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AND RDE CENTERS

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FEATURES

DEPARTMENTS

ABOUT THE COVER

Featured in this issue are a series of articles on Army laboratories and research, development and engineering centers. Represented on the front cover are (clockwise from top left) the Office, Deputy Chief of Staff for Personnel, the Army Materiel Command, the Medical R&D Command, and the Corps of Engineers. The back cover shows a Waterways Experiment Station comparison of precipitation information derived by raingages and by radar for use in mobility forecasts.

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Army Materiel Command Labs and RDE Centers

Corporate laboratories and research, development and engineering (RDE) centers constitute the Army Materiel Command's (AMC) resource to accomplish its research, development and engineering responsibilities in support of the materiel acquisition process. Collectively, these organizations:

- ensure timely availability of essential technology, both newly emerging and mature;
- integrate these technologies into conceptual systems;
- demonstrate the validity of the concepts; and
- provide engineering support throughout the system life cycle.

In sum, the laboratory/center system develops new technologies while maturing older ones, synthesizes technological components into operational systems, demonstrates the validity of the proposed systems and provides continuing support as the system develops and is fielded.

On Oct 1, 1985, AMC established the U.S. Army Laboratory Command (LABCOM), a major subordinate command (MSC) to oversee and direct its technology base efforts. LABCOM, headed by AMC's Deputy Chief of Staff for Technology Planning and Management MG James Cercy, comprises all those organizations within AMC which have a primary technology base mission, i.e., nurturance and development of generic technologies which cut across commodity areas. These are the Atmospheric Sciences Laboratory, the Ballistic Research Laboratory, the Electronics Technology and Devices Laboratory, the Harry Diamond Laboratories, the Human Engineering Laboratory, the Materials Technology Laboratory (formerly the Army Materials and Mechanics Research Center), and the Vulnerability Assessment Laboratory (formerly Office of Missile Electronic Warfare).

To these laboratories having command-wide mission responsibilities is added the Army Research Office (ARO), providing a comprehensive technology base coordination and planning ability, a key ingredient in insuring an integrated, comprehensive technology base program. ARO retains some of its direct linkages to AMC and DA Headquarters in continuing its role of direct support to academic research and Army-wide R&D activities, such as the University Research Initiatives Program.

LABCOM has several functions. It manages the technology base, both in its own laboratories and in all AMC RDE Centers; it manages the AMC "corporate technology center"; and, most importantly, it develops the investment strategy for the technology base. In keeping with these management functions, the commander of LABCOM has two primary assignments: to serve as chief operating executive of LABCOM and to serve as deputy chief of staff, technology planning and management, AMC.

Pulling together the individual corporate laboratories under LABCOM provides a coherent vehicle for management and integration of generic technologies affecting all AMC commodity lines, including identification of areas of omission and duplication. By including ARO in the LABCOM organization, the full spectrum of technology base efforts can be controlled under a single command and focal point. Additionally, this focused responsibility for management of the entire technology base assures the acceleration and exploitation of newly emerging technologies. This furthers AMC's corporate goal of expediting the fielding of new technologies identified as critical to military operations.

In all, the establishment of LABCOM and the commodity related RDE centers represents a major reorganization of AMC resources which will expedite development of effective and innovative military systems for the operational Army.

Paralleling LABCOM, with its generic technology base mission, are the commodity-oriented research, development and engineering centers. These are expanded versions of the former R&D centers. The addition of an "E" for engineering to their titles reflects the breadth of their roles. They are the RDE "centers of excellence" of the AMC commodity commands. For the assigned commodity, each RDE center is "full service" developer and integrator of technology, launcher of system developments, and source of life cycle engineering support.

The RDE centers have the responsibility to identify and exploit technology and system opportunities relevant to their commodity wherever and whenever these develop, including academe, industry, other government agencies, U.S. or foreign. In addition, they have a long list of other responsibilities. They must maintain constant cognizance of user needs and concerns, know and understand the threat, and be able to characterize the battlefield environment of future systems. They must be able to define and analyze system concepts, conduct market investigations to determine the ability of the current market place to meet system requirements, and provide industry with independent R&D and marketing guidance. Their responsibilities include developing and maturing commodity specific technology, orchestrating the timely availability of essential technologies associated with developing systems, and integrating available technology into testable

Chemical protective clothing and equipment is developed at the Chemical RDE Center. Dressed in the chemical protective overgarment and wearing M9 Detector Paper and the XM40 protective mask, a soldier analyzes water samples with the M272 Water Test Kit.

concept prototypes. Additionally, they have to provide support to the various program managers (PMs) and provide the cycle engineering support for fielded systems. Finally, they have to provide support to product improvement programs.

In sum, the eight RDE centers have been reorganized to implement AMC's acquisition doctrine, by providing direct, focused support to specific commodity areas, complemented by the generic technology base mission of LABCOM.

Army Research Office

The Army Research Office is the Army's "window" to the scientific community. ARO's extramural research support program represents Army-wide interest in mathematics, electronics, mechanics, aeronautics, metallurgy, materials, physics, chemistry, biology, and geosciences. The major user of this research program is AMC, but ARO also supports research in behalf of the Corps of Engineers, the surgeon general and other Army commands. The ARO program is coordinated with in-house laboratory programs, thereby resulting in a highly productive, cost-effective and consolidated Army research effort.

Its mission is to develop and assess the Army's research program and to recommend a technology investment strategy. Although this is primarily basic research, ARO is also called on by Army laboratories to sponsor research in more applied areas.

The key to ARO's mission is its contract program with universities and industry. ARO annually receives hundreds of proposals from universities, research institutes and industrial laboratories to conduct research. ARO supports those proposals having the most technical merit and relevance to Army needs. The programs are funded through contracts and grants.

Some of the major programs in which ARO supports research include:

- Mathematics Center of Excellence. This center will be established at the Mathematical Sciences Institute at Cornell University to initiate large programs in statistics, non-linear partial differential equations and other areas of interest to the Army.
- Historically Black Colleges Program. This program provides grants to historically black colleges to develop their research capabilities as part of a concerted effort to broaden the Army's base for top quality research.

In addition, ARO administers the Scientific Services Program under which federal agencies request assistance in solving specific scientific problems.

ARO also administers the Army Youth Sciences Activity Program which promotes and honors the achievements of high school students. This program includes the Junior Science and Humanities Symposia, the International Science and Humanities Symposia, the International Science and Engineering Fair, the Uninitiated Introduction to Engineering Programs, the Research and Engineering Apprentice Program and the Mathematics Olympiad.

Some examples of recent major accomplishments from ARO-supported research include the demonstration of monolithic, conformal, printed, millimeter wave antennas which may find application in areas ranging from "smart bullets" through radar or communications systems; and development of an intelligent statistical tracker for guided missiles.

Results of ARO-supported research are published in unclassified professional journals. The direct benefit to U.S. Army technology occurs through the efficient transfer of that scientific information to development programs.

The staff is comprised of more than 130 permanent employees, 45 of whom are scientists holding doctoral degrees. ARO is housed in a modern, 33,000 square foot GSA-leased two-story office building in Research Triangle Park, NC.

Atmospheric Sciences Laboratory

The Atmospheric Sciences Laboratory (ASL), located at White Sands Missile Range, NM, is AMC's principal laboratory for atmospheric and meteorological technology and equipment development. Its mission is to provide the Army with systems, techniques and expertise in the atmospheric sciences necessary to win the air and land battle. The ASL program encompasses tactical weather intelligence and atmospheric systems; atmospheric effects information for the design of Army weapons systems, tactics, doctrine, and training; and meteorological support to Army RDT&E programs.

ASL has developed tactical meteorological sensors and data processing systems to collect and distribute tactical weather intelligence information to combat decision makers.

Working with the Defense Nuclear Agency, ASL has incorporated tactical weather intelligence software into the Automated Nuclear, Biological, and Chemical Information System. ASL has supported the 9th Infantry Division and 3rd Armored Cavalry Regiment by providing tactical weather intelligence during the joint training exercise Border Star 85 at Fort Bliss, TX; the PM, smoke/obscurants by jointly sponsoring Smoke Week VII-A at Fort Sill, OK; the TRADOC Systems Analysis Activity by incorporating the effects of obscurants in force-on-force models; and the Chemical School by rewriting FM-3-10-3, Field Behavior of NBC Agents.

ASL basic research has focused on modeling and understanding atmospheric processes which affect the propagation of millimeter and infrared radiation through such adverse weather as rain and snow. These efforts are being applied to specific systems to more accurately estimate system performance for wargaming and system studies. In addition, developments in transport/diffusion models and aerosol physics theory are leading to new methodologies for depicting the movement of smoke, dust, and chemicals across the battlefield.

Atmospheric effects on electro-optical systems have been compiled by ASL in the Electro-Optical Systems Atmospheric Effects Library. ASL is the lead organization in this tri-service effort.

ASL researchers have developed an ultraviolet (UV) lidar system for determining the interaction of UV radiation with atmospheric aerosols. Laboratory tests explored the usefulness of UV lidar as a sensor of battlefield environmental intelligence. In addition, models are being developed to predict atmospheric effects on Army sensors using ultraviolet radiation.

Meteorological and atmospheric data are critical in tests of high priority Army weapons and materials. ASL provides professional consultation on test planning, field measurements and post-test analysis to project managers at 10 permanent Army test sites located in the continental United States, Alaska, the Republic of Panama, and on a TDY basis whenever and wherever needed. Projects supported include: Multiple Launch Rocket System, Firefinder Radar, Remotely Piloted Vehicle, Fiber Optics Guided Missile, Space Transportation System, High Energy Laser System Test Facility, and Pershing II.

ASL is organized into four operational divisions and two management and administrative offices. This structure is designed to assure a clear distinction among the laboratory's basic research, applied research, and support programs; reflect more accurately the laboratory's major thrusts in support of

Army programs; and consolidate similar functions in the same organizational elements to increase management effectiveness.

Management and administrative support is provided through the Plans and Programs Office, responsible for programming, budgeting, mission analyses, financial management and mission coordination; and the Management Services and Technical Support Office, charged with providing the full scope of administrative services.

Ballistic Research Laboratory

The Ballistic Research Laboratory (BRL) is a tenant organization at Aberdeen Proving Ground, MD. It is a large complex of advanced research facilities and has a diversified staff of scientists, engineers, technicians, and supporting personnel.

Since its establishment in 1938, the BRL program has evolved into a broad, comprehensive effort of closely coupled research and exploratory development. BRL addresses problems dealing with the entire spectrum of weapon systems—those existing, those on the drawing boards, and those still in the conceptual stages. Within this spectrum, the weapon systems range from small arms and their ammunition to large missiles and related warheads. The effectiveness of these systems against enemy targets must be known and understood. Corollary to this, methods for increasing the lethality and decreasing the vulnerability of these systems must be known and understood.

The BRL program is a continuing and integrated effort to provide the scientific and engineering base necessary to advance the group of technologies comprising weapons technology. BRL efforts find immediate application to the solution of problems occurring early or late in the materiel development cycle or during fielding of weapons systems; and potential application to the exploratory or advanced development of materiel currently identified to meet scientific and technological objectives, or to future systems.

The mission of the laboratory is to perform the functions of a lead laboratory for ballistics and vulnerability/vulnerability reduction, and establish and maintain a strong and viable weapons oriented basic research program in physics, chemistry, mathematics, and engineering related to ballistics, vulnerability, communications, detection, tracking, surveillance, propulsion, mobility, guidance and control, navigation, energy conversion, materials and structures.

The integrated meteorological system vehicle used by the Atmospheric Sciences Lab.

BRL also conducts a strong exploratory development effort to solve problems related to ballistics and vulnerability.

BRL's five principal research divisions are: the Interior Ballistics Division, where research is conducted on the interior ballistics of guns and rockets; the Launch and Flight Division, which performs research and engineering on aerodynamics of shells and missiles; the Terminal Ballistics Division, which conducts research in munition/target interactions and evaluates terminal effects of munitions; the Vulnerability and Lethality Division, where analyses are conducted on U.S. and threat munitions and equipment; and the Systems Engineering and Concepts Analysis Division, which conducts systems engineering analyses, and mathematically models total performance of complete weapon systems.

Support for the research divisions is provided by the Program Management Resource Division where financial, contractual, and personnel services are performed. The Technical Support Division provides model and prototype fabrication and mechanical services. Other supporting efforts for mission research are provided by the Scientific and Technical Information Office, Safety and Health Physics Office, Security Office, and the Foreign Intelligence Office.

Electronics Technology and Devices Laboratory

The Electronics Technology and Devices Laboratory (ETDL) is recognized as one of the Army's leading laboratories, having received the Army's Outstanding Laboratory Award in 1980 and 1983, and an Award of Excellence for 1981, 1982, 1984 and 1985. Located at Fort Monmouth, NJ, the laboratory evolved from the Signal Corps Laboratories of the World War I era.

ETDL operates at the leading edge of the state-of-the-art device technology. Its program represents the Army's primary thrust for advancing the technology base in electronics and electron devices, and tactical power sources to satisfy critical system requirements for new combat capabilities.

Specifically, the program encompasses the development of basic electronic building blocks to pace electronic equipment performance capabilities. These building blocks include integrated circuits, advanced semiconductor devices, microwave power tubes, battlefield power sources, signal processing devices, millimeter-wave components, frequency control devices, high pulse-power subsystems, compact and large-area display devices, and related supporting research in electronic materials and processing technologies. Through analysis of enemy threats, Army doctrine, mission area analyses, and specific mission area materiel plans, ETDL conducts a diversified electronics-oriented applied R&D program. This program focuses on critical device barrier problems and provides a high-leverage impact on the performance, reliability and affordability of battlefield systems.

ETDL has the Army's responsibility for the Very High Speed Integrated Circuits (VHSIC) Program, an Office of the Under Secretary of Defense (Research, and Engineering) managed tri-service effort. VHSIC is one of the highest priority technology base programs in DOD to develop advanced integrated circuit technology for early application in military systems. Its primary objective is to accelerate the introduction of advanced integrated circuit technology into weapon systems, eliminating the time lag between commercial availability and deployment in military systems.

ETDL will operate and manage the Army's new Pulse Power Center at Fort Monmouth, a major new facility scheduled for completion in 1986. The center will also provide an expanded capability for development, test, and evaluation of high energy/high power, power conditioning components that are important elements in the Strategic Defense Initiative. ETDL also has Army responsibility for the Tri-Service Microwave/Millimeterwave Monolithic Integrated Circuits Initiative that will be managed by the Office of the Under Secretary of Defense (Research and Engineering).

ETDL has one of the highest rated and funded in-house laboratory independent research programs in the Army ($2.3 million in FY85). The laboratory exceeded its program goals this past year, with 83 key technical accomplishments, which impacted over 46 development or fielded systems in seven mission areas.

The laboratory has some of the most sophisticated facilities in the Army today and presently has 331 employees, of whom 186 are professional scientists and engineers. In addition, ETDL has a unique graduate/undergraduate studies program whereby the laboratory brings into the workforce baccalaureate graduates (who work on advanced degree thesis projects in support of the laboratory mission), university faculty on sabbatical leave, and also qualified high school students who are employed during the summer and vacation periods.

Harry Diamond Laboratories

Harry Diamond Laboratories (HDL) constitute the largest electronics research and development laboratory in the U.S. Army.

Still pursuing the mission which was its raison d'etre 35 years ago, HDL continues to be the Army's principal activity for science and engineering in the field of electronic fuzing for rockets, mortars, artillery, and missiles. In addition to its leadership in fuzing, HDL has become nationally known, among all the services and their contractors, for its facilities in which the simulated effects of nuclear weapons can be studied, such as the AURORA X-ray facility. It is the world's largest full-threat gamma-radiation simulator. This has led to a core of scientists who are the Army's experts in nuclear hardening technology and survivability.

The Department of Defense has recognized the advanced research performed by HDL in radar technology and is supporting the continuing development, at HDL, of the technology base for the next generation of ground surveillance radar systems, which include mono-static, multi-static, netted, and millimeter-wave radar systems. These are common-module, high-performance ground surveillance radars incorporating advanced data processing techniques, displays, and electronic counter-countermeasures technology.

