacklyn	CPT	53	SC
COOK, James Alford	CPT	97	IN
CRABB, Jeffrey Alan	CPT	51	AV
CURL, Jefferson Moore	CPT	97	SF
DALIO, Thomas Phillip	CPT	97	IN
DAVIS, Patricia Hogg	CPT	53	SC
DICKENS, Chailendreia M.	CPT	97	SC
DIXSON, Debra Capelo	CPT	51	SC
DODGE, David Mason	CPT	51	AR
EADY, Donald Phillip	CPT	97	AD
ENSLEY, Trent Kevin	CPT	97	AR
FIELDS, Gregory Marlon	CPT	51	EN
FLOWERS, Kenneth	CPT	53	SC
FORD, Steven Patrick	CPT	97	FA
FULLER, Peter Nelson	CPT	53	AR
GAGE, Bruce Edmond	MAJ	51	AV
GARNETT, Donna Lee	CPT	53	SC
GIBSON, Donald Vincent	CPT	53	OD
GIUNTA, Joseph Anthony Jr.	CPT	97	AR
GONZALEZ, Ricardo	CPT	51	OD
GRAF, Robert Elwood Jr.	CPT	97	FA
HAFFEY, Paul Joseph	CPT	53	OD
HAIGHT, Timothy Arthur	CPT	53	SC
HANSON, Eric Eugene	CPT	97	QM
HARCHELROAD, Joan Lauree	MAJ	53	OD
HARDEN, Monroe Bailey Jr.	CPT	51	AR
HARPER, Robert Michael	CPT	53	SC
HARRIS, Carlton Erwin	MAJ	53	AG
HAYES, David Jonathan	CPT	53	MI
HEINE, Kurt Matthew	MAJ	97	AV
HELD, Bruce Jay Jr.	CPT	51	AR
HENSON, Roy Glen	CPT	51	IN
HESTER, Mark Evan	CPT	97	AG
HODGES, Andel Bennett	CPT	97	AD
HORNEY, Jay Alan	MAJ	97	AV
HOSTETTER, Daniel Gary	MAJ	97	FA
JACKSON, Bonnie Lee	MAJ	97	IN
JACKSON, Karen Jo	CPT	53	SC
JANCEK, Jeffrey Michael	MAJ	97	IN
JANKER, Peter Stanly	MAJ	53	AR
JOHNSON, Diane Elizabeth	CPT	53	SC
JOHNSON, Pamela Vinyard	MAJ	97	QM
JONES, Kermit Calvin	CPT	97	AD
JUPITER, Joseph Harvey	CPT	97	AR
KALLAM, Charles Thomas	MAJ	97	IN
KELLEHER, John Henry Jr.	CPT	53	EN
KERSH, Todd Byron	LTC	53	FA
KOEPSELL, Royal Warren	MAJ	97	EN
LAKE, William George Jr.	MAJ	97	AV
LAWLESS, John Noel Jr.	MAJ	97	AV
LEGRAND, Bruce Robert	MAJ	97	AR
LEGRANDE, John Peter	CPT	97	EN
LEONARD, Robert Eric	CPT	97	FA
LUDWIG, David William	MAJ	97	FA
MANCUSO, August Rodney III	MAJ	97	IN
MANGANIELLO, Anthony James	MAJ	97	AD
MANNING, Barry George	CPT	51	AD
MATTHIAS, Gregory James	CPT	53	AG
MATTIES, James Paul Jr.	CPT	51	FA
MCCORMICK, Daniel John	CPT	51	FA
MCELROY, Terence John	CPT	97	TC
MCFARLAND, Bruce Freeman	CPT	97	IN
MCGEE, Michael Robert	MAJ	53	AR
MCMATH, Michael Lamar	MAJ	97	FA
MEADERS, Mark Alan	CPT	97	AR
MERCER, Thomas Edward	CPT	97	FA
MERRIMAN, Ronald Scott	CPT	53	IN
MILLER, Christopher Matthew	CPT	51	AV
MILLER, Jerry Reid	MAJ	97	FA
MILLS, Ainsworth Bliss	MAJ	97	QM
MITCHELL, Max Herbert Jr.	MAJ	53	AV
MITCHERLL, Ralph Lee	CPT	97	QM
MOORE, David Murdock	CPT	97	IN
MORTON, Curtis Ray	COL	97	OD
NEKULA, Kevin Edward	CPT	51	AR
NEWSOME, Tricia	CPT	97	QM
NICHOLS, Richard Ervin Jr.	CPT	51	FA
NICOLELLA, Anthony John	CPT	97	AR
NIEVES, Robert Russell	CPT	97	AR
O'CONNOR, Edwin Sanderson	CPT	51	IN
O'FARRELL, Patrick Daniel	CPT	97	IN
PAPPAS, George Harry	CPT	53	SC
PATTERSON, William Neal	CPT	97	QM
PORTER, Danny Stanton	COL	97	FA
POWERS, Daniel Joseph	CPT	97	AV
PRINCE, Curtis Barrett	MAJ	53	AD
PULVER, William Carl Jr.	COL	53	AG
RAYMOND, Walter Russell Jr.	CPT	51	AR

REED, Marilyn Ann	CPT	97	CM
REESE, Toby Donald	CPT	97	QM
REICHELT, Richard Harry	CPT	97	AV
ROBERTS, Richard Arthur	CPT	53	SC
ROBINSON, Undra	MAJ	97	IN
RYAN, Michael Clement	CPT	51	IN
SAMPSON, Fred Raymond	CPT	97	IN
SANCHEZCASTELLANOS, Armando	CPT	51	AD
SANS, Luis Diego	MAJ	97	AD
SANSONE, Gregory John	CPT	97	AR
SANTENS, Michael Gene	CPT	97	FA
SISON, Reedchard Arias	CPT	97	QM
SKERTIC, Robert Paul	MAJ	53	FI
SLICKER, James Stephen	CPT	97	EN
SLOAN, Michael Robert	MAJ	97	QM
SMITH, Gary Steadman Jr.	CPT	97	AV
SMITH, Melton Ray	CPT	53	AG
SMITH, Robert Joseph	CPT	53	EN
STEARNS, Kenneth Martin	CPT	51	AD
STEVENSON, William Wayne	CPT	97	FA
STEWART, Gregory Edward	CPT	97	AV
STOKES, George Milton	CPT	53	SC
STORY, Leon	MAJ	53	AD
STROUP, Charles Frederick Jr.	CPT	51	AV
STUDER, John Anthony	CPT	51	IN
SURMACZ, Eugene Steven	CPT	97	AR
SUTHERLAND, Patrick Joseph	CPT	51	FA
THOMAS, Katherine Marie	CPT	97	QM
THOMPSON, Joseph Francis	CPT	97	IN
THOMPSON, Lee	COL	97	AV
THOMPSON, Leonhard Erwin	CPT	51	OD
TREVINO, Robert Raymond	CPT	51	FA
TUBELL, Wallace John Jr.	CPT	51	OD
VAGLIA, James Arthur	CPT	53	AD
VANFOSSON, Marion Herkelman	CPT	51	AR
VASQUEZ, Adolfo Efren	LTC	97	OD
WAGNER, Christopher Glenn	CPT	53	SC
WALSH, Damon Thomas	CPT	97	SF
WARREN, Matthew	CPT	51	FA
WASHINGTON, James McKenney	LTC	97	QM
WATERS, William Gwynne Jr.	MAJ	97	AV
WELCH, Donald Joseph Jr.	MAJ	53	IN
WESTRIP, Charles William Jr.	LTC	97	QM
WHITE, Otis Nathaniel Jr.	CPT	51	OD
WILEY, Anthony George	MAJ	51	EN
WILLIAMSON, Michael Eric	CPT	53	AD
WILLS, Michael David	CPT	97	AV
WOJTKUN, Gregory	LTC	51	EN
WOLFE, Daniel Glenn	CPT	97	AV
WUERZ, Randy Frederick	CPT	51	OD
YARBOROUGH, Michelle Faith	CPT	51	AV
YOUNGBLOOD, Jerry Lee	CPT	97	QM

107 Graduate from MAM Course

On Dec. 6, 1991, 107 students graduated from the Materiel Acquisition Management (MAM) Course held at the U.S. Army Logistics Management College at Fort Lee, VA. Research and development, testing, contracting, requirements generation, logistics and production management are examples of the acquisition work assignments being offered to these graduates.

Melvin E. Burcz, program executive officer for combat support, Warren, MI, gave the graduation address and presented diplomas. LTC Richard Alley, U.S. Army Air Defense Artillery School, Fort Bliss, TX, received the Distinguished Graduate award, and MAJ James Koch, U.S. Army Engineer Center and School, Fort Leonardwood, MO, received the Outstanding Graduate award.

The nine-week MAM Course provides a broad knowledge of the materiel acquisition function. It covers national policies and objectives that shape the acquisition process and the implementation of these policies and objectives by the U.S. Army. The MAM Course covers subject areas such as: acquisition concepts and policies; research, development, test, and evaluation; financial and cost management; integrated logistics support; force modernization; production management; and contract management. Emphasis is placed on developing mid-level managers so that they can effectively participate in the management of the acquisition process.