In HDL's radar, fuzing, and information and signal processing programs, integrated circuits are the subject of intensive research and development. HDL operates the Army's largest facility in which the most advanced integrated circuits can be computer-designed, fabricated, packaged and tested, after which the designs are released to private industry for production in large quantities.

Following its chairmanship of the National Conference on High Power Microwave Technology, the Harry Diamond Laboratories have continued to be the focal point for research into the potential, and the threat, of using this medium as the basis of a directed energy weapon.

Other unique areas in which HDL's scientists have achieved tri-service acclaim include countermeasures against anti-radiation missiles, acousto-optical signal processing, foreign material exploitation, integrated fuzing and guidance sensor functions for self-contained autonomous munitions, electro-magnetic pulse effects, and environmental simulation technology.

The management structure of the Harry Diamond Laboratories is civilian. Although there are a very few military officers assigned to HDL, their principal purpose is to infuse the scientific staff with their technical observations in the field. The permanent Army employees guarantee the retention of experience and a stability in management, validating the accepted principle that scientists should be led by scientists.

The line organization of HDL consists of the technical director, four specialized divisions, each headed by an experienced division director, and consisting of two subordinate scientific laboratories which concentrate on one or more of the mission areas. The director is assisted by a very small staff organization, consisting of engineers and scientists who, having worked in the line organization, now discharge essential forensic responsibilities.

Support services, such as legal, civilian personnel, finance and accounting, logistics, procurement and facilities, are performed by an Installation Support Activity that services both HDL and the collocated LABCOM headquarters.

Human Engineering Laboratory

Human factors engineering in the Army is one of the technologies concerned with taking people into account during the design and modification of weapons and equipment.

The Army Human Engineering Laboratory (HEL), the Army's lead laboratory for human factors engineering, provides direct human factors engineering support to subordinate commands, project managers, and to the Training and Doctrine Command centers and schools through the HEL representatives located at 20 detachment and field offices around the country. This network is designed to address human factors related to the specific work at each of the installations.

Work at the HEL cuts across all mission areas and is organized by directorates which include aviation and air defense; fire support and target acquisition; close combat, combat service and support; behavioral research; and individual soldier and battlefield environment. A special projects office takes on areas that are high priority, involve high technology, or are exploratory in nature.

The HEL is also the lead AMC agency for human factors engineering in Manpower and Personnel Integration

(MANPRINT), an Army initiative to ensure that people issues are considered through the materiel acquisition cycle.

Located at Aberdeen Proving Ground, MD, HEL has a staff of more than 200, and comprises 72 acres of property. Facilities include a computerized outdoor small arms firing range and an indoor firing range; a test area for experimenting with ammunition handling; a computerized obstacle course designed to evaluate individual clothing and equipment; and up-to-date metal, woodworking, and electronics shops. The Human Engineering Laboratory was established in 1951 under the Ordnance Corps.

Materials Technology Laboratory

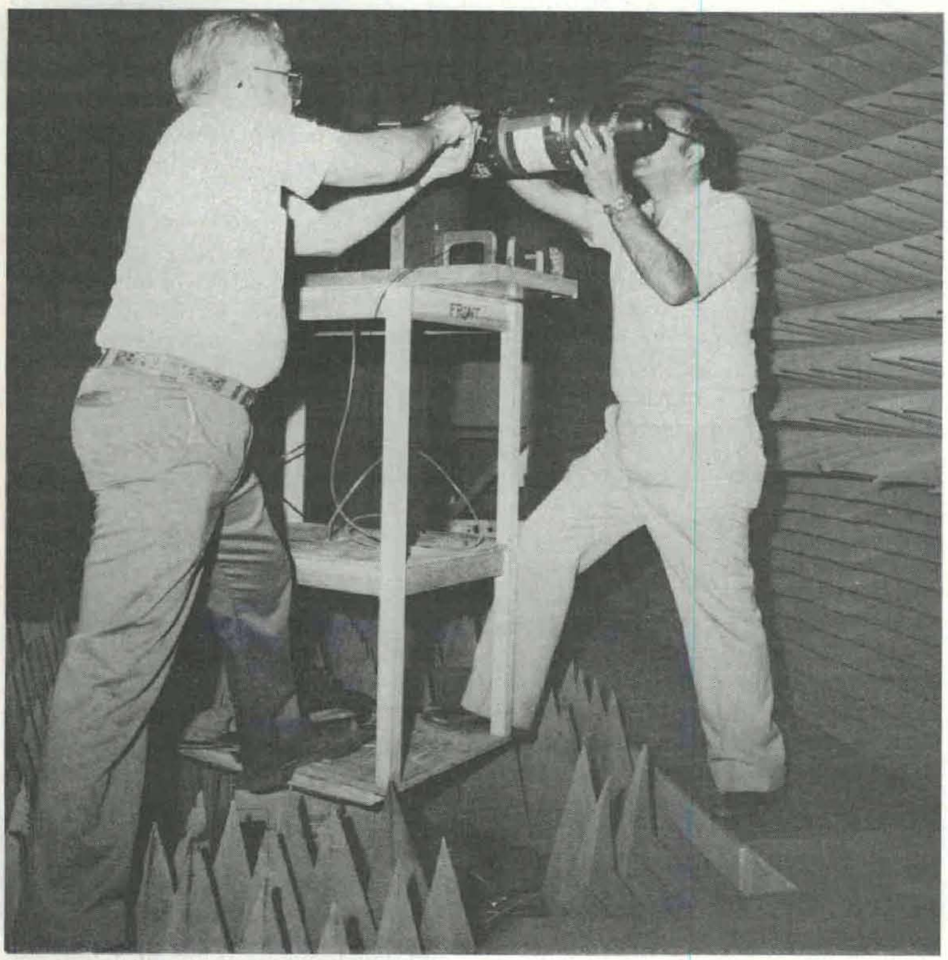
The Materials Technology Laboratory (MTL) in Watertown, MA, is responsible for managing and conducting the research and exploratory development programs in materials and solid mechanics.

The laboratory is the lead laboratory for materials, solid mechanics, lightweight armor, and manufacturing testing technology.

MTL's wide-ranging program encompasses research in metals, ceramics, organics, and composites. Providing a full-service capability includes research in non-destructive testing (NDT), development of materials specifications and standards, operation of an NDT training and certification program, management of the AMC Manufacturing Testing Technology program, and support throughout the Army in failure analysis. Additionally, MTL is designated the Army's Center of Excellence for Corrosion Prevention and Control and is assigned responsibility for adhesive bonding and for establishing an AMC-wide structural integrity program.

MTL's R&D program can be categorized into three thrust areas: battlefield sustainment, lighten the force, and battlefield lethality, which includes survivability as well as lethality.

Battlefield sustainment involves readiness of the force and focuses on improving reliability, availability, maintainability and structural integrity of Army systems. R&D in this area is focused on technologies required to meet the increased performance, reliability and survivability demands of current and future systems in aircraft armaments, missiles, ground vehicles, combat support equipment and personnel protection. Examples of these technologies include corrosion control and prevention, advanced engine ceramics, wear control, processing technology, and automation/artificial intelligence applied to advanced manufacturing capabilities.



Vulnerability Assessment Lab technicians prepare a seeker for special electronic warfare investigations in the small anechoic chamber.

The lighten the force thrust aims to reduce the weight of Army systems at no loss in structural integrity, and provide soldiers with greater mobility. This thrust currently focuses on a composite turret and hull plus development of a lightweight howitzer.

Battlefield lethality involves survivability which includes armor and protection against chemical, laser and directed energy threats. Anti-armor includes penetrators, sabots, gun tubes, artillery and chemical warhead liner materials.

Other areas of MTL's R&D expertise include advanced gear and bearing materials, elastomers for tank track pads, electro-optical crystal materials, and a capability to analyze the mechanics of materials aspects of the problems.

Due to its unique location, MTL is both a research laboratory and a separate Army facility. MTL's three major laboratories are the Metals and Ceramics Laboratory, the Mechanics and Structural Integrity Laboratory, and the Organic Materials Laboratory. In addition, the Ballistic Missile Defense Materials Program Office provides extensive support to the Strategic Defense Command in advanced materials research. On-site support services, provided by the Directorates for Technology Planning and Management, Human Resources, Resource Management, Installation and Services, and Information Management assure that the total resources (650 people, $60 million in funds, and 680,000 square feet of facilities in 10 building over 37 acres) are directed to better materials for tomorrow's Army.

Vulnerability Assessment Laboratory

The Vulnerability Assessment Laboratory (VAL) is headquartered at White Sands Missile Range, NM. Major elements of the laboratory are also located at Fort Monmouth, NJ, and Kirtland AFB, NM. The laboratory employs some 250 civilian and military personnel, nearly half of whom are professional scientists.

VAL has been chartered to provide an

independent assessment of the vulnerability of Army weapons and communications electronics systems to hostile electronic warfare (EW), and to assist project managers in reducing or eliminating those vulnerabilities by providing recommendations and technical expertise.

Typical EW threats include jamming, radar reflecting chaff that "masks" targets, and flares or reflectors that "decoy" missiles. As vulnerabilities to these threats are determined, VAL develops "hardening" techniques to make systems less vulnerable to the threats.

VAL maintains a comprehensive inventory of threat instrumentation of simulating electronic countermeasure environments as well as numerous special facilities. VAL's radio frequency anechoic chamber can accommodate most of the Army's largest weapon systems, including the M1 Abrams Main Battle Tank. A modified Air Force NKC-135, dubbed "Big Crow," is controlled by VAL and serves as an airborne EW platform. The recent installation of an inflight refueling capability has extended its nominal mission time allowing Big Crow to support the more complex tests now required by the Army. VAL also uses a rocket sled test facility at China Lake, CA, to evaluate electronic fuze performance in simulated tactical surface-to-air missile intercepts.

Electronic countermeasure assessments, which ideally begin early in the development cycle of a system, employ four basic techniques: engineering evaluations, laboratory investigations, computer simulations, and field experiments. Not only does this ultimately produce a better system, but it is more cost effective. Design changes can be made to preproduction systems for a small fraction of the cost of refitting fielded weapons.

Initial assessments are driven by technological capabilities and projected threat environments. However, since technology and threat are continuously evolving, VAL's vulnerability assessments must be updated. In a very real sense VAL's involvement with an Army weapon system remains active for as long as the Army considers a system viable.

VAL has five divisions which are structured to cover its mission areas—Air Defense, Communications-Electronics, Close Combat and Fire Support, Foreign Missiles, and Technology and Advanced Concepts. A sixth element—resource management—encompasses the necessary administrative, financial, logistic, and security functions.

RDE Centers

Armament RDE Center

The Armament Research, Development and Engineering Center (ARDEC) is located at Picatinny Arsenal in Dover, NJ.

This high-technology research, development and engineering facility concentrates its efforts on two main areas—weapons and munitions. ARDEC is the Army focal point for creating and maintaining the technology base for gun armament systems, a wide variety of conventional munitions and common tool and equipment items.

The center maintains control for the full spectrum life cycle engineering of armament materiel, including basic research, concept evaluation, advanced development, full-scale engineering development and engineering support for production, fielding and demilitarization.

ARDEC is responsible for materiel ranging from weapons and weapon systems, ammunition and fire control systems to demolition munitions, fuzes, and safing and arming devices.

The three major organizations within ARDEC are the Fire Support Armaments Center, the Close Combat Armaments Center and the Armament Engineering Directorate.

The Fire Support Armaments Center is oriented toward indirect-fire systems. It manages the research, development and engineering of fire support systems including artillery, mortars, mines, demolitions, fire control for the entire Army (except for missiles), ancillary items and other assigned systems. The center plans and conducts the technology base and life cycle engineering for these items including threat analysis and systems.

The Close Combat Armaments Center is oriented toward direct-fire systems. It manages the research, development and engineering of close combat systems including heavy armaments, light armaments, air defense, gun tubes, ancillary items and other assigned systems. The center plans and conducts the technology base and life cycle engineering for these items including threat analysis and systems integration actions required to assure early production, prompt fielding and continuing availability of assigned items.

The Armament Engineering Directorate manages the research, development and engineering of assigned items including energetic materials (such as explosive and propellants), pyrotechnic systems, fuzes, process technology and packaging. The directorate provides test engineering and evaluation engineering support to the Fire Support and Close Combat Armament Centers. ARDEC employs 4,403 civilian and 76 military officers and enlisted members, including 13 Senior Executive Service positions and 1,905 scientists and engineers. The center manages an annual program in excess of $986 million through 46 contractors world-wide, including NATO countries.

Chemical RDE Center

The Chemical Research, Development and Engineering Center (CRDEC) has served as the Army's lead research, development, and engineering laboratory for chemical defensive equipment and systems since its establishment in 1917. It is headquartered in the Edgewood area of Aberdeen Proving Ground.

Throughout its 69 year history, the chemical activity's name has changed many times, but CRDEC's mission is essentially the same—to develop the best possible defensive systems to protect American military forces and to provide them the proper equipment, knowledge, and materiel, to survive and perform a military mission in a chemically contaminated battlefield environment.

As the Department of Defense lead laboratory for chemical and biological (CB) defense related matters, CRDEC supports the joint services in these areas and is responsible for international coordination of chemical matters.

Center research programs emphasize CB defense systems to include individual and collective protection, decontamination, detection and identification, as well as warning and chemical training devices. In addition, CRDEC's programs include research and development of chemical anti-personnel agents, munitions systems, and riot control materiel.

Major research thrusts include reconnaissance, detection and identification, individual protection, collective protection, decontamination, and supporting technologies. CRDEC also serves as the Army's center for environmental technology relating to the effects of chemicals and other materials.

CRDEC engineers and scientists type classified seven times and fielded five items to Army units during the past year. Type classified items are the Chemical Agent Monitor, the M81 Simulator for Chemical Agent Automatic Alarm, the M280 Individual Decontamination Kit, the M48 NBC Gas Particulate Filter, the M76 Infrared Smoke Grenade, the M157 Smoke Generator Set, and the M256A1 Chemical Agent Detector Kit.

Five items developed and engineered by CRDEC personnel were fielded this year and will significantly enhance joint service capabilities. They are the M13 Decontamination Apparatus, the M825 155mm Smoke Projectile, the training kit for the M256 Chemical Agent Detector Kit, the M234 Riot Control Projectile Launcher, and the M743 Riot Control Projectile.

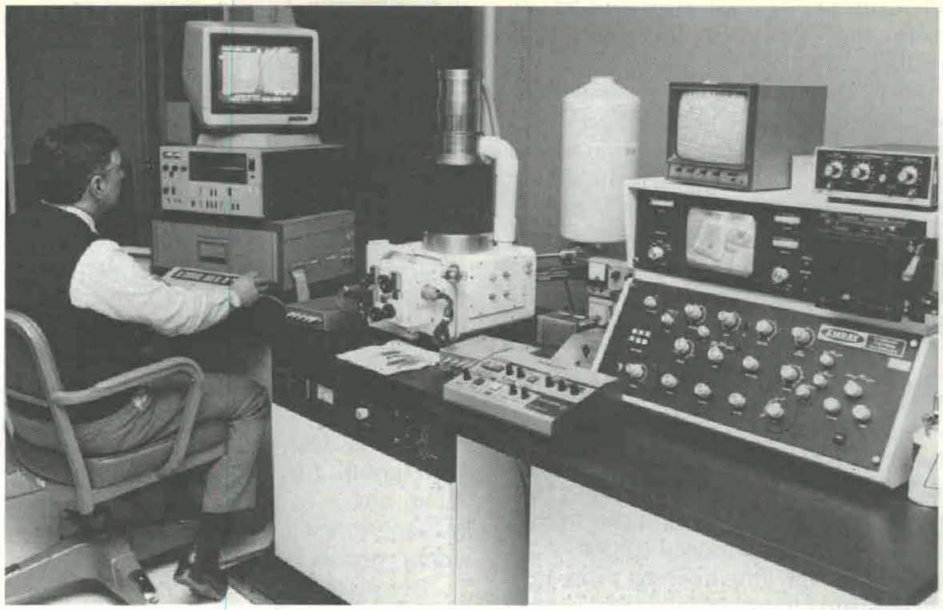
Two product improvement programs completed at CRDEC will have significant impact on field soldiers. These programs involved the M23 Breathing Apparatus and the M17A1 Protective Masks.

CRDEC's staff is comprised of 1,330 employees with 100 of these spaces assigned to military personnel. Military and civilian employees at CRDEC hold 86 doctoral degrees, 156 master's degrees, 504 bachelor's degrees, and 37 associate degrees.

Aviation RDE Center

The Aviation Research and Engineering (RDE) Center, headquartered at the Aviation Systems Command (AVSCOM) concentrates and focuses scientific and engineering assets into a single cohesive organization, having strong linkages with the user, combat developers, project manages, manufacturers, and the logistics support community involved with Army aviation as well as with the other major subordinate command RDE centers. The RDE center is compatible with and, in fact, complementary to the role of the traditional corporate laboratories.

The Aviation RDE Center concept was tailored to optimize AVSCOM's positive resource capabilities. As such, it is not a traditional "center" in some respects. A "center" most commonly refers to an organization located at one specific geographical site, that is administratively self-sustaining with a generally autonomous mission. Conversely, the Aviation RDE Center melds together, in one organization, several geographically dispersed technical organizations that collectively perform or support virtually all aspects of the AVSCOM aviation life cycle mission. An example is the RDE Center Aviation Research and Technology Activity (ARTA), which uses facilities and personnel capabilities of three NASA laboratories (NASA Ames, Moffett Field, CA; NASA Lewis, Cleveland, OH; and NASA Langley, Hampton, VA). These NASA labs and the collocated ARTA directorates have made major contributions to Army/DOD technology with a minimum Army investment. The Army profits by getting superlative technology and facilities and NASA benefits by working real-world problems for the Army. The unique mission and capabilities of the Aviation Engineering Flight Activity (AEFA) and the Avionics Research and Development Activity (AVRADA), likewise, provide Army aviation critical capabilities. The AEFA mission of independent test is a critical element of aircraft systems development and of the airworthiness qualification program, thus, contributing to AVSCOM being a smart buyer. AVRADA develops avionics and also provides AVSCOM the core capability for aviation electronics technology—a technology that is evolving and growing rapidly in its application to aviation systems.



Scanning electronic microscope with Energy Dispersive X-Ray Analysis and Image Processing System used by Electronics Technology and Devices Lab for electron beam diagnostics and failure analysis of microelectronic devices.

The Directorate for Advanced Systems (DAS) serves as a key element in meeting new and expanded interfaces. As a staff organization, DAS is charged with pulling together the AVSCOM RDT&E program, maintaining technical interfaces with other commands and activities, challenging user requirements, managing the transfer of mature technology from all sources (international, government, and commercial), assuring adequate consideration of nondevelopment items, managing product improvement alternatives, and insuring that planning is accomplished for life cycle technical support of aviation systems. The mission of command-wide management of product improvements was recently given to DAS to insure product improvements were properly prioritized with all other research, development and acquisition programs. The DAS plays a critical role in management of the RDE center.

The newest and smallest organization within the RDE center is the Test and Evaluation Management Office (TEMO). The TEMO was organized to perform life cycle test management for the command and to assist project, product and functional managers in carrying out their test and evaluation responsibilities. The TEMO serves as the AVSCOM focal point for test and evaluation matters.

The Directorate for Engineering maintains its responsibilities for establishing airworthiness qualification and maintaining design integrity for all

Army aircraft as well as providing life cycle engineering support to the command.

The Aviation RDE Center is headed by a commander, and a technical director (deputy). To facilitate operational continuity and minimize overhead personnel requirements, these positions are "dual-hatted" with the center commander and deputy serving also as the AVSCOM deputy commander for R&D and the technical director respectively.

CECOM RDE Center

The Communications-Electronics Command's (CECOM) Research, Development and Engineering Center supports the soldier in the field through its efforts in several hundred research, development and engineering programs. These efforts focus on the areas of command, control, communications, intelligence and electronic warfare. The center's mission encompasses a wide range of engineering disciplines, technology areas, and technical and administrative support activities.

Five functional directorates conduct the RDE center's work with the assistance of several support elements.

The Communications/Automated Data Processing Directorate conducts research, development and engineering in techniques and equipment on reliable, jamming-resistant battlefield communications. Its work is directed toward easing the transfer of high technology products to support the command, control and communications needs of troops in the field.

The mission of the Electronic Warfare/Reconnaissance, Surveillance and Target Acquisition Directorate is to deny the enemy the ability to locate, identify, neutralize or destroy aircraft, vehicles, missile systems and critical installations. The directorate provides the means to negate the enemy's non-communications electromagnetic equipment and systems.

The Night Vision and Electro-Optics Center at Fort Belvoir, VA, recognized as the national and international leader in night vision technology, provides the Army with the capability to fight as effectively by night as by day. Its area of interest lies in the rapidly advancing technologies of image intensifiers, low and medium energy lasers, image processing and automation, and far infrared.

Signals Warfare Directorate at Vint Hills Farms, VA, provides communications, intelligence and electronic warfare materiel to the Army. It is also responsible for international standardization activities within its mission area.

During the life cycle of a system, the Life Cycle Software Engineering Directorate ensures that the deployed software continues to support the operational mission. The directorate provides centralized life cycle management and support for mission-critical computer software used in a wide range of tactical and strategic systems.

After the RDE center has completed advanced development and user demonstrations, a project is transitioned to one of CECOM's project managers who will guide the program through the next phase of the life cycle, encompassing full-scale engineering development, production and fielding.

The RDE center's efforts are supported in turn by its Nondevelopment Items Advocate Office, Airborne Electronics RDE Support Activity, Advanced Systems Concepts Office, Technical Programs Office and Logistics Technology Office.

Missile RDE Center

The Missile Research, Development and Engineering Center (MRDEC) (formerly Army Missile Laboratory) is a major element of the U.S. Army Missile Command (MICOM) located at Redstone Arsenal, AL. It is the Army lead organization for guidance and control/terminal homing and high power/energy laser technology. The center is also the principal operative in executing MICOM responsibilities as the AMC lead command for smart munitions. A dedicated organizational element fulfills the latter mission by coordinating all smart munitions technology programs in the Army.

Center efforts include basic research for missiles, rockets and high energy lasers; exploratory development, advanced development; and technical/engineering support of project managed missile and rocket systems. The center works directly with the Army Forces Command and the Army Training and Doctrine Command to provide technology solutions to the Army's needs and to develop technology for future systems.

The center provides total life cycle system engineering capabilities. Critical capabilities include producibility engineering for products transitioning from development to production. The capability to develop repair parts for missiles out of production is also provided. A prototype fabrication facility exists for low quantity, fast turnaround assembly and that of preferred design concepts.

A "smart buyer" posture is maintained by sponsoring selected proof-of-principle demonstrations. These hands on demonstrations keep engineers and scientists technically active with state-of-the-art technology. Current technology integration activities include the Fiber Optic Guided Missile (FOG-M), Setter, Sparrow-Hawk, a teleoperated mobile anti-armor project and a precision deep attack missile system.

The center has 11 technical directorates and seven small offices. Missile and directed energy technology products and processes are developed within the technical directorates. They also provide engineering and design support to project and product managers. The center is directed by a member of the Senior Executive Service (SES) who is also MICOM's technical director. He is assisted by a military deputy and two SES associate directors who focus on technology base management and support to program/project and product managers.

The Advanced Systems Concepts Office is the center's principal interface with the user community. It is staffed with military officers with field experience in combat arms career fields.

The center operates with a minimum of organizational substructure. This permits great flexibility in moving critical engineering and scientific skills to current technical program areas. For example, the Advanced Sensors Directorate does not have a separate organization for each technical discipline. Each technical area is associated with a distinct supervisor but all personnel are assigned to the directorate at large. Thus, a radar expert can quickly and efficiently be assigned a task in the radio frequency technology area without lengthy civilian personnel procedures or other artificial organizational barriers.

TACOM RDE Center

The Tank-Automotive Command's RDE Center is the Army's center of excellence for ground mobility equipment. Its missions include expanding the technology base, performing systems engineering, and integrating AMC- and industry-wide technology efforts into ground combat and tactical vehicles.

While each of these missions is extremely important, the third mission—integration—is probably the most vital to the Army and to AMC. The center's team of engineers, scientists, and technicians consistently strives to integrate technology by developing quality equipment that is low in cost, easy to support, and effective on the battlefield. The center has focused heavily on this area in the past as is shown by its many accomplishments. As a world leader in adiabatic engine research and application, the RDE center successfully combined the efforts of several years of R&D aimed at increasing efficiency and lowering heat rejection in diesel engines.

The center also advanced its capability to model thermal signatures in helping to predict what an enemy can see when applying state-of-the-art sensors against U.S. combat vehicles. Additionally, RDE center engineers helped to reach a major milestone in U.S. tank design evolution by completing the final assembly phase of the tank test bed program—a program aimed at evaluating future combat vehicle concepts.

One of the center's current programs involves Vetronics, which holds much promise for revolutionizing combat vehicle designs. This program promotes a more efficient integration of the vehicle electrical/electronic systems and real-time integration while providing optimum vehicle and crew effectiveness.

The center is also an active AMC participant in formulating and implementing a logical, progressive, and cost-efficient robotic program for the Army. Technical efforts are concentrated in near-term field applications, technology coordination, and systems test beds.

Work continues to be directed in a number of other areas as well. These include:

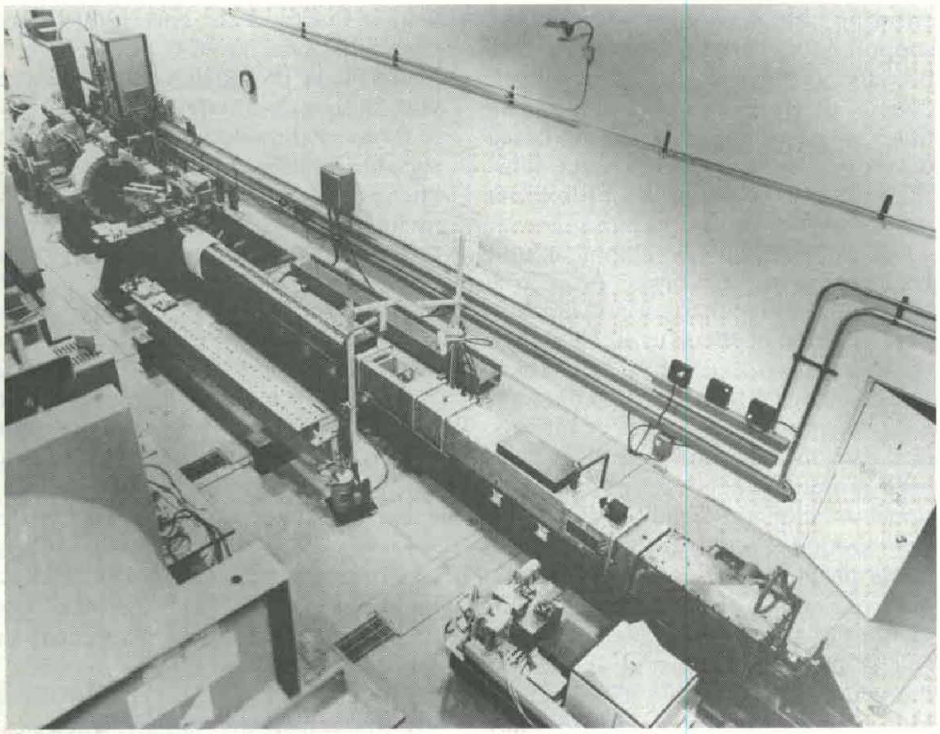
- addressing the spectrum of current and future vehicle mobility requirements regarding track and suspension;
- investigating the Advanced Integrated Propulsion System program, which provides technology demonstration of advanced propulsion systems for heavy combat vehicles; and
- developing and applying state-of-the-art military vehicle performance simulation techniques to solve design problems related to fielded systems and early conceptual requirements.

Those individuals responsible for overseeing and coordinating the RDE center's many diversified programs comprise an organization that is really a series of connecting links. Linkage with the combat development community is attained through the Advance Systems, Concepts, and Planning Directorate.

Linkage to PMs and systems already fielded is provided by the Systems Engineering Directorate. The interconnecting link between these is the Tank-Automotive Technology Directorate where tank-automotive technology is pursued by six commodity-oriented divisions.

The functions of the Engineering Data Directorate and Design and Manufacturing Technology Directorate include in-house fabrication, test facility operations, and manufacturing expertise. Work here is critically linked to the directorates previously mentioned. Separate cells of expertise have also been established to provide oversight and policy guidance in the areas of value engineering, NBC protection, and logistics technology.

Finally, the Technology Integration and Planning Office ensures that a coordinated effort, responsive to the Army's needs, is planned and carried out in all RDE center programs.



Electromagnetic (EM) Gun at the Armament RDE Center uses magnetic fields to launch projectiles. EM propulsion can fire projectiles much faster than they have ever been fired with chemical propellants.

Belvoir RDE Center

The Belvoir Research Development and Engineering Center is the U.S. Army Troop Support command's RDE center for combat engineering, logistics support and materials and fuels and lubricants. Located at Fort Belvoir, VA, the center is geared to excellence in improving the mobility, countermobility, survivability, energy, and logistics capabilities of the Army of the 1980s and beyond.

Efforts in mobility/countermobility strive to deny mobility to the enemy, and to keep friendly forces moving over natural and man-made obstacles. They involve countermine, counterobstacle, bridging, barrier and construction equipment. In the field of countermines, the center has AMC lead laboratory responsibility.

Survivability enhancement is sought through the development and acquisition of camouflage, tactical deception, field fortification, physical security, tunnel detection, robotic and topographic systems. Also lead lab for camouflage technology, the center provides material and consultation to U.S. and allied units world-wide.

Energy to move, shoot and communicate is more than half the center's logistic support effort. This essential element is provided through development of mobile electric power sources ranging from fuel cells for silent operations to pulse power generators for beam weapons systems. Air conditioners are developed for field use to facilitate efficient operation of missile, communications, data processing and medical systems powered by the generators.

The other half of logistics support is devoted to the delivery of goods such as fuel, water and other vital supplies where and when they are needed by an Army on the move. It encompasses a wide variety of water supply, fuels handling, materials handling, supply distribution, and marine equipment.

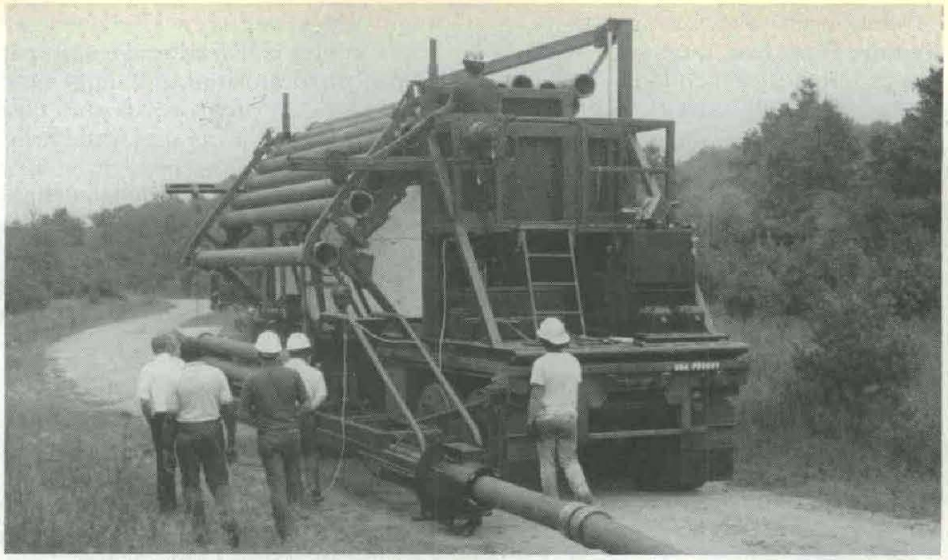
Fuels, themselves, as well as lubricants for land mobility and ground support equipment are developed or specified by the center. Its materials, fuels and lubes mission also includes investigation and development of functional fluids, corrosion preventives, metals, plastics, fabrics, coatings, elastomers, composites, adhesives and packaging used in equipment developed not only by the center but by other military services.