Promotion Results Exceed Army Average

Congratulations to those Army Acquisition Corps (AAC) majors and lieutenant colonels recently selected for promotion to lieutenant colonel and colonel, respectively.

Promotion rates for AAC officers first time select to lieutenant colonel and colonel far exceeded the Army average (18.6 percent above Army average for lieutenant colonel and 20.9 percent for colonel). This is a strong indicator of the high quality comprising the AAC.

1991 Lieutenant Colonel Promotion Results (percent)

Functional Area:	51	53	97	Total
Army	68.5	54.0	78.0	61.9
AAC	78.9	76.5	93.8	80.5

1991 Colonel Promotion Results (percent)

Functional Area:	51	53	97	Total
Army	52.0	36.3	48.3	38.6
AAC	61.4	54.5	56.3	59.5

Defense Acquisition Workforce Improvement Act (P.L. 101-510)

This is the fourth installment of extracts from the Defense Acquisition Workforce Improvement Act:

"Subchapter II—Defense Acquisition Positions

Section 1721. DESIGNATION OF ACQUISITION POSITIONS

(a) DESIGNATION.—The Secretary of Defense shall designate in regulations those positions in the Department of Defense that are acquisition positions for purposes of this chapter.

(b) REQUIRED POSITIONS.—In designating the positions under subsection (a), the Secretary shall include at a minimum, all acquisition-related positions in the following areas:

(1) Program management.

(2) Systems planning, research, development engineering and testing.

(3) Procurement, including contracting.

(4) Industrial property management.

(5) Logistics.

(6) Quality control and assurance.

(7) Manufacturing and production.

(8) Business, cost estimating, financial management and auditing.

(9) Education, training and career development.

(10) Construction.

(11) Joint development and production with other government agencies and foreign countries.

(c) MANAGEMENT HEADQUARTERS ACTIVITIES.—The Secretary also shall designate as acquisition positions under subsection (a) those acquisition-related positions which are in management headquarters activities and in management headquarters support activities. For purposes of this subsection, the terms "management headquarters activities" and "management headquarters support activities" have the meanings given those terms in Department of Defense Directive 5100.73, entitled "Department of Defense Management Headquarters and Headquarters Support Activities" dated November 25, 1988.

Section 1722. CAREER DEVELOPMENT

(a) CAREER PATHS.—The Secretary of Defense, acting through the Under Secretary of Defense for Acquisition, shall ensure that appropriate career paths for civilian and military personnel who wish to pursue careers in acquisition are identified in terms of education, training, experience, and assignments necessary for career progression of civilians and members of the armed forces to the most senior acquisition positions. The Secretary shall make available published information on such career paths.

(b) LIMITATION ON PREFERENCE FOR MILITARY PERSONNEL.—(1) The Secretary of Defense shall ensure that no requirement or preference for a member of the armed forces is used in the consideration of persons for acquisition positions, except as provided in the policy established under paragraph (2).

(2)(A) The Secretary shall establish a policy permitting a particular acquisition position to be specified as available only to members of the armed forces if a determination is made, under criteria specified in the policy, that a member of the armed forces is required for that position by law, is essential for performance of the duties of the position, or is necessary for another compelling reason.

(B) Not later than December 15 of each year, the Under Secretary of Defense for Acquisition shall submit to the Secretary a report that lists each acquisition position that is restricted to members of the armed forces under such policy and the recommendation of the Under Secretary as to whether such position should remain so restricted.

(c) OPPORTUNITIES FOR CIVILIANS TO QUALIFY.—The Secretary of Defense shall ensure that civilian personnel are provided the opportunity to acquire the education, training and experience necessary to qualify for senior acquisition positions.

(d) BEST QUALIFIED.—The Secretary of Defense shall ensure that the policies established under this chapter are designed to provide for the selection of the best qualified individual for a position, consistent with other applicable law.

(e) MANAGEMENT OF WORKFORCE.—The Secretary of Defense shall ensure that the acquisition workforce is managed such that for each fiscal year from October 1, 1991 through September 30, 1996, there is a substantial increase in the proportion of civilians (as compared to armed forces personnel) serving in critical acquisition positions in general, in program manager positions, and in division head positions over the proportion of civilians (as compared to armed forces personnel) in such positions on October 1, 1990.

(f) ASSIGNMENTS POLICY.—(1) The Secretary of Defense shall establish a policy on assigning military personnel to acquisition positions that provides for a balance between (A) the need for personnel to serve in career broadening positions, and (B) the need for requiring service in each such position for sufficient time to provide the stability necessary to effectively carry out the duties of the position and to allow for the establishment of responsibility and accountability for actions taken in the position.

(2) In implementing the policy established under paragraph (1), the Secretary of the military departments shall provide, as appropriate, for longer lengths of assignments to acquisition positions than assignments to other positions.

(g) PERFORMANCE APPRAISALS.—The Secretary of each military department, acting through the service acquisition executive for that department, shall provide an opportunity for review and inclusion of any comments on any appraisal of the performance of a person serving in an acquisition position by a person serving in an acquisition position in the same acquisition career field.

(h) BALANCED WORKFORCE POLICY.—In the development of defense acquisition workforce policies under this chapter with respect to any civilian employees or applicants for employment, the Secretary of Defense or the Secretary of a military department (as applicable) shall, consistent with the merit system principles set out in paragraphs (1) and (2) of section 2301(b) of title 5, take into consideration the need to maintain a balanced workforce in which women and members of racial and ethnic minority groups are appropriately represented in Government service.

Section 1723. GENERAL EDUCATION, TRAINING AND EXPERIENCE REQUIREMENTS

(a) QUALIFICATION REQUIREMENTS.—The Secretary of Defense shall establish education, training and experience requirements for each acquisition position, based on the level of complexity of duties carried out in the position. Unless otherwise provided in this chapter, such requirements shall take effect not later than October 1, 1993. In establishing such requirements for positions other than critical acquisition positions designated pursuant to Section 1733 of this title, the Secretary may state the requirements by categories of positions.

(b) LIMITATION ON CREDIT FOR TRAINING OR EDUCATION.—Not more than one year of a period of time spent pursuing a program of academic training or education in acquisition may be counted toward fulfilling any requirement established under this chapter for a certain period of experience.

Section 1724. CONTRACTING POSITIONS: QUALIFICATION REQUIREMENTS

(a) CONTRACTING OFFICERS.—The Secretary of Defense shall require that, beginning on October 1, 1993, in order to qualify to serve in an acquisition position as a contracting officer with authority to award or administer contracts for amounts above the small purchase threshold referred to in Section 2304(g) of this title, a person must (except as provided in subsections (c) and (d)—

(1) have completed all mandatory contracting courses required for a contracting officer at the grade level, or in the position within the grade of the General Schedule (in the case of an employee), that

the person is serving in;

(2) have at least two years of experience in a contracting position;

(3)(A) have received a baccalaureate degree from an accredited educational institution authorized to grant baccalaureate degrees, (B) have completed at least 24 semester credit hours (or the equivalent) of study from an accredited institution of higher education in any of the following disciplines: accounting, business finance, law, contracts, purchasing, economics, industrial management, marketing, quantitative methods, and organization and management or (C) have passed an examination considered by the Secretary of Defense to demonstrate skills, knowledge or abilities comparable to that of an individual who has completed at least 24 semester credit hours (or the equivalent) of study from an accredited institution of higher education in any of the disciplines listed in subparagraph (B); and

(4) meet such additional requirements, based on the dollar value and complexity of the contracts awarded or administered in the position, as may be established by the Secretary of Defense for the position.

(b) GS-1102 SERIES.—The Secretary of Defense shall require that, beginning on October 1, 1993, a person may not be employed by the Department of Defense in the GS-1102 occupational series unless the person (except as provided in subsections (c) and (d)) meets the requirements set forth in subsection (a)(3).

(c) EXCEPTIONS.—(1) The requirements set forth in subsections (a)(3) and (b) shall not apply to any employee who, on October 1, 1991, has at least 10 years of experience in acquisition positions, in comparable positions in other government agencies or the private sector, or in similar positions in which an individual obtains experience directly relevant to the field of contracting.

(2) The requirements of subsections (a) and (b) shall not apply to any employee for the purposes of qualifying to serve in the position in which the employee is serving on October 1, 1993, or any other position in the same grade and involving the same level of responsibilities as the position in which the employee is serving on such date.

(d) WAIVER.—The acquisition career program board of a military department may waive any or all of the requirements of subsections (a) and (b) with respect to an employee of that military department if the board certifies that the employee possesses significant potential for advancement to levels of greater responsibility and authority, based on demonstrated job performance and qualifying experience. With respect to each waiver granted under this subsection, the board shall set forth in a written document the rationale for its decision to waive such requirements. The document shall be submitted to and retained by the Director of Acquisition Education, Training and Career Development.

Section 1725. OFFICE OF PERSONNEL MANAGEMENT APPROVAL

(a) QUALIFICATION REQUIREMENTS.—The Secretary of Defense shall submit any requirement with respect to civilian employees that is established under section 1723 or under section 1724(a)(4) of this title to the Director of the Office of Personnel Management for approval. If the Director does not disapprove the requirement within 30 days after the date on which the Director receives the requirement, the requirement is deemed to be approved by the Director.