The center's entire RDE program is associated closely with Training and Doctrine Command schools and centers to insure consistency with the needs of the user. It also interfaces with the Laboratory Command and various other members of the Army-industry scientific community to incorporate technological breakthroughs where possible to meet potential requirements.

Its comprehensive product assurance follows an item from research through monitoring first-time buys to determine acceptability for fielding. Engineering provides the technical data for production and quantity procurement, and the logistics and technical support to keep equipment operational in the field.

Organizationally, the center consists of eight directorates and various staff offices. Major mission areas are focused on two commodity directorates, Combat Engineering and Logistics Support, with a third, Materials, Fuels and Lubricants providing technical support to both as well as to Army-wide users of fuels and materials. The latter is responsible also for the Belvoir Fuels and Lubricants Facility at Southwest Research Institute, San Antonio, TX.

The Advanced Systems Concepts Directorate is the primary interface with TRADOC, LABCOM and the scientific community, while Product Assurance and Test has been regrouped to become Product Assurance and Engineering Directorate. Expansion of the Information Management Directorate is providing automated engineer work stations.



This automated pipeline equipment system, under development at the Belvoir RDE Center, will speed delivery of fuels in the field.

The center has an authorized strength of 986 civilians and 59 military, and an annual budget of $255 million. Research, development, test and engineering accounts for 73 percent and procurement 17 percent, with operations, maintenance and engineering support claiming the remainder.

Natick RDE Center

The Natick Research, Development and Engineering Center is dedicated to ensuring the maximum survivability, supportability, sustainability and combat effectiveness of the individual soldier in all combat environments. The items, systems and commodities being developed by Natick will protect, subsist, shelter and resupply by airdrop the soldier on the battlefield.

Natick research, development and engineering on uniforms, protective clothing, personnel armor and life support equipment involves items which touch soldiers' lives on a daily basis. The challenge is to ensure that the footwear, handwear, clothing, canteens, load carrying equipment, sleeping gear, body armor, helmets, etc., remain functional in climatic conditions ranging from arctic to tropic. In addition, these items must be resistant to chemical ballistic projectiles, flames, lasers, and advanced surveillance capabilities. Finally, these items must be sized to fit the wide range of Army personnel, be mutually compatible, and be light enough and comfortable enough for the soldier to wear.

Natick's technical personnel are continually seeking to develop and improve the rations, food service equipment, food packaging and processing and feeding system vital to sustaining the Army. This effort requires a delicate balancing of factors. Food not only fuels the soldier but plays a vital role in maintaining his/her morale and ability to endure and press on. And the feeding process must not compromise the operation particularly on the mobile, widely dispersed, potentially toxic battlefield of the future. The new Army combat field feeding system to be fielded shortly is the end result of just such a balance.

Natick is the RDE center charged with designing and developing the systems to accurately airdrop personnel, supplies and equipment deep behind enemy lines. Current thrusts in this area include increasing airdrop capacity to take advantage of the cargo capacities of current and developmental aircraft, an airdrop controlled exit system which links airdrop platforms together so whole systems can be airdropped as a single load to reduce dispersion on the drop zone, and retrorocket system to provide the capability to soft land loads from a 300-foot altitude.

Finally, Natick is responsible for developing the tactical shelters, tentage and organizational equipment such as mobile laundries, bath systems and space heater the Army in the field requires to house the force.

The underlying priority at NRDEC is the concern for the soldier. Natick's existence is all about soldier survival on the battlefield.

Medical R&D Command Organizations

Introduction

The U.S. Army Medical Research and Development Command (USAMRDC) is a field operating agency of the Office of The Surgeon General (OTSG). The mission of USAMRDC is to plan, program, coordinate, direct, and review the Army Medical Department Research, Development, Test, and Evaluation Program.

The USAMRDC commanding general also serves as assistant surgeon general for R&D, as the medical materiel developer, and as head of contracting activity for OTSG. In addition, he has lead agency responsibility for DOD/joint service R&D programs for medical defense against chemical and biological warfare, infectious disease research, combat dentistry, and Army biotechnology programs.
programs.

As a field operating agency, the command staffs substantive policy matters and issues through OTSG. However, USAMRDC also communicates directly with Army elements, other government agencies, and civilian commercial and academic research organizations. As the assistant surgeon general for R&D, the USAMRDC commanding general advises the surgeon general and the Army Staff on health and medical aspects of all Army research, development, test, and evaluation programs.

USAMRDC operates nine laboratories, five overseas medical research units, and two management activities to facilitate research contracting and product development—the Medical Materiel Development Activity and the Medical Research Acquisition Activity.

Medical Materiel Development Activity

The Medical Materiel Development Activity manages execution of the development component of the Army Medical Department RDT&E materiel development responsibility to achieve DA and joint service materiel system performance schedule, cost and logistics objectives. The activity is concerned with all aspects of the acquisition strategy for system development, including integrated logistical support costs, technical risks and systems analysis, test and evaluation, engineering, quality assurance, production planning, and system supportability as well as satisfying regulatory requirements imposed by the Food and Drug Administration and other regulatory bodies.

Medical Research Acquisition Activity

The Medical Research Acquisition Activity provides acquisition support to the headquarters and the nine Medical R&D Command laboratories. The activity executes the contract program for the command. Contract specialists work with project managers and technical personnel in acquisition and procurement planning. The organization solicits and evaluates proposals, and negotiates with bidders to develop the "best deal for the government." Contract specialists negotiate contract changes, authorize equipment purchases and resolve patent issues.

Walter Reed Army Institute of Research

The Walter Reed Army Institute of Research (WRAIR) is the oldest and largest of the laboratories of USAMRDC. Founded in 1893 as the first school of preventive medicine in the United States, WRAIR has always had, as an associated mission, research in the field of military preventive medicine. Today the mission includes work in four of the command's five major research areas: military disease hazards, combat casualty care, Army systems hazards, and medical chemical defense.

The FY86 budget for the institute is in excess of $40 million, primarily for research. Other funds support teaching efforts. Courses include Tropical Medicine, Military Veterinary Medicine Short Course, Animal Specialist Course, Military Preventive Medicine Residency, Military Medical Research Fellowship and portions of the Infectious Disease Fellowship.

The institute workforce is staffed by approximately 1,100 researchers and support personnel and is about equally divided between military and civilian. As would be expected in such an institution, advanced degrees are held by many, and embrace a variety of disciplines. In 1985, their research was reflected in over 300 articles published or in print, in more than 100 professional journals. The WRAIR today pursues a research program extending from basic research through product development. Goal directed basic research is aimed at understanding the molecular biology of agents causing militarily important diseases such as malaria, hepatitis, and dysentery. These studies are complemented by basic research in epidemiology and immunology.

Basic studies in neurophysiology and behavioral psychology are aimed at discovering determinates of behavior and response to stress, leading to better understanding of combat psychiatric injuries.

Since its inception, the WRAIR has sought usable answers to military medical problems. Exploratory development in collaboration with the U.S. Army Medical Materiel Development Activity supports all the USAMRDC labs. Newly developed approaches utilizing such advances as genetic engineering and Deoxyribonucleic acid hybridization techniques are applied to disease prevention measures. Work is currently going on, for example, in the development of genetically engineered shigella vaccines and cyanide antidotes.

Also in active development are vaccines for dengue fever, hepatitis A, meningitis group B, malaria, shigellosis, klebsiella and pseudomonas. The dengue vaccine and one of the shigella vaccines have already undergone initial human testing and a malaria vaccine is in the first stages of human use trials. The pseudomonas and klebsiella vaccines are ready for their human trials, too. Field tests of drugs and vaccines in military and civilian populations provide important final evaluations of preventive technology.

Much of the work of the WRAIR goes on in the main laboratory, located at the Walter Reed Army Medical Center in Washington, DC, but small elements of the WRAIR have operated beyond the main campus since MAJ Walter Reed led the Yellow Fever Commission to Cuba in 1900. WRAIR special field activities are presently located at Fort Bragg and in Thailand, Malaysia, Kenya, Brazil, and West Germany. Overseas research provides current knowledge of medical threats to the Army.

Complementing the successful in-house research produced by the

Field evaluation of laser protective materials.

WRAIR, is its command responsibility for management of a broad program of extramural research. Contracts with leading university and industrial laboratories expand the USAMRDC capability in neuropsychiatry, infectious disease and drug development research.

The WRAIR, through a combination of teaching, research and product development, exemplifies preventive medicine in its broadest context: identification of potential hazards, development of specific prevention and treatment methods, instruction in their application, and construction of drugs and vaccines which simplify the task of conserving the fighting strength.

Letterman Army Institute of Research

Letterman Army Institute of Research (LAIR), Presidio of San Francisco, the youngest of the USAMRDC laboratories, has a staff of approximately 250 scientists and support personnel, both military and civilian, trained in a wide variety of biomedical disciplines. LAIR provides a general medical research capability and conducts research in the areas of dermal protection against biological and chemical hazards, combat casualty injuries and treatment, biomedical effects of military lasers, blood, and blood substitutes and mammalian toxicology. It also supports clinical investigation projects initiated by the staff of Letterman Army Medical Center. The FY86 budget for the institute is in excess of $12 million. The inhouse LAIR research effort is supplemented by extensive extramural contract programs.

Dermal protection research at LAIR has focused on the development of improved insect repellents and new topical formulations to act as toxic chemical barriers. Considerable success has been achieved in devising in vitro and in vivo models for rapidly evaluating the effectiveness, not only of potential repellents, but also drugs and toxic chemicals on living skin without risk to humans.

Trauma researchers at LAIR have designed and tested a variety of new animal models to evaluate the consequences of severe hemorrhage, the most frequent cause of death in combat casualties. The models are used to test the effectiveness of new resuscitation procedures that will be deployed in forward battlefield environments. An ordnance gelatin model also has been developed and evaluated with bullets fired from a variety of U.S. and foreign weapons. It is used to quickly familiarize surgeons with the wounding characteristics of different projectiles, hence providing a rational basis for improved casualty treatment.

The laser bioeffects team determines the dose-response relationships of a wide range of laser exposure conditions associated with militarily-relevant systems. Laboratory and field studies of laser-induced decrements in the visual performance of military personnel also are conducted, and a currently active program is concerned with the development and testing of protective eye wear for the combat soldier.

The blood research team at LAIR has been a leader in the field of blood preservation for many years, particularly the development of new preservation solutions which extend the shelf life of human donor blood. Other current efforts are concerned with the preparation and use of frozen blood; the development of oxygen-carryng blood substitutes; and the development of procedures for scavenging, decontaminating, and use of blood that would normally be lost during hemorrhage from combat wounds.

At the present time, LAIR has the only toxicology facility in the DOD that fully complies with all Good Laboratory Practice Regulations promulgated by the Food and Drug Administration and the Environmental Protection Agency, and with federal laws relevant to occupational health and safety. Investigators staffing this facility have capabilities for conducting a complete mammalian toxicity profile of test chemicals, including acute, subchronic, and chronic toxicity tests, teratology/reproductive studies; and genetic toxicity studies using bacterial, cellular, and invertebrate systems.

Aeromedical Research Laboratory

The U.S. Army Aeromedical Research Laboratory (USAARL), Fort Rucker, AL, was established in 1962. Its mission is the prevention or minimization of health hazards in the military operational environment, and the enhancement of the individual solider's performance. USAARL's research encompasses six major areas: acoustics, vision, crew workload and stress, vibration, impact studies and life support technology. Each of these areas has separate, yet related projects, with all research efforts driven by recognized Army deficiencies contained in mission area analyses.

Investigators are studying the effects noise (steady and impulsive) has on hearing and communication. The long-range goals are to establish new military design specifications to assist developers and protect operators of emerging systems.

USAARL conducts laboratory and field experiments to evaluate mission-related visual requirements, seeking to optimize visual enhancement and protection systems design to visual physiologic capabilities of the solider. A major research effort involves the utility of contact lens wear in unique environments and use of special protective lenses (polycarbonate) for aviators who fly night vision goggle missions.

One of the main problems facing Army aviators and ground troops is fatigue. Man has very definite limits. Exceeding these limits results in decrements in performance and potential safety hazards. USAARL scientists are studying workload and fatigue relative to operational and training requirements. In-flight assessment of aviator performance and analysis of human performance data provide information to base aircrew flight time and crew rest guidelines.

USAARL has been designated to evaluate and analyze helicopter life support equipment involved in aircraft accidents. This triservice program operates whenever there is an aircraft accident in which life support equipment either prevents an injury or allows an injury to occur. This analysis includes items such as helmets, crashworthy seats, and thermal protective clothing.

Studies indicate that about one in three aviator fatalities is due to head and/or neck injuries. Much remains to be known regarding head and neck injury mechanisms relative to force magnitude and vector. Work is ongoing at USAARL to widen the data base on impact injury, to ensure adequate protection through systems improvement, and design changes for new systems. tems.

USAARL's efforts in performing vibration health hazard research are addressing inadequacies in current vibration exposure standards. Special interest is being directed to vibration levels and operator task complexity found in new high-speed tracked and wheeled vehicles as well as aircraft.

Currently, USAARL is continuing the research program designed to study the effects of chemical defense pretreatment and antidote therapy on mission completion capability of Army aviators.

Institute of Dental Research

The mission of the U.S. Army Institute of Dental Research (USAIDR) is to conduct basic and applied research leading to the development of methods, materials, and materiel for improving the management of combat maxillofacial injuries, and for providing the soldier with dental support in the combat environment. The current research program can be divided into three major thrusts: maxillofacial wound repair and healing, maxillofacial wound infections, and field dental patient management. Approximately 70 percent of the USAIDR research effort is contained within the first two thrusts and is dedicated to the development of synthetic biodegradable implant materials for maxillofacial bone repair, improved surgical methodology for managing combat maxillofacial injuries, and several unique sustained-release systems for delivering antibiotics to infected wounds. Research is also in progress on the development of field dental equipment, the treatment of field dental emergencies, the development of a Computer Assisted Postmortem Identification System, electromagnetic pulse hardening of materiel, and salivary diagnosis of chemical warfare agents.

The USAIDR, located at the Walter Reed Army Medical Center and Fort George G. Meade, has a professional staff of 25 scientists consisting of Dental and Medical Service Corps officers and civilians with advanced degrees in the basic and applied sciences. In addition, almost all the dental officers have specialty training. Scientific support personnel include bioscience assistants, laboratory and operating room technicians, and animal caretakers.

The USAIDR is commanded by a dental officer and is organized under a Division of Research headed by a civilian deputy for research and Division of Research Support headed by a Medical Service Corps officer. The Division of Research has seven functional branches. The Division of Research Support, staffed by three Medical Service Corps officers, military enlisted and civilian personnel, provide the administrative, financial, and logistic support of the USAIDR.

Product development for support of the soldier in the field is the major focus of the USAIDR research effort, and a number of products are now in advanced development. Biodegradable polymers in combination with bone derivatives have been shown to be a highly effective and practical approach in animal experimentation and clinical trials are planned in late FY86 for one of the USAIDR developed materials. As adjuncts to the bone repair systems, the USAIDR has developed sustained-release microencapsulated antibiotics and antibiotic contained wound dressings which offer significant advantages in managing the high infection rate in combat maxillofacial wounds.

In the area of materiel development, the USAIDR has produced prototypes of a field dental X-ray and a field dental operating unit which are highly effective, rugged, lightweight, and have low cube. Field testing for these units is planned for FY86 and 87.

The Computer Assisted Postmortem Identification system is expected to be implemented in FY87. It has been an outstanding success when used and refined in several mass casualty situations including the recent crash of a chartered aircraft at Gander, Newfoundland.