(b) EXAMINATIONS.—The Secretary of Defense shall submit examinations to be given to civilian employees under subsection (a)(3) or (b) of section 1724 of this title to the Director of the Office of Personnel Management for approval. If the Director does not disapprove an examination within 30 days on which the Director receives the examination, the examination is deemed to be approved by the Director."

LETTERS

Dear Sir:

I read with great interest the article in the November-December 1991 issue "Military Lessons Learned from the Gulf War," written by Cadet Jason T. Hoffman. There was one aspect of the Gulf War that was not addressed by Cadet Hoffman.

During Operation Desert Shield/Desert Storm a large number of Department of Defense civilians and Department of Defense contractor technical experts were deployed to the theater of operations to provide depot level and higher echelon maintenance support on the "high tech" equipment of the modern military.

During the Vietnam War failed equipment was evacuated back to the United States for repair and the turn around time approached one year before the equipment was returned to the user. By having DOD civilians and contractor technical experts in the theater of operations major repairs were completed in theater, and the high tech equipment was returned to the user usually within two weeks. Contractor warranty and maintenance support of high tech equipment is proving to be very cost effective to the military and should be addressed in future planning.

Billy H. Shockey
LTACFIRE/FIREFLEX Field Engineer
Litton Data Systems

Army RD&A Bulletin Responds:

Thank you for your letter. We welcome feedback such as this from our readers.

Scientists Receive Award for Cooperative Efforts

Army researchers are doing more with less money by using a process known as "leveraging."

Leveraging is the heart of today's Army technology planning and management strategy, and two scientists at the Walter Reed Army Institute of Research (WRAIR), Washington, DC, were honored recently for leveraging in-house research with industry and academia.

Two Army physicians, COL Jerald Sadoff, MC, and COL Alan Cross, MC, received the E. Karl Bastress Award for excellence in leveraging the Army Research and Development Program.

This award was instituted by the deputy chief of staff for Technology Planning and Management at the Army Materiel Command and is administered by the Army Laboratory Command.

Bastress served as the manager of the Army Technology Transfer Division and the Independent Research and Development program from 1982 until his death in 1988. He was respected throughout the Department of Defense, industrial and academic communities.

"In this era of dwindling budgets, it is more important than ever to share costs, establish effective cooperative programs and make informed decisions on what to include, or what not to include in our technology programs," said MG Jerry Harrison, deputy chief of staff for Technology, Planning and Management, Army Materiel Command.

"Successful leveraging techniques reflect Army policy to increase the technology base through cost-sharing and partnerships with industry, academia and international organizations," Harrison said.

Sadoff, director of the Communicable Disease and Immunology Division, and Cross, chief of the division's Department of Bacterial Diseases, made major advances in the Army's long-term effort to prevent and treat sepsis. Sepsis is a form of shock caused by the presence of micro-organisms in blood and tissue.

Some specific programs go back more than 15 years, but in 1984, shortly after the signing of a "no-dollar" agreement with the Swiss Serum and Vaccine Institute, specific vaccines were developed against two organisms that cause more than 70 percent of the septic shock cases worldwide. These vaccines were produced in Switzerland, using technology developed by Sadoff, Cross and their colleagues at WRAIR.

After undergoing safety and efficacy testing in soldiers at WRAIR, Fort Lewis, WA, and Fort Hood, TX, the vaccines were used to prepare a gamma globulin enriched in antibodies against the two organisms. The enriched gamma globulin is used in people at risk of developing septic diseases such as Klebsiella and Pseudomonas.

Following successful early tests, expanded clinical tests were initiated in a Department of Defense and Veterans Administration consortium of 16 military and Veterans Administration hospitals.

A vaccine for E. coli, the most common cause for traveler's diarrhea, was also developed using the same collaboration.

Sadoff and Cross also took advantage of other developments in the pathogeneses and treatment of sepsis. A collaboration with a British firm, Celltech Ltd., allowed researchers to show that a monoclonal antibody could be used to treat sepsis.

The data generated by the investigators was used to conduct early studies in humans, the first step toward Food and Drug Administration approval for a new drug. When Celltech could not sponsor expanded clinical trials, Sadoff and Cross collaborated with Centocor, a Pennsylvania firm, to test a similar monoclonal antibody and their research continued.

These are only two examples of many technology transfer agreements initiated by Sadoff and Cross.

This year's E. Karl Bastress Award winners successfully used cooperative research and development agreements to leverage a modest in-house effort into a highly successful program—one that actively seeks to attract the collaboration of industry, other government agencies, and university centers.

Technology transfer, from the Army to the civilian community and from that base to the Army, has generated several biological products that were merely concepts a few years ago.

DTIC Announces New Tech Report

The Defense Technical Information Center (DTIC) has announced the availability of its Technical Report Database on compact disk-read only memory (CD-ROM). The data on the first issue covers 1970 through June 1991 and includes unclassified bibliographic citations to technical reports, patent applications, and conference papers. These citations cover scientific and technical information that was produced to support the management and conduct of DOD research, development, engineering and studies programs.

The annual subscription includes one complete, updated issue of the CD-ROM each quarter. Purchase of this product is limited to DTIC-registered users who are authorized access to export-controlled data.

For additional information on purchasing the CD-ROM or on becoming a registered DTIC user, call (703) 274-6434 or write to: Defense Technical Information Center, DTIC-BCP (CD-ROM Information), Building 5, Cameron Station, Alexandria, VA 22303-6145.

MTL Invention Measures Projectile Velocity

The computer is quicker than the bullet.

Engineers and ballisticians once had to guess the velocity of a projectile before it was launched. They had to set delayed signals based upon guess work to capture the shadow of the fast moving projectile on flash film at desired locations along the flight path. This kind of procedure translated into a hit-or-miss situation because not all guesses are correct. By being off even a fraction of a second, the X-rays were activated at the wrong time when the projectile was not in the field of view. A reliable and accurate way of measuring projectile velocity and capturing the projectile was desperately needed.

Thanks to a group of engineers at the U.S. Army Materials Technology Laboratory (MTL) in Watertown, MA, the erratic procedure is a thing of the past now. MTL materials engineer Dr.

Albert Chang and former MTL employee Phil Vincent were recently awarded a U.S. patent for a "microcomputer real-time flash X-ray controller for data acquisition." This invention measures projectile velocity and automatically generates appropriate delayed signals to activate flash X-rays, high speed cameras, target impact instrumentation, oscilloscopes and any other ballistic diagnostic equipment at the right time.

Amazingly, a personal computer, backed mainly with software, does all the work. The MTL team turned a common instrument into a high precision lab tool.

"We tried various methods. We bought various computer boards, but they just didn't have the flexibility the PC does," said Chang.

The PC measures the projectile velocity, makes some necessary calculations, waits until the projectile arrives at the desired location, and then issues the signal to activate the X-rays. The idea had been tried before by others, but the systems weren't as flexible, according to Chang.

Chang came to MTL as a Westinghouse contractor in 1986, working on various projects along with a co-worker from Westinghouse. He officially joined MTL in 1989; Vincent left MTL recently. Chang and Vincent first conceived their idea in 1987. They toyed with it for some time. The project eventually gelled, but first they had to convince some critics.

Chang said that because of the extremely high projectile involved, scientists and ballisticians wondered if the PC was capable of doing the job in time. When the first powerful 386 PC became available, the team began experimenting with the idea on the PC and then implementing the setup in the MTL ballistic range for the live-fire tests. When the first flash X-ray film showed the shadow of the projectile, everyone involved was elated.

Obstacles occurred along the way. Because neither Chang nor Vincent had much experience in computers, they had to "feel" their way along. Chang bought a lot of books, and taught himself about computers. In the process, he picked up invaluable knowledge while at the same time building a machine important to the military.

"We saw ourselves as hobbyists or amateurs (with computers) but we got the job done," said Chang. "Not everything went right, of course. One time we put the wrong voltage (to a homemade interfacing circuit), the opto-coupler chip was fried and hit the ceiling! We were definitely not computer experts, more like hackers."

With all the rough edges now smoothed out, this product has become part of the standard procedure in MTL ballistic ranges.

"We turned an ordinary PC into a lab instrument. I think every ballistic range could use something like this," said Chang.

Navy Calls on MTL to Save USS Constitution

As the oldest commissioned naval ship afloat in the world today, the USS Constitution has always seemed indestructible. The ship, based in Charlestown, MA (part of Boston), was undefeated in 42 battles and was nicknamed Old Ironsides by sailors who saw British cannonballs bounce off its sides. As it approaches its 200-year anniversary, the USS Constitution currently serves as a tourist attraction, drawing nearly one million visitors per year.

From a distance, the ship appears to be as strong as ever. Upon close inspection, however, the USS Constitution looks very unhealthy. While countless signs of material deformation can be seen around and inside the vessel, the most noteworthy problem remains the "hogging" of the ship. Hogging refers to distortion of the hull caused by the midship body being buoyed up while the sharper ends bear down.

U.S. Navy experts said that the USS Constitution will continue to incur deformation from hogging and weakening joints between wooden members if new ideas aren't set forth to preserve the ship for the long term. Although the USS Constitution would seem to have an infinite life, the truth is, in many respects, the USS Constitution is no different from other wooden ships, which typically last only 20 to 30 years. Any wooden vessel starts a slow death immediately when launched under natural sea occurrences such as inconstant buoyancy along the length of the ship (which causes hogging), water intrusion (which leads to decay) and metal fastener corrosion (which weakens both a fastener and the wood around the fastener).