In addition to the USAIDR in-house research effort, an active and effective contract program is being conducted at universities, non-profit research institutes, and other government labs.

Institute of Surgical Research

The U.S. Army Institute of Surgical Research (USAISR), also known as the Army Burn Center, is located at Fort Sam Houston, San Antonio, TX. Its mission is investigation of problems of mechanical and thermal injury, and the complications arising from such trauma; caring for patients with such injuries; conducting studies at the basic and clinical levels; and training of physicians and ancillary medical personnel in the principles of management of thermally injured patients.

USAISR has served as the model for other burn centers throughout the world. Some of the many advances in burn care which have emanated from the institute are the Brooke formula for fluid volume replacement; development of topical sulfamylon burn cream; establishment of the first Army renal dialysis unit; use of biologic dressings for temporary burn wound coverage; development of diagnostic means, including the use of the 133 Xenon lung scan to detect inhalation burn injury; use of the ultrasonic flow meter to assess adequacy of peripheral circulation in patients with circumferentially burned limbs; and the detailed description of post-burn hypermetabolism as well as definition of effective techniques to provide total metabolic support to badly burned patients.

Thermal research developments directly attributable to the institute have decreased the mortality associated with zero to 50 percent body surface burns to one-third that of 16 years ago and that associated with 50 to 60 percent to one-half that of 20 years ago.

In addition to the preceding contributions, the USAISR established trained flight teams to provide prompt aeromedical transfer of soldiers who receive thermal injuries. Such aeromedical transfer insures continuity of care along the evacuation route and by providing trained attendants, reduces inflight complications and increases survival significantly. During the past 19 years, these flight teams have made an average of eight flights per month.

In compliance with USAISR's mission to train physicians and ancillary medical personnel in the principles of management of thermally injured patients, the institute has current affiliation agreements for such educational activities with 71 medical schools and hospitals throughout the United States.

Medical Bioengineering R&D Laboratory

The U.S. Army Medical Bioengineering Research and Development Laboratory (USAMBRDL) is characterized by broad mission responsibilities being met by a diversified, multidisciplinary team of scientists and engineers performing basic and applied research and development. The overall mission focuses on the protection of soldiers in combat and training scenarios, employees in Army-unique industrial exposure settings, and the environment.

Within the medical materiel mission, emphasis is on the Army's need for field medical equipment for casualty care on the chemical battlefield. The laboratory is also continuing to develop field medical, dental, and vector control equipment. In its hazard assessment mission, the laboratory conducts research and exploratory development to assess hazards associated with Army-unique chemical toxicants, and unique occupational and environmental settings.

Dynamic projects of the Field Medical Materiel Development Division are aimed at the development of equipment which can quickly detect chemical contaminants on patients, a wrap to protectively encapsulate a patient in a chemical environment, and devices to resuscitate patients wearing protective masks and to non-invasively read vital signs of chemical casualties during evacuation. State-of-the-art medical technology is adapted for field use in laboratory projects which are aimed at developing a mobile high-capacity X-ray, a field carrying litter gurney, and modern sterilization equipment. Research is also conducted to provide the foundation for recording and teletransmitting diagnostic radiographs and other medical data in digital form. Flywheel technology is under development to allow a generator for an X-ray to be exceedingly light and compact.

A comprehensive program in the Health Effects Research Division is designed to provide the data base to enable the Army to establish standards for compliance with executive orders, the Clean Air Act, and the Water Quality Act, and derive standards for cost-effective pollution abatement procedures at munition plants. Research is conducted in occupational health to determine hazards associated with military-unique substances or scenarios, and in environmental quality to develop criteria to protect air, land and water quality during production and use of Army-unique materiel. This division's occupational health research group seeks to assure that weapons safety and healthy hazards are addressed sufficiently early in the development process to provide cost-effective soldier-weapons system compatibility. Current research emphasis is directed toward smokes and obscurants to identify field and industrial workplace hazards during manufacture and disposal, field sanitation and water criteria to protect the operational capability of the soldier, conventional weapons systems to determine hazards associated with the operation of ground weapons, and combat vehicles.

Medical Research Institute of Chemical Defense

The U.S. Army Medical Research Institute of Chemical Defense (USAMRICD), at Aberdeen Proving Ground, MD, traces its history back to elements of the Army Medical Department that, in 1915, were responsible for designing protective equipment against chemical agents. Once known as the Biomedical Laboratory, the institute was, for years, controlled by the Army Materiel Command. In 1979, it was reorganized under the Office of the Surgeon General, becoming an element of the U.S. Army Medical R&D Command.

USAMRICD is the Army's lead laboratory for development of a medical defense against chemical warfare agents. The institute is responsible for research, development, test and evaluation of methods of prevention, resuscitation, treatment, and management of chemical casualties. It assists in the integration of the concepts and products of its mission activities into the logistical system, doctrine development, and training.

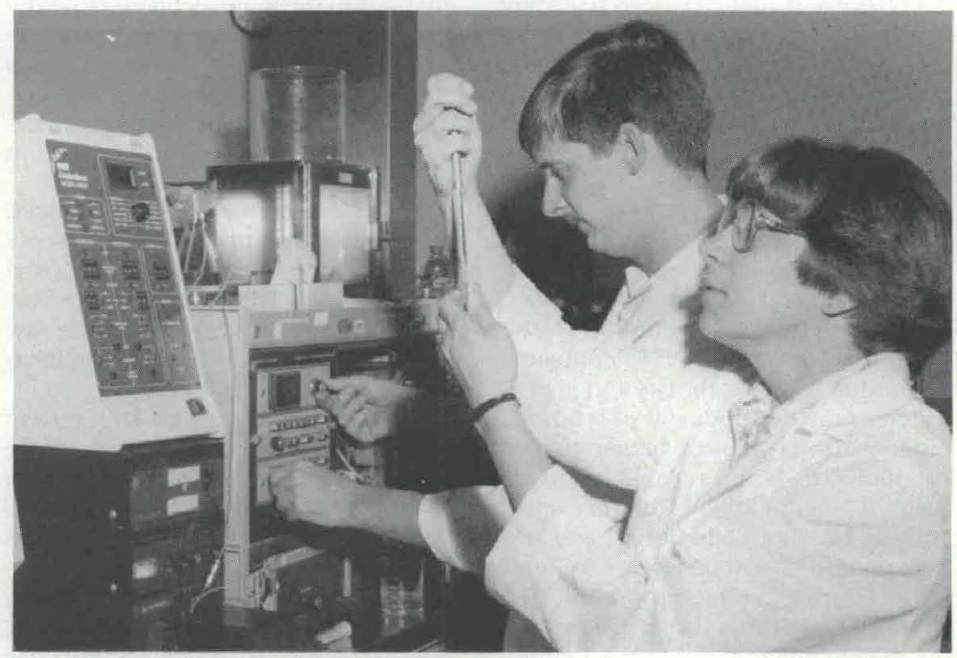
Classes of antidotes and pretreatment compounds are investigated in an attempt to prevent or treat chemical agent intoxication. After identification, improved therapies are thoroughly evaluated, and the possible toxicological effects, effective doses, safety, and efficacy are determined.

In support of the effort to identify pharmacological intervention for chemical agent poisoning, research is conducted into the mechanisms of actions of chemical agents and into the agent effects on organs of the body. The permanent or temporary effects of exposure to various agents as well as the onset, sequence, duration and severity of these effects are delineated.

The injurant effects of agents on skin are studied, and methods for protection and decontamination are assessed. These methods include removing agent from the skin as well as minimizing and preventing agent penetration through the skin.

The USAMRICD offers training to military medical and non-medical personnel in the management of chemical casualties. As part of the course, "The Medical Management of Chemical Casualties," triage exercises are conducted, giving practical experience in recognizing, evaluating, and treating chemical exposure.

The institute's research efforts are supported by a substantial contract program as well as by collaboration with other USAMRDC institutes, other government laboratories, universities, and allied countries.



Standardizing methods for analysis of drug metabolites.

The USAMRICD employs scientists from a variety of disciplines, such as human and veterinary medicine, biology, physiology, psychology, pharmacology, and biochemistry. The scientists are assisted by technicians, aides, and secretaries, as well as administrative personnel.

Medical Research Institute of Infectious Diseases

The U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) serves as a research and reference laboratory for the Department of Defense. The broad mission of the institute is the development of strategies, products, information, procedures, and training for medical defense against agents of biological origin and naturally occurring infectious diseases of military importance that require special containment. The in-house research program is complemented by a large extramural program which, in terms of funding, is approximately two and a half times the size of the in-house program. Most current contracts are with universities and research institutions.

The research program at USAMRIID is conducted in two buildings totaling approximately 300,000 square feet of floor space. The main building contains 23 laboratory suites. Facilities for studying aerosol-induced infections in experimental animals are used extensively to evaluate new vaccine and drug products.

The institute contains a 20-bed general medical ward and a 16-bed research ward which can be isolated into a self-contained environment for volunteer studies. Within this complex, a special patient containment area is available to safely house, diagnose, and treat patients who may have been accidentally exposed to infectious agents within the laboratory or may have acquired the disease naturally by exposure in an endemic area.

The institute has a total staff of approximately 500 people. Medical doctors, veterinarians, microbiologists, pathologists, chemists, molecular biologists, physiologists, and pharmacologists comprise a professional scientific staff of over 100.

The objective of the research program is the development of systems to medically protect military personnel against biological attack. The systems include drugs, vaccines, diagnostic capabilities, and various medical management procedures to eliminate or minimize the effects of the attack and preserve fighting strength. Many of the potential biological agents are also natural disease threats which impair the deployment of forces into an endemic area.

When developing strategies that can be used to counter a biological threat, it is necessary to identify opportunities for intervention relative to exposure to the agent and the onset of illness. Emphasis is placed on the pre-exposure period. Providing protection in the form of immunization prior to exposure also overcomes a large logistics problem in that the supply of drugs, anistera, antitoxins, and other supportive supplies and equipment that would otherwise have to be carried to the field to treat affected personnel is minimized. In addition to immunization, other forms of prophylaxes, such as chemoprophylaxis, may be used in the pre-exposure period. In the case of certain toxins, it may be impossible to apply any type of protection prior to exposure. If exposure occurs and the individual has not been protected, rapid diagnosis becomes the key factor and is essential for proper treatment and medical management.

In general, active immunization with vaccines is still considered the ideal method of disease prevention and has been the most effective method used to control infectious diseases caused by conventional agents. Since it may be impossible, however, to develop vaccines against all potential agents, an antiviral drug development program was begun four years ago to provide broad-spectrum protection. This effort is being expanded significantly to exploit R&D initiatives. In addition to antiviral drugs, research on interferon and immunopotentiators is being pursued.

USAMRIID serves as a reference laboratory for medical defense against agents of biological origin and high-hazard, infectious diseases. The laboratory is frequently called upon to consult on outbreaks of disease where high-hazard, infectious agents are suspected.

Research Institute of Environmental Medicine

An important function of the U.S. Army Research Institute of Environmental Medicine (USARIEM) is to advise military commands of human physiological responses which could limit military operations or pose a threat to the soldiers' physical well being and develop strategies designed to protect the soldier and enhance performance. Established in 1961, USARIEM is located on the grounds of the U.S. Army Natick Research, Development and Engineering Center, 17 miles west of Boston, MA, and is housed in a three-story structure of 76,000 square feet; one of the most advanced and sophisticated research buildings in the world devoted entirely to problems of military environmental medicine. The mission of USARIEM is to conduct research on the effects of temperature, altitude, work, and nutrition on the health and performance of the individual soldier or combat crews operating Army systems.

Major research areas include military performance, human adaptations to climate and related stresses, the biophysics of clothing and the pathophysiology of environmentally-induced diseases such as cold injury, acute mountain sickness and heat stroke. These have produced a profile of past, current, and future research that ranges from the most basic to the most applied studies in the field. Current research includes the use of laboratory animals and human volunteers exposed to heat, cold or altitude.

USARIEM also conducts research on the biomedical processes limiting physical performance to determine physical fitness requirements and seek solutions to medical problems related to physical fitness training. Another important responsibility is to develop the technology base required to evaluate feeding strategies for operational rations and supplements to minimize performance decrements under sustained combat conditions.

USARIEM has a staff of 157 personnel including 32 scientists at the doctoral level and another 17 with master's degrees representing the disciplines of physiology, biochemistry, pharmacology, psychology, physical anthropology, medicine, physics, mathematics, computer sciences and veterinary medicine.

Available to USARIEM investigators are many unique, highly specialized environmental chambers capable of supporting animal and human research in a wide variety of simulated environmental extremes. Fourteen environmental rooms are collectively capable of providing controlled temperatures ranging from minus 40 to 140 F. Two altitude chambers with an airlock can simulate altitudes up to 100,000 feet, control temperature from minus 30 to 105 F, and change humidity from 20 to 80 percent. Both can be operated 24 hours a day for an indefinite number of days in succession. The institute maintains a field facility on the summit of Pikes Peak, CO, at an altitude of 14,110 feet.

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Cold Regions Research and Engineering Lab

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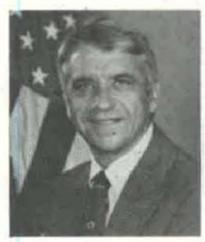

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Waterways Experiment Station

Army Corps of Engineers Laboratories

The U.S. Army Corps of Engineers conducts both military research, development, test and evaluation (RDT&E) (primarily 6.1 & 6.2) and civil works R&D and directs four laboratories: the Cold Regions Research and Engineering Laboratory, Hanover, NH; the Construction Engineering Research Laboratory, Champaign, IL; the Engineer Topographic Laboratories, Fort Belvoir, VA; and the Army Engineer Waterways Experiment Station, Vicksburg, MS.

In addition to conducting research in the laboratories, the Corps of Engineers is also the Department of the Army director monitor for environmental research. This includes both the Environmental Sciences Program, conducted by the Army Materiel Command's (AMC) Atmospheric Sciences Laboratory, and the Environmental Quality Program, conducted by AMC's Toxic and Hazardous Materials Agency and the surgeon general's Medical Bioengineering R&D Laboratory.

All Corps laboratories conduct both civil works and military RDT&E. The Directorate of R&D for the Corps is responsible for an R&D program of more than $250 million that includes both civil works and military RDT&E as well as reimbursable work.

Reimbursable work includes advanced systems development for AMC, the Defense Mapping Agency, the Defense Nuclear Agency, and the other services, where customers come to the laboratories to have specific R&D performed. Because of the variety of R&D (RDT&E, civil works and reimbursable), a synergism results that benefits all programs. More than 2,300 personnel are employed in the four Corps laboratories.

Cold Regions Research and Engineering Laboratory

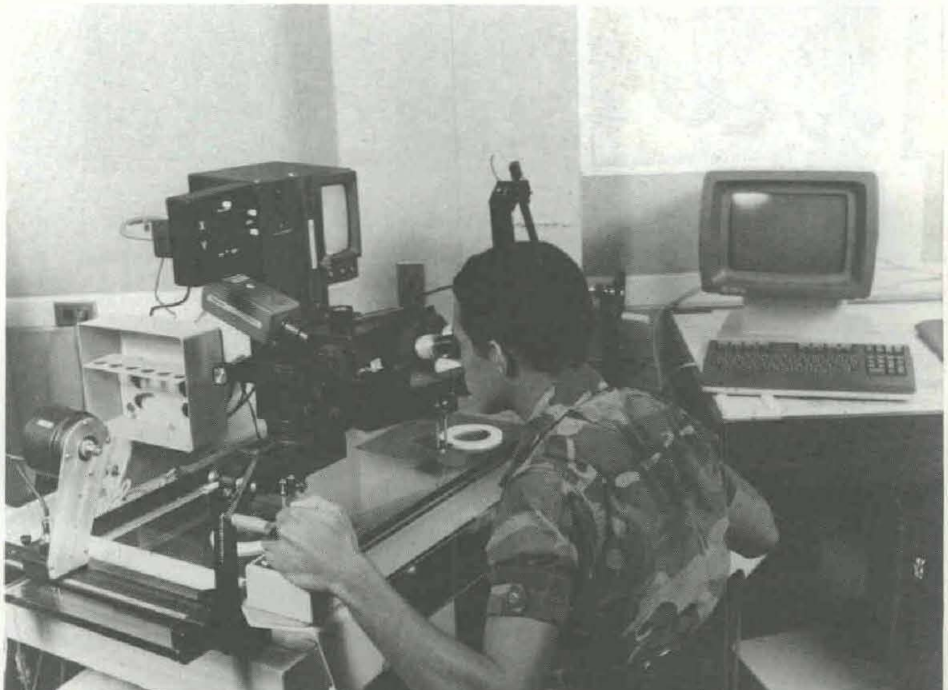
The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), in Hanover, NH, was created in January 1961. It merged the Snow, Ice and Permafrost Research Establishment (created in 1949) and the Arctic Construction and Frost Effects Laboratory (created in 1953), both of which were outgrowths of the Army's World War II experience in Alaska, Iceland and Greenland.