As a result of hogging, the USS Constitution structure has bent 15 inches since 1927. Although it is hard to say how much more it can bend, logic would dictate not to take the chance. The Navy is currently seeking solutions to save the USS Constitution. Part of the solution is working with composite materials specialists at the U.S. Army Materials Technology Laboratory (MTL) in Watertown, MA.

Robert Pasternak, a materials engineer at MTL, started work on this project in August 1990 by testing composite materials that could be used in structures to reinforce and stabilize the bending wood, while also serving as a long-lasting structural material to the Constitution. Pasternak tests the composites for strength in tension and bending. He's also looking at creep (increasing deflections over time) by using various calculations. Pasternak said that when all the data is available, work should move ahead rapidly. The project could be completed sometime in 1994.

"It's an interesting project," said Pasternak. "And it's not just for the USS Constitution. Whatever we learn here could be applicable to other Army projects with future systems."

Peter Witherell, Naval architect and project engineer for the USS Constitution at the Puget Sound Naval Shipyard Detachment in Boston, stresses the importance of retaining as much of the ship's remaining original material as possible, and at the same time, preserving the ship's hull form and structural integrity for the future.

In the past, the problems have been solved by periodically replacing the old materials with new ones, especially during overhauls. Witherell said that the overhauls aren't made to last. Approximately 10 percent of the existing ship's wood is thought to be original.

Witherell has been involved in USS Constitution research since 1980. He is virtually convinced that a supporting structure made from composites will serve as a long lasting remedy for the stately ship.

As experienced engineers, Pasternak and Witherell are working to unlock the perfect blend of stiffness, strength and desirable fabrication characteristics found in composite materials in order to design a framework that will help support the USS Constitution for years to come. What they know now is that the composites have many advantages over wood and metals (which have also been discussed as possible construction materials for a supporting framework). Composites are stronger than wood. The strength and stiffness properties can be adjusted using various types and orientations of fibers. Also composites are more flexible than metals.

Pasternak and Witherell agree that composites can only help the USS Constitutions's condition; however, problems have surfaced. For instance, various historians have expressed displeasure over the potential "modernization" of the structure—they contend that the ship should be maintained in wood, even if it means using wooden laminates.

Witherell disagrees with this, especially with the view that laminated wood is considered "acceptable" but laminated composites are not. He appreciates the philosophy on keeping the USS Constitution traditional; however, he said that it is not logical to expect that approaches which are normally used to maintain a wooden vessel for 20-30 years will help preserve a vessel that is 200 years old. Those approaches, he said, will create a wooden replica that uses large amounts of wooden laminates. He also argues that modern-day systems such as electric lighting, fire alarms and sprinklers serve to provide safety and continued preservation. Witherell said that using composites in a supporting structure that helps to solidify the structure of the ship is just another aspect of that preservation approach.

"Detractors do see composites as a foreign substance," said Witherell. "But I look at it like this: If the ship had no historical significance, then replacing the wood periodically wouldn't matter. But since it does have historical significance, you can't keep replacing the wood because you'll wind up with a replica. Composites are the best way to preserve what we have so you don't have to keep replacing (material like wood)."

Pasternak said that the composites will not be visible where people frequent the ship. Wood will remain above the composite structure below. Witherell added that even in the parts of the ship that people don't visit, painted-over components of the composite framework will be indistinguishable from the surrounding wood. In terms of appearance, the only "compromise" necessitated by the framework installation will be six pairs of diagonal members, not in original design, to be added inside the ship, against the hull.

"I guess there are compromises you have to make," said Pasternak. "If it appears historically correct where people visit, that should be acceptable."

The work between the Navy and the Army will also help apply composites to other programs. Witherell, for example, was not an expert when he first worked with composites. Now he feels more comfortable with the processes and can use his experience to help the Navy. Pasternak, who was well versed in composites before the project began, is now a notch or two above when he first started.

"This (project) won't be all solved by MTL," said Pasternak. "The Navy has their fields of expertise and we have ours, and it's starting to come together." Barring any catastrophic delays, the USS Constitution will be alive and kicking for its 200-year anniversary in 1997.

"We're going to make sure it stays together for years to come," concluded Pasternak. "It's an exciting project."

The preceding was written by Eric Hurwitz, a public affairs specialist at the U.S. Army Materials Technology Laboratory in Watertown, MA. He attended the Boston University School of Public Communication, and holds a B.A. in journalism from Suffolk University in Boston. He is currently studying education at Salem State College in Salem, MA.

Engineers Commemorate Military Construction Mission

Although last December's spotlight was on remembrances of Pearl Harbor, another 50th anniversary observance also took place.

Dec. 1, 1991 marked the 50th birthday of the Army Corps of Engineers' military construction mission. It was on that date in 1941 that President Roosevelt signed a bill authorizing the transfer of the mission for the entire War Department from the Quartermaster Department to the Corps. Because of months of planning for the change, it was implemented swiftly, on Dec. 15.

Earlier, during 1940, the Corps had replaced the Quartermasters as construction agents for the Army Air Corps. The Air Corps program gave the Engineers confidence with an unfamiliar mission. The Corps had known heavy construction, fortifications, waterways and harbor work. But it had had little or no experience in airfield and troop facility construction, or in industrial production line activities. By mid- 1941, projects for the Air Corps were increasing to consume up to 80 percent of Corps resources, while civil works projects were declining.

Construction peaked in 1942, with almost 85 percent of the $11 billion program completed. The massive Pentagon was completed in 1942 after 16 months of 24-hour shifts. Also in that year, the Corps military and civil construction missions were split into separate divisions.

Success in the World War II construction mission brought the Army Corps of Engineers a reputation for flexibility. Engineer districts consistently assumed Quartermaster work and completed it successfully, proving repeatedly that the decision to assign military construction to the Corps was a sound one.

Belvoir RD&E Center to Host Briefing for Industry

To facilitate a mutually profitable exchange of information with industrial, research and educational organizations, the U.S. Army Belvoir Research, Development and Engineering Center will conduct an Advance Planning Briefing for Industry on March 24-25.

"Senior Army officials will brief attendees on the needs of soldiers in the fields of combat engineering, logistics equipment, countermine systems, materials, fuels and lubricants," said COL Michael R. Norris, center commander. "We will also tell them how to do business with the center."

The briefing is in cooperation with the Fairfax-Lee Chapter of the Association of the United States Army (AUSA) and will be held at the Springfield Hilton Hotel, Springfield, VA. Also included will be tours of the Night Vision and Electro-Optics and Belvoir RD&E Centers, where project engineers will man exhibits and be available to answer questions.

"This event should be of interest to industry and academia executives, advance systems planners, directors of research, development, engineering and production; and to those concerned with the formulation of corporate long range planning," said Norris.

Because of space limitations, priority will be given to the first 500 applicants. The briefing is unclassified and is open to all bonafide industry and academia representatives. Registration cost is $165 for industry and $140 for academia members. Additional information is available from Joe Morales, (703) 664-4175; or Chick Wilson, (703) 920-7600.

Researchers Develop Experimental Unmanned Robotic Vehicle

Researchers from the Tank-Automotive Command (TACOM) Research, Development and Engineering Center (TARDEC), Warren, MI, and Carnegie Mellon University in Pittsburgh have developed an experimental robot High-Mobility Multipurpose Wheeled Vehicle (HMMWV) that can follow a road and avoid obstacles without manual assistance.

The vehicle, dubbed Nav Lab II, is an ambulance version of the M998-series HMMWV modified to operate as an autonomous road-following vehicle. Using the same automotive components as its standard counterpart, Nav Lab II has computer-controlled actuators that control acceleration, braking and steering.

During demonstrations in Pennsylvania, the vehicle traveled unaided for about two miles at speeds up to 47 mph.

The Nav Lab II project, a three-year effort that has been underway for the past year is part of a long-term program sponsored by the Defense Advanced Research Projects Agency (DARPA), Arlington, VA. The aim of the DARPA program is to develop artificial intelligence that would allow robotic military vehicles to "think" the same as people and execute high-risk battlefield tasks now handled by soldiers.

Unlike its predecessor, Nav Lab I, built in 1986, Nav Lab II can travel farther and faster and can be programed to enact a wider range of tasks. In operation, on-board cameras view the scene ahead of the vehicle and feed the images into a computer. The computer then analyzes these images to find the edges of the road and automatically generates the appropriate driving commands that enable the vehicle to follow the road and avoid obstacles.

"During testing," explained Paul J. Lescoe, TARDEC Nav Lab project engineer, "we have a safety driver on-board the vehicle, who would step in to stop it if any of the equipment should malfunction. In the autonomous control scenario, the idea is that the need for an operator really isn't there. You may program the vehicle from a suitcase size, portable control station with what you want it to do, and then push a 'go' button, and it would execute its mission."

Nav Lab II will currently receive only video images, Lescoe said. However, plans call for the addition of expanded computer programs and a more sophisticated sensor package providing laser and infrared data, making night driving possible, he added.