The laboratory's mission is to conduct and coordinate research and technology applicable to the Army's needs in those geographic areas of the world where cold presents a problem.

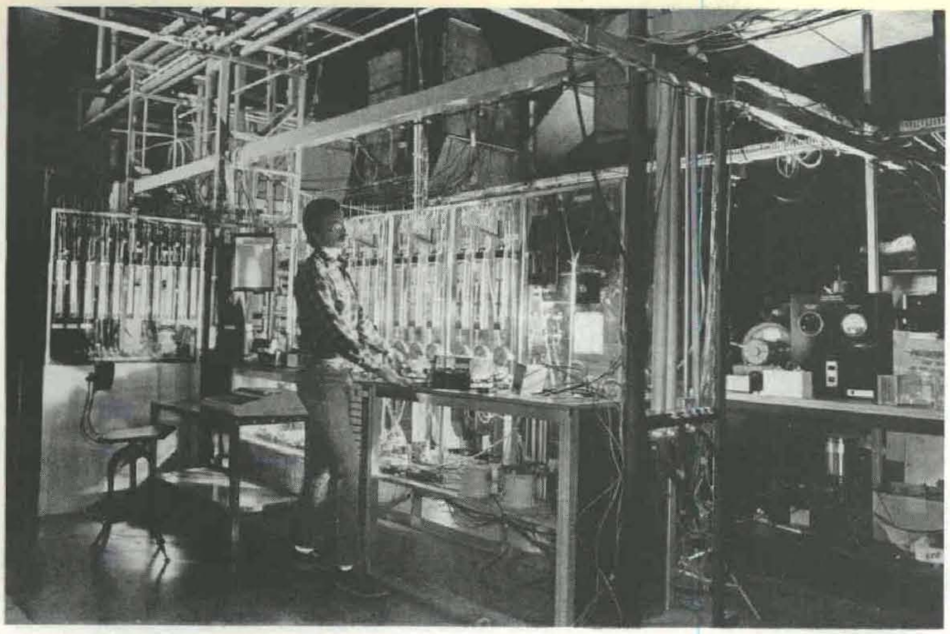
The total authorized strength of CRREL is 296 (278 civilian and 18 military), with a budget for FY86 of $26.5 million. CRREL has six main buildings in Hanover (which total 284,000 square feet on 31 acres of land), including the main laboratory, the Ice Engineering Facility, a logistics and supply building, a plant and equipment building, an equipment storage building and the Frost Effects Research Facility.

CRREL maintains a presence in Alaska at facilities located at Fort Wainwright in Fairbanks. Applied cold regions research, appropriate to the Alaska location, is carried out by CRREL researchers. Facilities available include six buildings (totaling 30,000 square feet) and a permafrost tunnel (a 360-foot shaft drilled into permanently frozen ground).

CRREL's basic and applied research covers a broad spectrum of cold regions studies. Basic research includes work in the physical, mechanical and chemical properties of snow and other forms of frozen precipitation, freshwater ice, sea ice and frozen ground. Basic research supports applied research in the major cold regions mission areas of fire support, combat support, combat service support, base support, flood control and navigation, surveying and remote sensing, civil works environmental quality and civil works con-



A light table mensuration system for extracting feature data is part of the Terrain Analysis Work Station at the Engineer Topographic Labs.


CERL heating, ventilating, and air conditioning test facility. (Photo by News-Gazette, Champaign, IL)

struction, and operation and maintenance. Major civil works cold regions research topics include ice engineering, river ice management, cold regions hydrology, remote sensing, and environmental impact.

As the only federal laboratory dedicated to cold regions research, CRREL has an international reputation and maintains close ties with the international research community and with federal and state agencies for which it provides consulting services on a reimbursable basis. As the center of cold regions scientific and engineering expertise for the Corps of Engineers, CRREL supports Corps districts and divisions by publishing field engineering reports, conducting demonstrations, sponsoring technical seminars for field engineers, and by making field visits to consult on engineering problems.

Construction Engineering Research Laboratory

The U.S. Army Construction Engineering Research Laboratory (CERL) in Champaign, IL, was organized by the Corps of Engineers in 1968 to consolidate Army research efforts in areas relevant to construction of buildings and structures. The laboratory's mission is to provide research and development to support Army programs in facility construction, operations and maintenance in the United States and overseas by achieving better quality vertical construction with attendant environmental safeguards at the least cost in time, money, and resources.

CERL's mission can be translated into several thrust areas: construction support for the Army in the field; enhanced construction management; reduction of the environmental impact of military construction and operation; better construction, operations and maintenance for the dollar; and improved quality of life for the soldier and his family.

In addition to direct support to the Corps of Engineers and the Army, CERL provides a variety of mission-related services on request to the Air Force, Navy, and other federal agencies. An increasing amount of contact is being made with other federal, state, and local agencies in areas of common interest.

The laboratory employs over 200 full-time personnel (including seven military officers) and another 250 contract personnel from the university community—principally from the University of Illinois at Urbana-Champaign. The permanent professional staff includes 34 employees with doctorate degrees, 79 with master's degrees, and 62 with bachelor's degrees.

CERL had an operating budget of $37 million for FY85. Funding is distributed among four research divisions: Energy Systems Division, Engineering and Materials Division, Environmental Division, and Facility Systems Division.

The Energy Systems Division is responsible for research in energy systems with emphasis on development of tools, techniques, and criteria for energy conservation, energy management, and use of alternative energy sources.

The Engineering and Materials Division conducts research and development studies to advance military technology in the fields of metallic and non-metallic materials, science, and synthesis for the improvement of the design, construction, maintenance, and repair of military and civil works facilities.

The Environmental Division is responsible for research in environmental quality technology to support the Army's training, readiness and mobilization missions.

The Facilities Systems Division is responsible for research and investigations related to management engineering for the planning, design, construction, operation and maintenance of military and civil works facilities, and to methods for enhancing the livability of military installations.

Engineer Topographic Laboratories

The U.S. Army Engineer Topographic Laboratories (ETL), at Fort Belvoir, VA, is a field operating activity of the U.S. Army Corps of Engineers that performs research and development in the topographic sciences and prepares terrain analysis for the military community.

With a staff of 327 civilian and military personnel and a total FY86 budget of $78 million, ETL directs it primary efforts toward improving the combat capabilities of U.S. forces. Researchers at the laboratory are working on techniques and equipment to provide commanders in the field the fast, accurate topographic support they need.

Designed by ETL to put the speed and flexibility of automation to work for the terrain analyst, the Digital Topographic Support System (DTSS) is scheduled for fielding by the end of the decade. The DTSS will give Army terrain teams the ability to manipulate digital terrain information, generate tactical terrain graphics, and replace the manual methods currently used in the field to store, process and analyze terrain data.

Another major effort at ETL is the development of the Terrain Analyst Work Station (TAWS), which allows analysts to produce, update. revise and manipulate digital terrain data bases. TAWS has been demonstrated in the field, initially for the 1st Armored Division, Ansbach, Germany, and more recently at Fort Bragg, NC. Soldiers were taught how to use the equipment, and successfully produced numerous terrain products.

Combat commanders need to get color copies of special maps and related products fast, and ETL's Quick Response

Multicolor Printer will provide this capability. A laser scan of the original copy achieves the color fidelity and high resolution needed for topographic products. The printer will be mounted in a van or similar shelter, and will be capable of producing up to 75 multicolor copies per hour, overprinting new information onto existing maps and copying transparent overlays.

To help commanders and their staffs identify the conditions they will face on the battlefield and predict how these conditions will affect military equipment, personnel and operations, ETL has developed the Battlefield Environmental Effects Software. Among the software programs is the Environmental Critical Values Checklist, which shows the effects of climate, weather and terrain conditions in 11 different subject categories, such as aviation, vehicles, weapons and personnel.

ETL plays a key role in the Autonomous Land Vehicle project, an effort to make a vehicle "smart" enough to guide itself over a planned route. The Autonomous Land Vehicle is part of the Defense Advanced Research Projects Agency's Strategic Computing Program. ETL also performs in-house research involving route planning, land navigation and computer vision.

When completed, the vehicle technology can be adapted in design to produce autonomous fighting vehicles, cargo and ammunition carriers, and reconnaissance vehicles. Letting an unmanned vehicle take the risks in some hazardous duties will save soldiers' lives on future battlefields.

Engineer Waterways Experiment Station

The U.S. Army Engineer Waterways Experiment Station (WES) in Vicksburg, MS, is the largest R&D facility of the U.S. Army Corps of Engineers. Through a complex of five technical laboratories—the Hydraulics, Geotechnical, Structures, and Environmental Laboratories, and the Coastal Engineering Research Center—WES supports the military and civil missions of the Corps of Engineers, the Army, other federal agencies, the nation, and America's allies.

WES performs research and development in systems, equipment, procedures, and techniques relevant to engineer support of combat and other military operations and material development to meet Army requirements. WES also conducts civil works investigations and research studies required for water resources development to protect and preserve U.S. navigable waters and related resources.

WES physical model of the Trident submarine base at Kings Bay, GA.

The WES Hydraulics Laboratory is the world's largest and best-equipped facility for research and practical application of experimental hydraulics. It conducts wide-ranging studies of fluid in motion through the use of mathematical and physical scale models of rivers, harbors, beaches, estuaries, and various man-made structures.

The WES Geotechnical Laboratory conducts research in soil mechanics, structural foundation design, embankment design, slope stability, earthquake engineering, engineering geophysics, seepage analysis, military pavements, mobility and trafficability, rock mechanics, engineering geology, and expedient surfacing and dust control. The laboratory is a center of expertise in vehicle mobility for the Army and the Department of Defense.

The WES Structures Laboratory investigates the response of structures to the effects of statically and dynamically induced loads. Emphasis is on ways to make structures and construction materials such as concrete stronger, more durable, and more economical. Research also concerns forces created by loading from nuclear and chemical explosions and earthquakes. The laboratory's Blast Load Generator is the largest such facility in the world for simulating nuclear and conventional blast pressures on model structures.

The WES Environmental Laboratory investigates the effects of man's activities on the environment as well as the effects of the environment on military activities. Research includes water and land resource management, wastewater management, hazardous waste disposal, coastal ecology, aquatic plant control, water quality, dredging effects, remote sensing, mine/countermine, military hydrology, camouflage, perimeter security, water supply, and battlefield environmental effects.

The WES Coastal Engineering Research Center (CERC) is the nation's foremost research and development laboratory for coastal engineering. it was relocated to WES from Fort Belvoir, VA, in 1983. CERC performs research on waves, winds, water levels, tides, currents, and resultant coastal processes. Investigations are concerned with shore and beach erosion control, coastal flood and storm protection, harbor entrances and coastal channels, coastal structures, sand bypassing, coastal dredging, navigation improvement, and harbor design and maintenance. CERC maintains a research facility with a 1,840-foot-long pier at Duck, NC, which is the only facility of its type in the United States.

WES covers approximately 700 acres, employs more than 1,600 personnel (including over 650 engineers and scientists), and has a total FY86 budget of $130 million. Many of these engineers and scientists have international reputations in their respective fields. The facilities, equipment, and personnel at WES make it one of the best equipped research facilities in the world.

Army Research Institute

The Army Research Institute for the Behavioral and Social Sciences (ARI) is the Army's principal laboratory for soldier-oriented research. A field operating agency responsible to the Army deputy chief of staff for personnel, the institute consists of four operating elements: three laboratories—the Manpower and Personnel Research Laboratory (MPRL), the Systems Research Laboratory (SRL), and the Training Research Laboratory (TRL), and an Office of Basic Research.

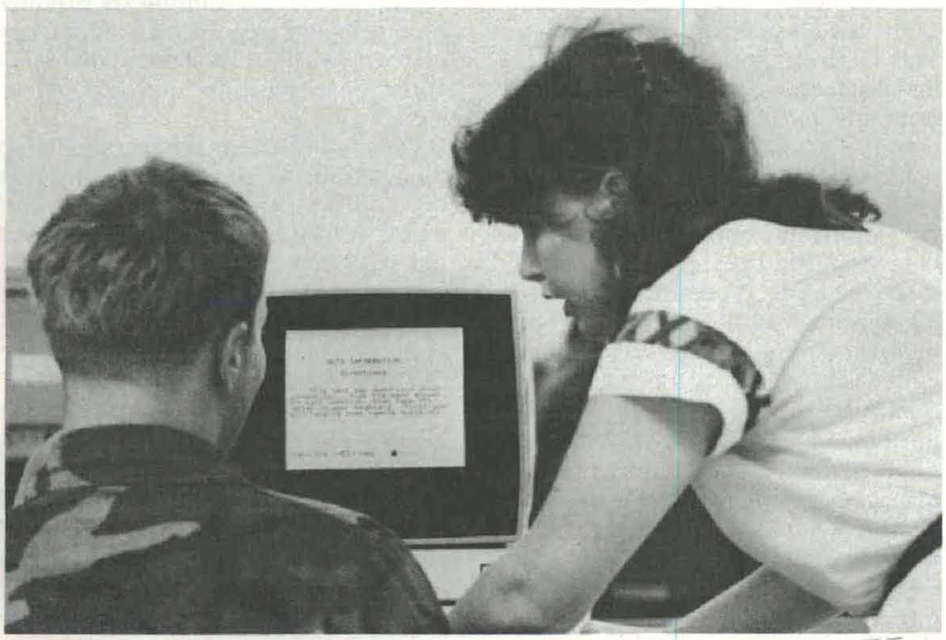
Composed of over 200 research psychologists as well as numerous sociologists, economists, statisticians, and a skilled support staff, ARI has the mission of maximizing combat effectiveness through research on the acquisition, development, training, and utilization of soldiers in military systems.

MPRL investigates methods of recruitment, selection, classification, assignment, and retention of Army personnel. It also examines leadership issues, organizational structure and management, and the dynamics of unit cohesion. SRL conducts research on human factors in equipment design to obtain optimum performance from new systems entering the Army inventory. Researchers apply psychological concepts of human perception and cognition to the design of computerized systems and procedures. TRL draws upon theories of learning, motivation, cognition, measurement, and evaluation to formulate research on Army training methods and practices. It also conducts research on basic soldiering skills, and individual and unit training.

The Office of Basic Research supports the development of scientific advances in ability assessment, instructional technology, cognitive processing, and intelligent systems. It capitalizes on new research and emerging technologies by involving innovative civilian scientists in projects of potential use to the Army.

At ARI, the focus is on the soldier. Major accomplishments include the Multiple Integrated Laser Engagement System, developed in cooperation with the Army Training and Doctrine Command (TRADOC) and the Army Materiel Command; reverse engineering of selected weapon systems, which led to Manpower and Personnel Integration (MANPRINT); and recruiting research that provides military leaders with valuable information needed to achieve an Army comprised of quality soldiers. Research results and products range from the Armed Services Vocational Aptitude Battery to the Realistic Air Defense Engagement System.