"The primary mission soldiers are hoping to use robotic vehicles for is reconnaissance. But it could also do other missions, such as removing land mines on the battlefield or maybe deliver ammunition or fuel to a vehicle," Lescoe said of the kinds of military roles such a vehicle would play.

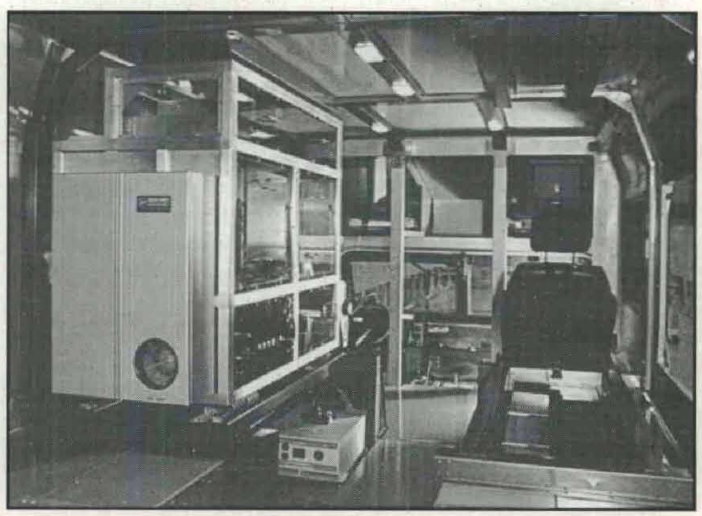
Robotic vehicles probably won't carry weapons packages or independently fire munitions, Lescoe said.

"That is a task where we probably will always make sure there is an operator in the control loop to figure out when the munitions should be fired," he said.

The TACOM-Carnegie Mellon project will culminate in a mid-1994 demonstration, in which the goal is to operate Nav Lab II at speeds up to 60 MPH over a five-mile course, Lescoe said.

The preceding was written by George Taylor, a technical writer-editor for the U.S. Army Tank-Automotive Command.

Nav Lab II autonomously operating over a rough dirt road.



Inside view of Nav Lab II's processing and control hardware.

TACOM Eyes Laser System for Vehicle Navigation

A U.S. Army Tank-Automotive Command (TACOM)-sponsored research project performed by the California-based Odetics, Inc., has led to the development and successful operation of a computer-controlled laser system that may someday serve as an important vehicle navigational aid for both manned and unmanned ground vehicles.

Such a system would serve as an alternate for the Global Positioning System, a network of earth satellites that provides positioning information to update dead reckoning navigational systems used for land navigation. Over time, these systems lose their accuracy, due to a tendency to drift, and must be updated periodically.

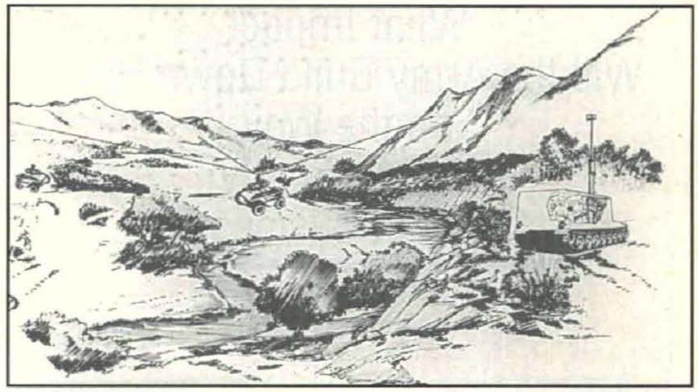
Though the satellites perform well, the enemy could jam their radio signals. In addition, they could be susceptible to anti-satellite technology. But the new laser concept, dubbed the Location Identification System, could serve as a reliable, alternative way of updating dead reckoning navigational systems, because the equipment involved would be self-contained within the vehicle. Thus, it would not be vulnerable to enemy threats.

The system consists of an eye-safe laser range finder and a computer containing digital terrain maps produced by the Defense Mapping Agency and a special algorithm developed by Odetics that enables the computer to convert range finder measurements into meaningful data.

To update his navigational equipment with the new system, the vehicle operator would first use the laser range finder to measure the distance between his vehicle and any surrounding elevation features, such as hills or mountain ranges. These distances can be determined by the time required for the laser beam to travel between the range finder and a given terrain feature.

The data from the range finder are then fed into the computer, which correlates them with the digital terrain maps to determine the vehicle's precise location.

"Our approach in developing the system was to use equipment that would already be on a vehicle so that we didn't have to add new components," explained David Busse, TACOM Research, Development and Engineering Center project engineer. "So we used a laser range finder, which a vehicle would already have for reconnaissance or fire control, and a digital terrain map, which would be stored in a computer on-board the vehicle." Odetics developed the laser concept under terms of contracts awarded to the firm as part of TACOM's Small-Business Innovation Research (SBIR) program.



Location Identification System controlled from the Unmanned Ground Vehicle Control Test Bed.

Under way since 1983, SBIR is a Department of Defense-wide program established in compliance with a Congressional mandate. That directive requires federal agencies whose annual R&D budgets are $100 million or more to award at least 1.25 percent of their R&D contracts to small businesses.

In July 1986, TACOM awarded Odetics a six-month, Phase I contract calling for the development of the software needed for the navigational update system. That effort was completed on schedule, and the command, in September 1988, awarded the company a two-year, Phase II contract to build a breadboard model of the system.

Busse said a system prototype successfully completed tests in a vehicle at Camp Pendleton, CA, and Fort Knox, KY. He said the tests involved driving the vehicle to numerous surveyed points and operating the laser navigational update system at each point. The outputs of the system were then compared to the surveyed point locations to determine its accuracy.

Busse said that at both Camp Pendleton and Fort Knox, the system performed well. He said the next step will be to integrate the system into an experimental robotic High-Mobility Multipurpose Wheeled Vehicle at TACOM for use in further research with an Unmanned Ground Vehicle Control Test Bed.

The preceding article was written by George Taylor, a technical writer editor for U.S. Army Tank-Automotive Command.

ATTENTION OVERSEAS OFFICERS

Because of recent deactivations and relocations, numerous USAREUR unit and address changes have occurred. Please contact your local personnel office to insure that the address indicated on your Officer Record Brief is correct and reflects any recent changes.

Also, there has been a recent change in the world-wide military postal system. Beginning Oct. 1, 1991, APO and FPO address formats were changed to speed handling of military mail through the use of automated address readers and sorters. The new four-line format for a unit is as follows:

COMMANDER
CO B, 2d BN, 43d IN
UNIT 12345
APO AE 09021

There are some key points about the new address format:

- For Europe, AE is now used where NY used to go.
- The ZIP codes for several of the APOs in USAREUR have changed. Check with your local postal branch for a listing.
- Only the new basic five-digit ZIP code will be used by the sorting machines. The nine-digit ZIP code is no longer used in USAREUR.
- Each USAREUR unit will be assigned a "unit number" that appears on line 3 in the example format above. These numbers will be assigned in early 1992, and must be included in your address by Jul. 15, 1992. Contact your local postal branch for assistance.

Your ORB address must be current and accurate in order to continue receiving *Army RD&A Bulletin*. Please be sure that it is updated.

What Impact Will the Army Build Down Have on the Way You Currently Conduct Business?

COL William J. Stoddart
Project Manager
Heavy Tactical Vehicles and Acting Project Manager
Light Tactical Vehicles

The build down of the Army will have a number of effects on the ways in which the project manager conducts his business. While at first glance, the effect might be considered negative, there are a number of opportunities for the project manager to make positive contributions to the acquisition process.

Project managers will be challenged to find more efficient and cost effective ways of doing business. They must become more innovative in streamlining the requirements in their contracts which should, in turn, both smooth and shorten the acquisition process. A key part of this streamlining is the mandate to challenge and require justification for each data item requested by various functionals and challenge the practice of giving these offices almost total authority to determine the content and scope of solicitation requirements in their area of expertise. An area of particular interest is the procurement of technical data, where PMs must move away from the acquisition of complete technical data packages to a level of data which will be cost effective to us in recompeting the system and its spare parts.

We must do this without losing the vital input of the user and tester communities. Instead of looking at a specific vehicle to fill a corresponding role, we must be prepared to expand the roles of various systems to meet different requirements where it makes sense, thus reducing the proliferation of vehicles and their associated support costs. In a period of diminishing resources, this new thinking is critical to meeting General Sullivan and Mr. Conver's direction that we maintain our technological edge, while insuring that the Army is adequately equipped, manned and trained. This new thinking, in turn, requires increased interface between the material developer, the user and the tester.

While we are meeting our own challenge, we must not lose sight of increasing pressures on the contractors which make up our vital industrial base. We must communicate our requirements as quickly and as clearly as possible. This is of particular importance given industry's significant investment in planning for our new programs and the changing nature of some of our efforts (i.e., utilizing service life extensions for existing systems to supplement new vehicle buys).

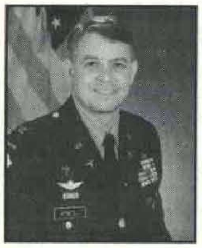
We must also structure our program quantities and delivery schedules with the goal of sustaining key parts of the industrial base in a time of diminishing procurements. Since delays cost both the contractor and the Army money, there must be increased emphasis on establishing realistic contract delivery schedules and enforcing timely performance against such schedules by all participants.

The build down will force us, the acquisition community, to be at the leading edge to insure our smaller force maintains its current capability. By challenging existing procedures and traditional roles, we can in turn provide better products and a more responsive system for our outstanding soldiers and leaders.

COL Thomas Reinkober
Project Manager
Aircraft Survivability Equipment

I believe before this question can be answered we need to look at the circumstance surrounding the build down. The first and most obvious is the desire to reduce the military budget by reducing force size. The impact on Aircraft Survivability Equipment will be similar to all other projects. Smaller fleets will result in the purchase of fewer pieces of equipment directed only at those aviation assets that remain in the fleet. This will likely reduce APA funding needs. The need for research and development funding should remain at least level depending on certain factors which have not completely stabilized yet. These factors depend in large part on the second circumstance that leads to a build down. Maintaining a large fighting force has been a drain on the budget for many years but until recently it was considered essential to provide an effective deterrent to a large Soviet and Warsaw pact force in Europe. That force is no longer there and because of that our need for a large fighting force seems to have vanished. The resulting mission of this smaller force will however be potentially more demanding because of its global nature in uncertain times. In the business of Aircraft Survivability Equipment this means that the PM must look even more closely at a world wide threat that will include what previously would have been called Red, Gray and Blue threats. This may significantly increase the capabilities we need in countermeasures with a potential increase in R&D as well as an increase in per unit procurement costs. It also means that the PM will need more, not less, support from the intelligence community. We now have to look at many potential threat systems widely distributed throughout the world. Even though the U.S. is cutting back on defense spending there are a lot of countries with the money and inclination to continue or start building a sophisticated military capability. There are also a lot of new countries from the FSU (Former Soviet Union, not Florida State University) that will soon realize that a large number of all U.S. families have food on the table because of arms sales. It will likely be much easier business for many former Soviet military industries to get into the arms sale business than to commercialize. These will be challenging times trying to maintain our edge as we build down the force and budgets decrease while the potential for conflict (all be it smaller conflicts) may well increase.

COL Robert C. Atwell
Product Manager
Longbow Apache



The build down of our Army will greatly effect how we conduct the acquisition business. The most profound impact will be on the Army investment accounts. Diminished defense spending coupled with shrinking business requirements will leave the defense industrial base in an overcapacity state. This overcapacity will generate greatly increased overhead rates and skyrocketing acquisition unit costs for our critical weapon systems.

The resulting fiscal burden being placed on both the defense industrial base and the Department of Defense has not been seen in the recent past. If left unchecked, the continuous erosion of return on investments and the decaying financial strength of the Army's prime suppliers will continue. We are witness to the early stages of a permanent reduction of the defense establishment. We must recognize and deal with the most visible change of that reduction (industry overcapacity) if we hope to continue Army modernization within projected funding levels. We, in the Army, cannot afford to sit idly by; we must play an active part in helping to restructure our industrial base.

Recognizing that the defense market is not going to grow again is, therefore, the first big step. In order for us to nurture a strong, correctly-sized defense industrial base, we need to be conscious of our unique role in the process; that is, ensuring reasonable rates of return and reasonable risk to our contractors. This will foster conditions to ensure the right size of our industry and the permanent elimination of overcapacity. Without the Army's assistance and industry cooperation, we will not be able to bring a strong defense base into the 21st century.

COL James Gustine
Project Manager
Patriot

As with all major Army acquisition programs, the Patriot project is vitally concerned over the projected build down of U.S. forces going into the next century. The reduction of the defense budget means we must use every management tool at our disposal to efficiently develop and procure weapons systems for the future and ensure the most "bang for the buck." I believe we are streamlining the Patriot program to do just that. We have structured our R&D program to focus on near term, high payoff system improvements while continuing our leadership in value engineering and TQM with our contractor team. We are also fine tuning contracting to ensure the government gets the best value for each dollar spent.

While losing only one battalion of six batteries in force structure, the draw down of conventional forces in Europe will result in a shift in center of mass from OCONUS to CONUS accompanied by several simultaneous role changes for Patriot.

The net result of these changes are that the Patriot Project now will:

• Provide logistics support to a CONUS heavy force while maintaining the ability to provide the same level of support should they be deployed forward to any part of the globe.

• Focus on the abilities of Patriot as a valued member of the combined arms team, expanding interoperability in communications with sister services and allies, and improving its deployability and supportability.

• Continue a robust growth program to enhance system capabilities against air breathing and especially tactical ballistic missile threats, building on the lessons learned from Desert Storm.

• Continue an aggressive Foreign Military Sales program in order to reap the benefits of lower unit costs to help offset the reduced defense budget.

While the build down is affecting Patriot differently than most other mature weapons systems, I feel we've structured the program to continue Patriot as the premier air defense missile system in the world.

COL James C. Barbara
Project Manager
Block III Tank/Common Chassis Program

The Army's build down to the future is having several dramatic effects on the way project managers do business in Armored Systems Modernization - Future (ASM-F). Fortunately, ASM-F is a relatively new program and since the Army build down has been forecast for several years, we have organized ourselves accordingly. First, within the PMOs, CALS has been our over-arching objective. Each person's work station has been totally computerized, and will soon be hooked into a local area network. We have E-mail capability, and modems and fax machines are available. Our library uses the DOD information handling system, which is a CD ROM-based system. We currently have in excess of 60 disks, all enhancing the efficiency and productivity of this office.

Our contacts/contractors are the more important area where you can see our anticipation of the build down. We are focussing on total weapon system performance responsibility—at the time of production—as our goal. We scrubbed deliverables as part of the RFP to minimize the administrative burden and maximize the flexibility of the contractor. Our specifications were all performance-oriented. The contractor is allowed to do cost, schedule and performance trade-offs against a set of priorities. Our test and evaluation process is a joint program. The government and contractor are going to develop test plans, concur in the test environments, witness the tests as appropriate, concur in the results and endorse them as a joint conclusion. Government testing will focus at the system level only. We will make extensive use of computer-aided design, where much of our testing can be done before we bend metal, computer-aided engineering and ultimately computer-aided manufacturing with all the producibility aspects accounted for way up front. A system integration laboratory will implement much of our testing, emphasizing simulation, simulators and gymnasticators and interacting with the final empirical test program of miles, hours, rounds, etc.

We also have proactive management focussing on the principles of TQM. We are utilizing the CSCSC process as a management tool not just a cost account reporting tool, and our WBS must be traceable back to the user requirements.

Training "old dogs" to do new tricks is critical to this new way of doing business. The entire team (PMO, DCMAO, contractors) are in a learning environment. Many of us have had specialized training to understand the government's new roll as smart buyer and the contractor's new performance responsibilities.

It's very exciting, and we expect to get much better value for our tax dollar.

The Political Economy of Defense Contracting

By Kenneth R. Mayer, Yale University President, 1991

Reviewed by COL Michael R. Jorgensen, acting director for contracting, deputy assistant secretary of the Army (procurement), Office of the Assistant Secretary of the Army (Research, Development and Acquisition)

This book provides a comprehensive investigation of the popular myth that politics drives defense procurement. In the process, the reader is treated to an excellent statistical analysis of several contractual years of data, much of which was previously unavailable. There is also thorough coverage of the DOD acquisition process including the acquisition cycle, the Planning, Programing and Budgeting System, source selection and the role of the Congressional committees in Defense acquisition. Both the evidence presented and the subsequent analysis strongly support the author's conclusion that the accepted belief has no basis in fact.

There are four major arguments that proponents of the myth advance as proof of their claims. First, congressmen support those weapon systems that produce jobs in their districts. Many correlations such as Boeing being supported by congressmen from the State of Washington, are presented. We also discover, however, that there are significantly more non-correlations that exist. They go unreported or are conveniently ignored by the mythists. The facts are that the distribution of major Defense contracts reflect the industrial capacity of those districts. Contracts for aircraft go to the locations that contain the aircraft plants.

A second argument states that campaign contributions donated by defense contractors' Political Action Committees (PACs) have a significant impact on a Congressman's support for a particular system. Again, correlations are abundant. Further detective work and some astute analysis determines that the actual impact of PAC campaign contributions is questionable at best. Congressmen will vote the same way on a system whether the PAC contributions go to congressmen that historically support defense systems.

A third argument postulates that the Pentagon awards contracts to specific contractors in order to generate congressional support for specific systems. While it is true that the military departments have become very effective in lobbying Congress, and can "tailor" information submitted to Congress to show systems in the best light, statistical analysis of major contract awards points to the fact that a congressman's vote depends on his beliefs, rather than Pentagon influence.

A final argument states that congressmen can, and do demand that a contract be awarded to a preferred contractor in their district. It is true that Congress can influence some programs by inserting specific language into the annual authorization bill, however, the real impact of this type of influence is minimal. A congressman will claim that he was instrumental in influencing DOD to award a contract in his district. In reality, he or she is taking credit for an award that would have been made to that contractor regardless of the congressman's machinations. (A legislator who loses will mitigate the loss by charging that other congressmen unduly influenced DOD!). In other words, the political activity that pretends to influence defense contracting is for show, not for dough.