Other recent ARI research products encompass human factors evaluations in user testing of several Army systems, including prototype armored maintenance vehicles, quiet reliable generators, multiple subscriber equipment for voice and data communications, and the M9 Armored Combat Earthmover; the Multipurpose Arcade Combat Simulator for infantry weapons training, which has so far been developed for the M16A1 rifle, MK19 40mm automatic grenade launcher, M72A2 Light Anti-Tank Weapon, and M203 grenade launcher; a combat vehicle identification training program, including use of thermal imagery equipment; a transitional performance aid for equipment records and parts specialists (MOS 76C); and improved ammunition storage and reload systems for the Bradley Infantry Fighting Vehicle, based on human factors evaluations of the original equipment.



Psychologist administers computerized version of Armed Services Vocational Aptitude Battery.

The institute's headquarters is in Alexandria, VA. Specific projects are assigned to technical areas at the headquarters and to eight field units at Fort Benning, Fort Rucker, Fort Knox, Fort Leavenworth, Fort Hood, Fort Bliss, Presidio of Monterey in California, and in Orlando, FL. Seven scientific coordination offices act as two-way channels for research ideas and efforts and perform liaison activities for management groups in the field and the laboratories. They are located at the Operational Test and Evaluation Agency, the Aviation Systems Command, and U.S. Army Europe. The Office of Basic Research oversees a scientific coordination office in London where ARI encourages the participation of outstanding foreign scientists and institutions.

ARI researchers also conduct joint projects and exchanges of information with their counterparts in other countries through such organizations as the NATO Defense Research Group and the Technical Cooperation Program. The latter includes scientists from Australia, Canada, the United Kingdom and New Zealand.

ARI exists solely to meet the needs of the Army. Its greatest strength is its scientific and support staff which is committed to excellence in research, relevance in products, and effectiveness through implementation. Topical emphasis and specific research projects within each area vary from year to year as Army needs change.

Centralized Product Manager Selection

By COL(P) William S. Chen

Background

Since 1974, colonel-level project managers have been selected by a Department of Army centralized selection board. Over the years, the Army has recognized the important role of project managers.

While the Army has had lieutenant colonel and even colonel product managers, their roles have been less recognized. Like project managers, product managers are delegated authority and assigned responsibility for the centralized management of a development/acquisition program. The differences between positions lies in the magnitude, scope, dollar value, and relative importance of the program.

Hitherto, the selection of product managers has been by a U.S. Army Military Personnel Center (MILPERCEN) Board.

Approved by the Army chief of staff on July 8, 1985, a Department of Army selection board convened in March 1986 for the first centralized selection of product managers. With results announced simultaneously with the Lieutenant Colonel Command Selection Board, the centralized selection of product managers recognizes the importance of product management and has major implications for the professional development of officers in the Materiel Acquisition Management (MAM) field. What portends for the future is the opportunity afforded successful product managers—recognition and a clear path to colonel-level project management. This relationship is precisely the same as the accepted standard that successful battalion command can lead to brigade command selection.

Selection Board Process

Having served as president of the FY86-87 Product Manager Selection Board, I would like to discuss the board process and share some observations based upon that experience. Given the significance attributed to product management, I would also like to discuss some implications to the MAM Program and the need to develop a skilled population of officers from which the Army can select its future product managers.

The mission of the Product Manager Selection Board was to select those officers best qualified to serve in designated product manager positions at the grade of lieutenant colonel. The letter of instruction (LOI) signed by the secretary of the Army described product management as "... having the same relationship to the materiel acquisition process as command has to military operations. Both require the skillful integration of scarce resources to achieve an important objective."

The LOI procedural guidelines were to determine first those considered "fully qualified" and then those considered "best qualified" for selection in the six product management categories—aviation, armament/munitions, communications-electronics/automatic data processing, missile/air defense artillery, tank-automotive and other (general). The board was asked to select a principal and four alternates for each position being considered, unless otherwise limited by the number of qualified officers. The board was also asked to select best qualified alternates for any subsequent unprogrammed product manager vacancies. No more than 10 percent of the product vacancies could be filled by promotable majors from the most recent promotion list. This is similar to restrictions on command selection. No promotable majors from the most recent promotion list could be selected as alternates.

Our board consisted of three serving project managers, a director of combat developments from a Training and Doctrine Command center and school, and three officers representing overseas major commands. One of the board members from overseas was a colonel-commander. Two of the board members were from non-white racial minorities. All board members were MAM certified and graduates of the Program Management Course, Defense Systems Management College. The combined board membership had knowledge and experience in aviation, armament/munitions, communications-electronics/automatic data processing, and missile/air defense artillery. This expertise proved invaluable as the evaluation process evolved from initial selection efforts independent of functional orientation to final selection of the best qualified officers.

The officers considered by the board were lieutenant colonels or promotable majors who were members of the MAM Program and assigned Additional Skill Identifier 6T. This population consisted of 765 officers. Approximately half of this population was MAM certified by prior MILPERCEN boards using criteria which included strong MAM experience and graduation from the Program Management Course at the Defense Systems Management College.

The board viewed certified officers to be fully qualified and proceeded to "hard vote" the MAM certified officers. However, the board recognized the need to thoroughly review the non-certified officers. For the most part, board members confirmed that non-certified officers were not as qualified as certified officers. Where board members determined that non-certified officers were indeed fully qualified those non-certified officers received hard votes.

The procedures used by the board in voting files were basically the same as used in command selection boards, except that each fully qualified officer was scored or evaluated in the six product management categories. The board operated as one panel and board members voted one each fully qualified officer file.

Once all board members completed their scoring, an order of merit list was developed for each category. Each category's order of merit list then formed the basis for further selection of the best qualified officers.

Early on, the board members recognized the need to better understand the product manager positions to be filled. In fact, the board requested from the materiel developer additional information on the status of programs; specifically, whether the programs were in development or in production and fielding. This information was essential to better identify the suitability of individuals against the positions to be filled.

This particular board was asked to select 26 officers as principals for established product manager positions. The number of positions by category were: aviation (six), armament/munitions (two), communications-electronics/automatic data processing (13), missile/air defense artillery (two), tank-automotive (one), and other (two). The other (general) category included the positions of product manager, amphibians/watercrafts and physical security equipment. Board member expertise was particularly helpful in understanding the nature of the positions to be filled and determining the best qualified individual officers from each category's order of merit list. Officers selected as a principal for a given position were not designated for any other position. Alternates were allowed to be designated for more than one product, but the board provided an additional alternate candidate for each duplicate if qualified alternates were available. Best qualified alternates for unprogrammed product manager vacancies were also selected by category and by order of merit.

Personal Observations

Having gone through the experience of this first Product Manager Selection Board, I would like to provide some of my personal views and observations.

• The complexity of the selection process was probably underestimated. In contrast to promotion, school, or command selection boards, where there is emphasis on "yes-no" and order of merit categorizations, the product manager selection required an order of merit evaluation in six categories and then a placement into specific positions as principals and alternates. Initially, the board was scheduled to complete its selection in four days, but an additional working day was added. The board members perceived that the results of this first Product Manager Selection Board would be closely scrutinized by the materiel acquisition community; therefore, there was a conscious decision to make deliberate and careful selections.

• MAM certification turned out to be a significant determinant for fully qualified. MILPERCEN MAM certification boards should continue to use high standards for certification and challenge the retention of 6T officers who fail to get certified after repeated consideration by MAM certification boards.

• There was a good population of officers in readily identifiable categories such as aviation, munitions, communications-electronics/automatic data processing, air defense missiles, and tank-automotive. The materiel developer commands have major subordinate commands or agencies aligned to those categories or related areas. At those commands there are also project management offices such as Apache, Single Channel Ground and Airborne Radio Subsystem, Patriot, Tank Systems, and Tactical Management Information Systems, where majors and lieutenant colonels can gain valuable program management experience. There is also a specific branch identification in air defense artillery so that an officer's qualifications can be identified with the category of missile/air defense.

• There were very small populations of officers with armament acquisition experience and surface-to-surface missile experience. I believe that this is due to the sparse number of major armament weapons system acquisition programs and armament project management offices. Thus, the base from which officers could gain program management office experience is limited. There is also no specialty code for armament per se; the board had to search hard for officers with armament-related acquisition background and experience. The difficulty in finding qualified surface-to-surface missile officers is probably directly related to the small number of field artillery missile officers in the MAM Program and the inability to determine whether specialty code 73 missile materiel management officers are more oriented toward surface-to-surface or surface-to-air missile systems.

• There was even a smaller available population of officers with experience in amphibians/watercrafts and physical security equipment. It was only through a detailed review of Officer Efficiency Report job descriptions and rater narratives that board members were able to single out individuals with related experiences.

• The board's ability to select the best qualified officers was significantly facilitated by the board members' knowledge of the positions to be filled. This was particularly true for selected aviation positions having special technology applications and selected communications-electronics/automatic data processing positions having unique hardware and software applications.

• For officers with logistics specialty codes such as 91 (maintenance management), 92 (materiel services management), and 97 (contract and industrial management), it was difficult to identify which commodity categories the officers were best qualified. This was due in part to the general nature of their duties. Nevertheless, board members were able to better evaluate officers when commodity category expertise was either well identified in Officer Efficiency Report job descriptions or readily apparent by association to the officer's assignment history reflected in an Officer Record Brief.

Implications

Based upon the above, several implications exist for the MAM Program and for individual officers aspiring to be product managers.

• The MAM Program must be able to identify the number of MAM officers by commodity category. I am not aware of the method whereby MAM officers are identified by commodity category. Current Officer Personnel Management System specialties align with most of the commodity categories, except for armament and tank-automotive. Since there are product manager as well as project manager positions in the armament and tank-automotive categories, it is essential to be able to identify MAM officers qualified in those categories. Without such a capability, neither MILPERCEN nor MAM program managers will know whether the available MAM population will provide a sufficient pool of officers to meet the position requirements. I recommend that the MAM Certification Board perform the function of certifying officers by commodity category.

• Next, having identified MAM officers by commodity category, the MAM Program development process must ensure that there is a professional development and training program to qualify officers in each of the commodity categories. Here, the materiel developers must play a major role in identifying those MAM developmental positions by category. By so doing we can assess whether there is a sufficient base to provide professional growth opportunities by category. A major challenge will be to identify sufficient MAM developmental positions in project management offices so that captains and majors can acquire hands-on project office experience preparatory to duty as a product manager. Just as recent troop duty at battalion level is important prior to battalion command, recent project management office experience is important prior to being a product manager.

• Individual officers can contribute to their professional development by recognizing the need to be identified and qualified in at least one commodity category. MAM officers must ask themselves if their assignments as reflected in their Officer Record Brief readily identify them as having expertise in a given commodity area. MAM officers should strive to be qualified and identified in established commodity areas.

• Raters and senior raters have the opportunity to help by ensuring that job descriptions are accurate. Where appropriate, job descriptions could single out commodity orientation. Raters and senior raters can also use their evaluation blocks on Officer Efficiency Reports to comment on the demonstrated potential to serve as product managers in specific commodity categories.

• Materiel developers who have product manager positions must be extremely careful in writing the job descriptions and specifying the specialty codes for the positions. Boards will make selections based upon cited qualifications. Commands should be realistic in designating the required and/or desired specialty codes. Parochial perspectives on specialty codes should be avoided to preclude exclusion of otherwise best qualified officers.

Summary

I hope my reflections on the board proceedings and discussion of implications for the MAM Program provide insights for improvement of the selection system and enhancement of the MAM professional development program. Some of my comments apply equally well to the target population of MAM officers striving to become colonel-level project managers.

I believe that the centralized product manager selection process will result in the selection of high quality officers for product management and further enhance the stature of the MAM program. Our successful product managers will provide a strong base from which to select future colonel project managers.

COL(P) WILLIAM S. CHEN is the PM, Division Air Defense Gun system (SGT York). He is a graduate of the Air Command and Staff College, Defense Systems Management College and Industrial College of the Armed Forces.

HDL Tests New Mortar Fuze

A prototype mortar fuze under development by Harry Diamond Laboratories (HDL) has demonstrated a high degree of timing accuracy during firing tests. The new fuze could dramatically enhance the Army's mortar capability.

Thirty 60mm, 81mm, and 120mm mortar rounds were fired over the Potomac River earlier this year from the Naval Surface Weapons Center's test firing range.

The rounds were fitted with prototypes of a new digital electronic time fuze currently under development at HDL. The fuzes were set to burst the mortar rounds in the air at predetermined times, varying from 8.1 seconds to 32.8 seconds. All rounds but one burst within 60 milliseconds of their preset times, according to HDL officials.

Mortars are used in close battles to destroy targets and to illuminate or obscure the battlefield. The digital electronic time fuze allows the soldier the option to decide, to the nearest 10th of a second, precisely when the mortar will detonate. Representatives from various Army agencies—all with a vested interest in mortars—were invited to observe the test firings.

"The thing that impressed me was the accuracy of the timing," said Max Cogar, an equipment specialist with the U.S. Army Infantry School at Fort Benning, GA. "We fire mortars in support of the infantry. This fuze gives us more accurate steel on target and also more burn time for illuminating the field. The school supports development of the fuze."

The consistency of the fuze is what impressed Susan M. Wienand, a project engineer with the Office of the Project Manager, Smoke and Obscurants at Aberdeen Proving Ground, MD. "Seeing fuzes being fired is a lot better than looking at drawings or photos," she said. "It was good to see they were so consistent. We can definitely use the fuze in our mortar cartridges. It's an advance for the soldier."

Mechanical engineer Bob Epstein said the fuze has "definite potential" for the 120mm smoke round he is responsible for at the U.S. Army Chemical Research, Development, and Engineering Center at Aberdeen Proving Ground, MD. "Smoke rounds are used in both offensive and defensive modes," he said. "They disrupt the command and control of the enemy, and they shield your maneuvers and prevent the enemy from locking onto you as a target. The electronic time fuze has superior accuracy compared with the mechanical or pyrotechnic time fuzes we now use, and could replace those fuzes on the 4.2-inch bulk white phosphorous round."

According to HDL Mortar Fuze Project Officer Dr. Carl Campagnuolo, the digital electronic time fuze is part of a three-fuze family under development at HDL. The trio could replace some 25 fuzes now in the Army inventory while satisfying all 60mm, 81mm, 120mm, and 4.2-inch mortar applications. The other two family members are the M734 multi-option fuze and the XM745 point-detonating/practice fuze.

Because all three fuzes share a high commonality of parts, including safing and arming devices that satisfy the latest Army safety standards, unit product costs will be relatively low, Campagnuolo said.

The digital electronic time fuze is an M734 multi-option fuze in which the electronic front end has been replaced by a crystal-controlled digital clock with three miniature thumb-wheel decade switches for setting burst times in tenths of seconds. Since the switches make an audible click as they are advanced, soldiers can hand-set them in the dark, if need be.

The prototypes fired in the test were fabricated by the Eastman Kodak Co. of Rochester, NY. HDL officials propose using them as "the starting point for a low-risk, short-schedule engineering development of a precision electronic time fuze for mortars," they said.

Proactive Test, Measurement, and Diagnostic Equipment Support

By COL William P. Farmer

If you knew you were going to need an item four years from now, would you wait four years to buy it retail if you could get it wholesale or free by ordering it early? Test and calibration equipment is among those centrally managed items most frequently overlooked when orders are placed. The article which follows introduces a new service to materiel developers based on lessons learned in one functional area of the materiel acquisition life cycle spectrum. Its purpose is to serve those who go through this life cycle only once.

Introduction

The increasing complexity of the Army's systems has caused materiel developers to look more at the development of Built-in-Test/Built-in-Test Equipment (BIT/BITE) to test and maintain their systems. In fact, the Army encourages the use of BIT/BITE to alleviate the need for external Test, Measurement, and Diagnostic Equipment (TMDE). However, in most cases it is not cost effective or technically feasible to depend solely on BIT/BITE. Use of Automatic Test Equipment (ATE), general purpose test equipment, or system peculiar equipment is still required to detect and isolate malfunctions in failed components. Therefore, it is absolutely essential that test equipment be defined, developed, procured, tested, and deployed concurrently with Army weapon systems and end items.

TMDE, as defined in AR 750-43, April 1, 1984, includes any device used to evaluate the operating condition of a system, or equipment used to identify or isolate any actual or potential malfunction. It includes diagnostic and prognostic equipment and calibration test/measurement equipment.