The contracting process itself survives the detailed investigation well. It is a sound process, under continual observation, based in legislation, and managed by professionals. If the integrity of the Program Managers remains intact (and it normally does), the process is relatively immune from improper influence. Invariably an investigator will find that acquisition decisions are made based on military strategy, not political strategy.

In the final analysis then, we find that the myth that politics influences acquisition of weapons systems is just that—a myth. It continues to exist because congressmen promote it, reported correlations support it, and the general public is not sufficiently informed to believe otherwise.

This book is an excellent primer for those who wish to know the facts. It also belongs on a recommended reading list for acquisition professionals.

Designing for Quality: An Introduction to the Best of Taguchi and Western Methods of Statistical Experimental Design

By Robert H. Lochner and Joseph E. Matar White Plains: Quality Resources, 1990

Reviewed by MAJ James E. Koch, TRADOC project officer, Combat Mobility Vehicle, Fort Leonard Wood, MO.

Designing for Quality provides a basic explanation of how to use statistically designed experiments to improve quality of design and quality of conformance. The authors have given the book three strengths. First, a succinct overview of the concept of quality is provided. Second, the work is written so that anyone without a mathematics phobia can gain a practical understanding of statistically designed experiments. Third, the sample problems reinforce the concepts in a logical step-by-step approach.

The Taguchi philosophy on quality sets the stage for the book. This notion that quality must be designed into products and processes is radically different from our past approach of trying to improve quality through on-line inspection techniques. Dr. Taguchi applied engineering principles instead of focusing on management practices to improve quality. The result was experimental designs which honed in on reducing the variation of process and product performance characteristics. The reduced variation makes the design robust. A robust design is insensitive to what Taguchi labeled noise factors—"uncontrollable sources of variation in the functional characteristics of a product." The product gains this robust nature by determining the impact of the noise factors through parameter design, then setting those factors one can control at levels which minimize the impact of the noise factors.

Various experimental designs are examined with sufficient detail and explanation for the quality novice. Two-level experiments with full factorial designs, two-level experiments with fractional factorial designs, and experimental designs for factors at three and four levels are all examined. The meat of the book examines the fractional factorial designs and evaluating variability using two level designs. Besides focusing on Taguchi, the book also contains a synthesized presentation of orthogonal designs. Regardless of the design, the authors provide useful real world examples that walk the reader through the calculations and formats. The examples reinforce the authors' contention that statistical experimentation reduces the minimum required number of experimental trials, while providing the maximum relevant information.

This is interesting, easily digested, worthwhile reading if one wants a cursory understanding of statistical experimental design and how application of the concepts improves total quality.

The Professional's Guide to Database Systems Project Management

By Michael F. Rothstein and Burt Rosner
John Wiley and Sons, Inc., 1990

Reviewed by CPT Timothy F. Schroth, recent graduate of the U.S. Army Materiel Acquisition Management Course, M.S. degree in systems technology (command, control, communications) from the U.S. Navy Postgraduate School and B.A. in physics from Temple University.

"Programmers and analysts do, to some extent, perform management roles, but they are not conditioned to handle all the scenarios in which a project manager may become involved." The authors further state in their preface to *The Professional's Guide to Database Systems Project Management* that their book is "... a companion guide for those who want to succeed. It's objective is to create an awareness of what is involved in the management of projects—big and small—from a project manager's point of view."

The authors have been successful in attaining their stated objective. They cover in great detail the technical aspects of developing and documenting a database system and offer a number of helpful hints, "how-to-do" advice, and their insight on project management.

More than half the book is dedicated to the detailed, technical aspects of developing, documenting, and implementing a new database system. This includes: understanding the current user environment; developing the data model and data flow; modeling the processes used; programming standards; and the post coding environment.

Throughout, the authors provide examples of the methods and the forms they use to capture and record this mass of necessary information. They lead you through the forms and sprinkle advice about techniques they have tried and found successful.

The four chapters dedicated to general project management provide basic guidelines aimed at the novice project manager. "Project management means knowing, at all times, what needs to be done and what is being done."

The authors discuss the very beginning of the project, talking to your boss, setting up your "staff," developing the initial project schedule and even include some well known personal time management techniques. They later discuss procedures for reviewing and updating the schedule and cost estimates, planning and conducting the testing of the new system and discuss a little about the fielding and sustainment phase of the system.

One observation made by the authors that should interest military project managers is on the nature of project management for database systems. "It is true that if you budget a data processing project the same way you estimate the time and cost of building a new building or starting production of a new product you will get cost overruns. It is not true if you consider (it) ... more akin to budgeting R&D ..."

Despite the annoying and numerous typographical errors throughout the first half of the book, the authors have presented, in detail, the depth and complexity of database system development. While the authors do indeed establish "an awareness of what is involved" in project management as it relates to database systems, this is not a book for readers interested in detailed advice and guidance for project management.

BOOK REVIEWS

If you have read a book which you feel may be of special interest to the RD&A community, please contact us. The editorial staff welcomes your literary recommendations. Book reviews should be no longer than two double-spaced typed pages. In addition, please note the complete title of the book, the author's name, address, and commercial and DSN phone numbers. Submit book reviews to the address below.

Army RD&A Bulletin
ATTN: SARD-AC
5001 Eisenhower Avenue
Alexandria, VA 22333-0001
Phone: (703) 274-8977/8

Beyond the Myths and Magic of Mentoring

By Margo Murray with Marna A. Owen
Jossey-Bass Publishers, San Francisco, 1991

Reviewed by CPT Jack H. Achs, White Sands Missile Range, NM.

In her book *Beyond the Myths and Magic of Mentoring,* Margo Murray has brought to light a very useful tool for organizations to develop and retain talented employees: facilitated mentoring. Having a known value or benefit to participants and organizations alike, mentoring has traditionally been a hit or miss situation with no formal applications. Margo Murray has challenged that view by developing the Facilitated Mentoring Model. This model identifies key elements needed to design and implement facilitated mentoring programs. She illustrates various models of facilitated mentoring and provides specific guidelines for assessment.

Mentoring is not a new concept. Having originated in ancient Greece, mentoring has been a useful tool throughout history. Mentoring also has different names and hence levels of development or intensity: sponsoring, role modeling, or coaching. No matter what you call it, a good facilitated program should be structured to meet specific needs of the organization. It should not be a hit or miss situation.

Key elements of a facilitated mentoring program include:

- Identification of the organizational need
- Identification of the mentors, proteges, and coordinator(s)
- Development and negotiation of the protege's plan (growth or skill development)
- Evaluation

These key elements can be structured to be generic or tailored to be very specific and exacting. A good example of a specifically tailored facilitated mentoring program is the U.S. General Accounting Office's (GAO) Executive Development Program. This program leads to the eventual selection of the protege as a Senior Executive Service member within the GAO.

Whatever degree of mentoring you choose, the overall success of the program depends on how well it is facilitated. Compared to the informal mentoring we often read about, a facilitated mentoring program establishes goals, time limits, and is constantly evaluated.

Thus, facilitated mentoring is a managed and resourced tool. This tool can quickly become a training multiplier benefiting the organization and its personnel. Organizations can look at facilitated mentoring as a cost-effective way to train or promote from within.

Anyone seriously considering this type of mentoring program should find Margo Murray's book very useful. She has laid to rest any myth or magic of how a facilitated mentoring program is designed, implemented, and evaluated. This book and its concept should not be overlooked as a viable resource tool in any developing organization.

Superintendent of Documents **Subscriptions** Order Form

Order Processing Code:
*** 5190**

☐ **YES,** enter my subscription as follows: **To fax your orders (202) 512–2233**

____ subscriptions to **ARMY RD&A BULLETIN (ARAB)** for $6.00 per year ($7.50 foreign).

The total cost of my order is $________. Price includes regular domestic postage and handling and is subject to change.

(Company or Personal Name) (Please type or print)

(Additional address/attention line)

(Street address)

(City, State, ZIP Code)

(Daytime phone including area code)

(Purchase Order No.)

May we make your name/address available to other mailers? YES ☐ NO ☐

Please Choose Method of Payment:

☐ Check Payable to the Superintendent of Documents

☐ GPO Deposit Account

☐ VISA or MasterCard Account

(Credit card expiration date)

Thank you for your order!

(Authorizing Signature) 12/91

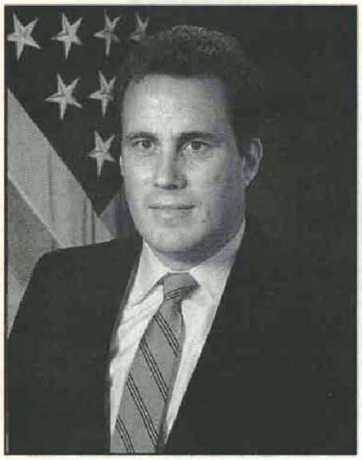
Mail To: New Orders, Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250–7954

AWARDS

Award Recipients Named

Listed by agency, the following Army Acquisition Corps personnel are recent recipients of key awards. **Strategic Defense Command:** COL George E. Patch, Legion of Merit (LOM); LTC Walter D. Spodeck, LOM; LTC Thomas A. Shpakowsky, LOM; LTC Charles A. Williams, Meritorious Service Medal (MSM); LTC James L. Mitchell, MSM; MAJ Terry S. Day, MSM; MAJ Logan I. Cox III, MSM. **Army Acquisition Executive Support Agency:** COL Joseph Ganino, LOM; COL Archie B. Taylor, LOM; LTC William L. Bond, LOM; LTC Dennis W. Crowe, LOM; LTC Ralph D. Knotts, LOM; LTC Roy W. L'Heureux, LOM; LTC Robert J. Stavale, LOM; CW4 Edwin L. Williams, LOM; LTC Stephen P. Barton, MSM; LTC William Penky, MSM; MAJ Charles M. Barnett, MSM; MAJ Gerard P. Barrett, MSM; MAJ Randy L. Borchardt, MSM; MAJ Bryant A. Debruyne, MSM; MAJ David W. Graybeal, MSM; MAJ Harry L. Kettler, MSM; MAJ John Macik Jr., MSM; MAJ Joseph I. Moore, MSM; MAJ Reid K. Mrsny, MSM; MAJ Raymond Pelt, MSM; MAJ William B. Reilly, MSM; MAJ Craig G. Searfoss, MSM; MAJ Thomas M. Shirk, MSM; CPT Mark W. Akin, MSM; CPT Robert J. Boyd, MSM; CPT Ronald G. Snowden, MSM; CPT Peter G. Tuttle, MSM; CPT Jeffry L. Anderson, MSM; SGM Clyde J. Bostic, MSM; SSG William R. Schuck, MSM.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1992– 311-809/40004



FROM THE ARMY ACQUISITION EXECUTIVE...

The goal of Army modernization is to equip the American soldier with world class equipment in sufficient quantity and in the shortest possible time, consistent with sound business practices and within affordability constraints. In my January-February 1992 article, I outlined three sets of principles to guide us in achieving this goal: modernization strategy, resource allocation strategy, and acquisition strategy. I stated that each of these strategies merited a more specific discussion that I would cover in upcoming issues. The topic of discussion in this issue is our modernization strategy, the general approach to modernizing the Army.

As the defense budget declines and the Army reshapes to a smaller force, we must focus on maintaining an Army that is trained, ready and well-equipped. We have a moral obligation to put world class equipment into the hands of the soldier in both the near-term and the far-term. We cannot afford to take a modernization "break." Time, technology, and the world's political environment do not stand still.

It is intuitive that the Army's smaller force of the future will need to be more modern. In the past, we could afford to maintain M60 tanks and other older equipment that could have been deployed in the latter stages of a large conventional war in Europe. We no longer have that luxury or that threat. Still, the Army spends scarce dollars to keep outdated equipment in the inventory that, for all practical purposes, has no wartime mission or a very, very limited one.

Therefore, a key component of our modernization strategy should be to retire, at the earliest opportunity, all old and obsolete equipment. Criteria for retirement should focus on: high operating and support (O&S) costs, low combat effectiveness in our most likely scenarios, and little growth potential for technology insertion.

All the Army leadership agrees that we will adopt a policy of continuous modernization. Over the last 15 years, we have put in place a modernization program that provided the basis for an overwhelming advantage in equipment and an overwhelming victory in the Persian Gulf. We simply cannot take this success for granted. We must build on it.

Our modernization strategy has moved away from accepting near-term risk in favor of providing our soldiers superior equipment with a wide advantage over any adversary at any time. This requires sufficient and balanced investment from the technology base to production. Without sufficient funding and the proper balance between R&D and production, the acquisition system will deteriorate and cease to put superior technology in the hands of our soldiers. The success of our modernization strategy is tied to the level of procurement funding. We need money to get ideas out of the laboratory and into the hands of our soldiers.

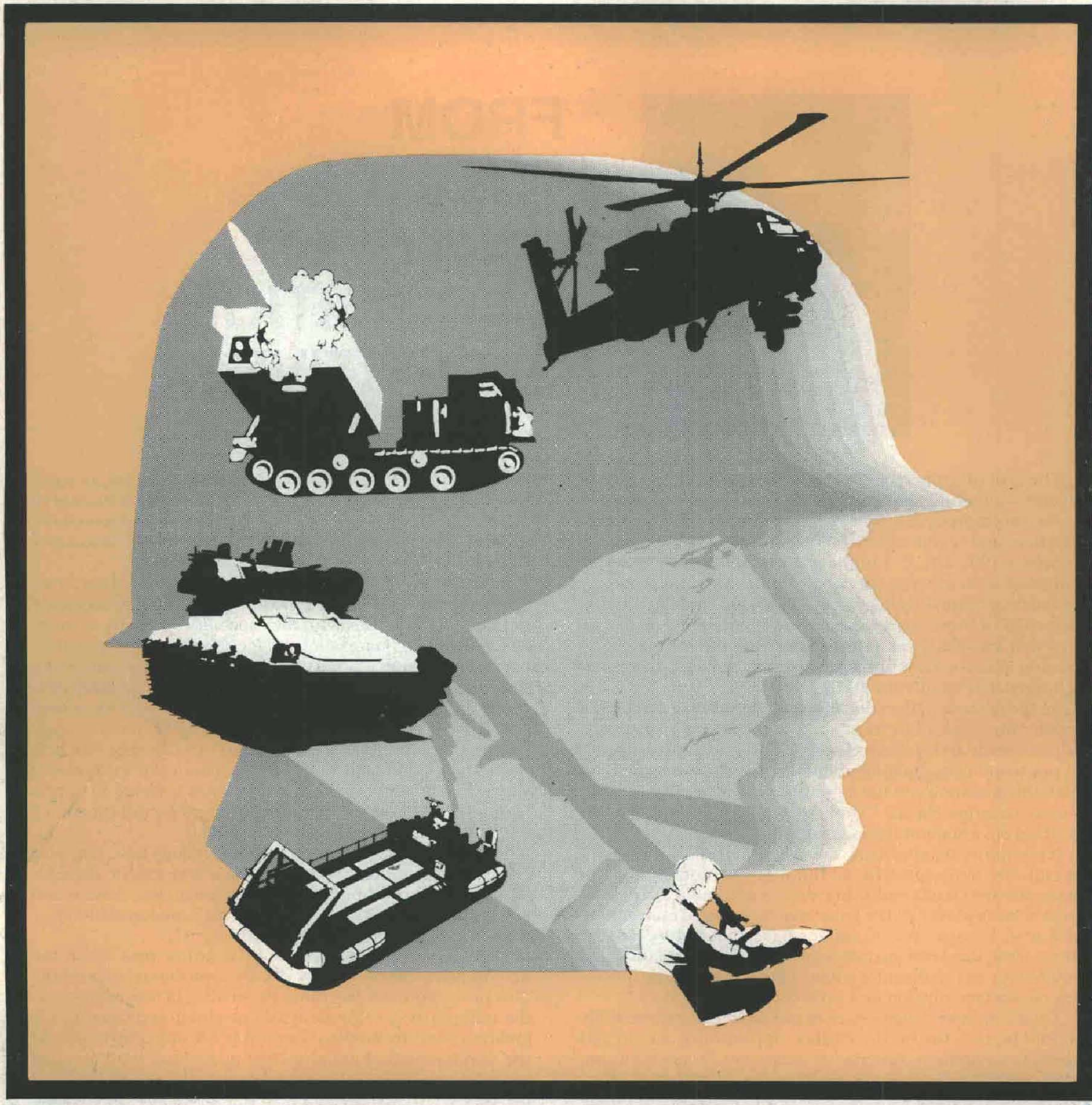
Modernization in the near-term should be achieved by upgrading our fielded equipment to insert modern technology that will provide us with the capability necessary to maintain an overwhelming combat edge. New systems should be developed, manufactured, and fielded only when upgrades can be shown to be insufficient (because of a credible new threat, because current equipment has exhausted its growth potential, or because the emergence of a new technological opportunity requires a new end item). Recognizing that new starts will be difficult to fund and defend in the current and anticipated budget environment, we must evaluate all opportunities to upgrade our current equipment by inserting modern technology into existing platforms.

We will continue to protect the technology base. The success of our modernization strategy, to a large extent, depends on its vitality and strength. A vibrant technology base is and will remain a central feature of the Army's modernization program. We will not eat our seed corn.

Many of you have undoubtedly heard or read about the new Department of Defense (DOD) approach to acquisition. This new approach has three elements: (1) less reliance on the traditional development and production programs, (2) greater use of technology insertions (or upgrades), and (3) the development of experimental prototypes with no guaranteed production. You may recognize a similarity between the new DOD strategy and that which we have been advocating on these pages for some time. This is not a coincidence. All of DOD acquisition is now facing the fiscal austerity that the Army has been living with for several years, and there is simply no way that declining acquisition budgets can support the increasing funding profiles of traditional development/production programs.

My next article in *Army RD&A Bulletin* will focus on the new DOD acquisition approach and its implications for us in the Army. Subsequent articles will resume the discussion on resource allocation strategy and acquisition strategy.

Stephen K. Conver



ARMY RD&A BULLETIN
ISSN 0892-8657

Army RD&A Bulletin
5001 Eisenhower Avenue
Alexandria, VA 22333-0001

SECOND CLASS
POSTAGE PAID
AT ALEXANDRIA, VA
(and Additional Offices)