The total cost of test equipment requested by Army materiel developers in FY85 exceeded $349 million. This figure does not include the cost of equipment used in research and development. With these included, total estimated cost exceeds one half billion dollars. These costs and the logistic indispensability of test equipment make the organized systematic approach to the acquisition and management of it a subject that cannot be over emphasized.

In response to the critical need for responsiveness in diagnostic equipment management, the U.S. Army Central TMDE Activity (USACTA), Lexington, KY, has developed a new approach to providing support to materiel developers. The purpose of this proactive TMDE support (PTS) methodology is to assist in the identification and documentation of system testing requirements and provide expert assistance in selecting technically suitable, supportable, and cost effective equipment to satisfy those requirements. The specific phases of the methodology will be addressed later following a brief discussion of some of the events leading to its creation.

Background

One of USACTA's primary missions is to provide continuous support to Army developmental systems. This includes assistance in recommending test equipment (Army preferred or TMDE modernization items) through our participation in activities such as integrated logistic support (ILS) meetings, Logistic Support Analysis Record (LSAR) reviews, ILS document reviews, special study efforts, and system assessments. One of the key tools we use to provide this support is the Army TMDE Preferred Items List (PIL).

This list is a catalog of preferred Army items which are supportable in terms of calibration, procedures and equipment, technical manuals, and repair parts. The list also serves as an acquisition guideline to minimize duplication, proliferation, and introduction of non-standard equipment into the Army inventory. Other lists of desirable Army items include a PIL candidate list and an ATE priority list. These lists also include Army TMDE Modernization (TEMOD) items. These items are state-of-the-art electronic test equipment to replace fielded general purpose items which are obsolete or unsupportable.

One of the recurring deficiencies USACTA found (unrelated to PIL usage), was the frequent inconsistency of ILS documentation of test equipment requirements. For example, a test set identified as required in a Maintenance Allocation Chart might not be identified in a Materiel Fielding Plan or a Basis of Issue Plan. Other critical deficiencies were that Army preferred and modernization items were not being adequately considered by contractors of developing systems, and calibration requirements and interchange data were not being identified early enough.

Another important mission of USACTA is to provide acquisition approval for test equipment and to manage the Department of the Army TMDE Register. The register is a comprehensive list of all proposed, developmental, and fielded Army test equipment. When requesting acquisition approval, the materiel developer submits the required documentation for equipment acquisition approval and registration.

USACTA evaluates these requirements against proposed test equipment capabilities. Because of a lack of understanding by the materiel developers, data submitted have often been inaccurate, incomplete, and in conflict. This has resulted in difficulty in evaluating acquisition approval requests, and approving or recommending alternate items of test equipment. Depending on the completeness of information provided and the complexity of the testing requirements, this process could take up to one month. USACTA determined that it was reacting to incomplete data and that the turn-around time was excessive. Recognizing these shortcomings, USACTA established an objective to become more responsive in the test equipment selection and acquisition approval process and to relieve the materiel developer of most of the paperwork. To accomplish this, USACTA developed a proactive support methodology consisting of four phases.

PTS Phases

The first phase in the PTS process is to reach basic agreement with the materiel developer and explain the process to him. First, agreement is reached that any previous errors or deficiencies will not be used to direct criticism toward the materiel developer or other participants. In fact, PTS participants agree to coordinate all status reports or project summaries through the PM/developer. This no-fault approach is a keystone to full team cooperation. After reaching basic agreement to provide proactive service to the PM/developer, USACTA contacts other principle Army test equipment activities to form a PTS team. Invited participants include the U.S. Army TMDE Support Group, Huntsville, AL, the applicable commodity command/test equipment maintenance engineering representatives, and PM, TMDE, Fort Monmouth, NJ.

In the second PTS phase, USACTA identifies all of the system's known potential test equipment requirements. This involves reviewing the ILS documentation and developing two matrices (TMDE requirements vs. ILS source documents and TMDE evaluation) from the documentation.

The requirements vs. ILS source documents matrix is developed to ensure all equipment is identified and to locate any inconsistencies between ILS documents. The evaluation matrix is used as a project control document to ensure that all proactive participants are fully cognizant of all key data. It is also used to document results of our analysis.

Since the equipment item number on the source matrix is assigned to the same item on the evaluation matrix, it is easy to cross reference information between the two matrices. The evaluation matrix lists information for each item, such as make and model numbers, nomenclature, military type designator, ILS source document and technical data. Other pertinent information includes the item's Federal Code for Manufacturers, maintenance data, recommendations and comments, and calibration data.

The third phase of the PTS methodology consists of support team visits. An initial meeting is held with the project manager of the system to coordinate the two matrices, obtain additional data on proposed equipment, and plan for further actions. Other essential players are also requested to participate as support team members. The matrices are reviewed in detail by the team to resolve inconsistencies and discrepancies in the ILS documentation. In order to compile an accurate list of the system's test equipment, items are deleted from or added to the matrices as appropriate. A site visit to the contractor's facility is scheduled to finalize the equipment selection and testing requirements for the system are discused with contractors along with the team's recommendations.

In the final PTS phase, the support team completes the documentation required for acquisition approval and registration, and on site acquisition approval is provided to the materiel developer. Also, during this time calibration requirements are identified for each proposed item and DA 3758 Forms (Calibration and Repair Requirements Summary Worksheets) are completed.

Summary

To date, two applications of the PTS methodology have been completed with excellent results. Unfortunately, the two systems to which the methodology was applied were approaching their fielding dates. Had the analysis been done earlier, the data interchange requirements for diagnostic equipment could have been passed to the item manager resulting in additional savings to the government. To achieve maximum benefits of PTS methodology, it is important for PMs and materiel developers to initiate this support early in the 6.4 phase of the program. Those benefits are:

- development of a well-documented baseline for tracking the system's TMDE, correcting ILS documentation equipment inconsistencies, and resolving test equipment issues;
- reduction of test equipment required by the system by substitution of standard Army diagnostic equipment and elimination of unnecessary items;
- increased use of Army Preferred/TMDE Modernization items resulting in increased supportability;
- identification of calibration requirements;
- reduced paperwork required by materiel developers and significantly shortened acquisition request turnaround time.
- improved communication between the test equipment community, materiel developer, and contractors.

The success of this methodology in quickly resolving materiel developer's test equipment selection and acquisition has convinced us to expand this approach to other full-scale engineering developmental efforts and to develop a modified approach for systems earlier in their life cycle.

A systematic and responsive approach to the selection and acquisition of diagnostic equipment is a continuing need. This proactive team approach has demonstrated that test equipment management demands good support planning and a close dynamic working relationship among the materiel developer, test equipment community, and contractor. Any Army materiel developer interested in obtaining additional details or taking advantage of this service may contact the commander, USACTA, at AUTOVON 745-3206 or Commercial (606) 293-3206.

COL WILLIAM P. FARMER wrote this article while he was commander of USACTA prior to his retirement from the Army following 30 years of active service. He has a bachelor's degree from the U.S. Military Academy and an MS degree in mechanical engineering from Mississippi State University.

CERL Releases LCCID Computer Program

The U.S. Army Construction Engineering Research Laboratory (CERL) has released its new Life Cycle Cost in Design (LCCID) computer program. It allows the economic analysis of energy and nonenergy building features during the design process and performs life cycle cost calculations that conform to Army, Navy and Air Force design guidance. LCCID will be used primarily for the economic analysis of Military Construction Army projects.

The LCCID is distributed on two 360K floppy diskettes and will run on IBM Personal Computers and compatible equipment with 512K random access memory. LCCID is provided at no cost to military personnel. The cost to private organizations is $35. A separate memorandum of understanding will be required for users desiring a source version to ensure that their modifications will not hamper program accuracy or effectiveness.

For more information, write to the BLAST Support Office, 140 Mechanical Engineering Building, 1206 W. Green Street, Urbana, IL 61801 or call commercial (217) 333-3977.

Twelve Testing Mistakes

By William J. Haslem

The following article was initially published in the ITEA Journal of Test and Evaluation. ITEA is the International Test and Evaluation Association.

Reading a good book on a long winter evening can be one of life's simple pleasures. The book that inspired me to write this article was Mortimer J. Adler's *Ten Philosophical Mistakes* (MacMillan Publishing Co., New York, 1985). In that short book, Adler very capably expounds on 10 common mistakes that philosophers have made. As I reflected on this excellent book, I wondered if it would be possible to identify a similar list of mistakes that are commonly made by testers. Being doubtful that philosophers have a monoply on mistakes, I set out to list 10 testing mistakes. Apparently, testers make more mistakes than philosophers because I went beyond 10 to an even dozen. Not being blessed with Adler's powers of intellect or exposition, I will nonetheless attempt to identify 12 common mistakes made by testers.

Ignoring the Assumptions

Testing normally involves some sort of a sampling scheme. A sample of the test materiel is tested and the results are projected to the population. A very basic assumption underlying this process is that the sample is representative of the population. Every tester will readily accept this basic truth. Yet, in reality, few test samples are truly representative of the population, especially if the sample is of a very expensive or complex item such as a tank, aircraft or ship. Often, the sample is from a very small production run, sometimes from a different contractor than will do the later full-scale production, and the manufacture of the sample is very highly supervised and inspected.

On each developmental test, we should ask ourselves how representative the sample is of the population of systems yet to be produced. The answer can be unsettling, but the validity of the test is probably more dependent upon this basic assumption than it is upon how well the test itself is conducted.

Sample Size Errors

Related to the underlying sampling assumption is the problem of sample size. If the assumption that the sample is representative of the population is true, then determining sample size should be an easy, straightforward matter of applied statistics. If you believe that, you may as well believe that philosophers never make mistakes! Each sample size determination is itself made upon the basis of other assumptions, the main one being the distribution of the failures to be encountered. If you use an exponential sampling scheme, what evidence do you have that the underlying distribution will indeed be exponential? Are "burn-in" failures likely to distort the distribution? Would another distribution assumption make more sense for this type system?

A good statistician can usually cope well with sample size problems, and can determine the number of items needed to be tested and the duration of testing to obtain reliability estimates. But the statistician has no methodology for determining the duration of performance tests. How long should a vibration test be conducted? Or, how long should a cold chamber test be? These types of questions are much more difficult. The easy answer is, "as long as the military standard specifies." But this answer merely shifts responsibility to the military standard proponent, who probably doesn't know why the durations specified in the standards were chosen. The numbers are suspiciously round and convenient, leading one to question whether they were based on any empirical data.

How long is long enough? Should a cold storage test be 72 hours, nine weeks or 10 years? I don't know, and I'm not aware of a data base that would really allow such a determination. Yet we testers keep on running tests by specifications, standards, or traditions, without really knowing how long is long enough.

Forgetting the Hypothesis

Testing is scientific—or so it should be. What does this mean? It only means that testing is a part of the scientific method. While there is not complete agreement on just what the scientific method is, generally the part of it related to testing is shown in Figure 1. Testing, then, is a part of the scientific method in that it provides the basis for accepting or rejecting some hypothesis. The hypothesis may be implied or explicit, but it is nevertheless the basis for testing. Normally the tester does not label the hypothesis as such, but usually refers to it as a "test criterion."

The test criterion allows formulation of a hypothesis. For example, a test may allow acceptance or rejection of the hypothesis that a test vehicle is (or is not) capable of accelerating to a speed of 50 mph in 10 seconds or less. The tester

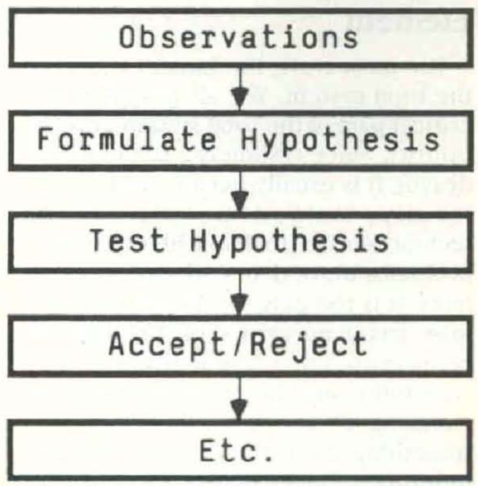


Figure 1. Scientific Testing Method

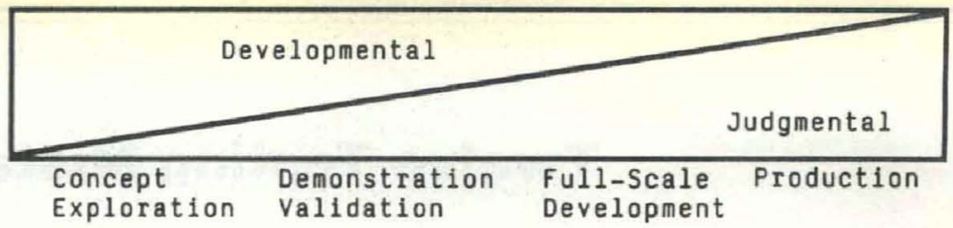


Figure 2. Tester Orientation

has a criterion, and a hypothesis, but acceptance or rejection depends on the answers to further questions. Under what conditions? On dry roads or wet? At what temperature? On what fuels? On what slopes? Carrying what loads?

The more specific the criterion (and the hypothesis) the easier it is to evaluate the test results. However, people who write test criteria (usually called requirements documents) and organizational and operational concepts have a propensity to be general, while the tester needs to be specific. The gulf between the two can result in considerable disagreement. The tester can make a serious mistake by ignoring exactly what hypothesis is being evaluated until it is time to write the report. An explicit hypothesis, along with an analytical plan that is clearly stated in the test plan, can avoid misunderstanding and argument later when the report is written.

Confusing Data Collection With Testing

Data collection is a part of testing, but it is not testing. Unless the data gathered is somehow used to accept or reject a hypothesis, it is superfluous. If you want to see a tester squirm, ask him what he is going to do with those 36 channels of vibration data, and what hypothesis will be accepted or rejected on the basis of those data, or ask how the data are related to actual use in the field. Just as activity is not necessarily work, gathering data is not necessarily testing. Too often, reams of data are gathered with no plan or clear idea of how they will be used. And very often they are not used. Can our nation afford such nice-to-have data? I doubt it.

Forgetting the Human Element

For most tests, the human is part of the total system. Yet, all too often this critical part of the total system gets last priority. Since testing is a scientific endeavor, it is usually performed by technically trained people. These technicians like to deal with equipment problems more than with people problems. It is too easy for the tester to dismiss frequent errors or breakage as being caused by a "dumb soldier" or by "not following the manual," instead of checking to see if maybe there isn't something about the design of the test item that induces human error.

A system that is very ingenious but so complicated that the typical user can't operate it is of little use and may be very dangerous to our defense since we may know it is technically advanced, but may not be fully aware of its human limitations. Testers who use military operators frequently have difficulty in getting personnel having appropriate military skills. Operating forces don't want to give these people up for testing and it often results in fewer people than needed and those with the wrong skills being used. To adequately test a system, appropriate personnel as well as equipment are required. The tester who ignores the human element has only tested a part of his system and may be ignoring the most critical part.

Testing Little Things Like Big Things

Big things need big tests. Little things need little tests. Testing mittens should be simpler than testing missiles. This seems obvious to most people, but not to all. Many people argue for standardized development cycles, standardized test procedures, and standardized everything. Standardization has its advantages, but it should never be allowed to be a substitute for common sense. I have seen far too many tests conducted simply because the procedure is in some military standard. An example is a MIL-STD-810 dust test conducted on a packaged test item. What was being tested? The effects of dust on wood? The test item was snugly inside the wooden box in a hermetically sealed can! I'm sure every tester can think of hundreds of such examples of tests being conducted simply because of standard test procedures.

Testing should be adjusted to the complexity and nature of the test item. Little things should get developed and tested faster than big things. Alas, that's not always the case.

Ignoring Prior Data

If there is one factor that could be used to distinguish the test and evaluation profession from all other professions, it is probably the tester's tendency to ignore prior data (history). Good arguments may be given for starting a test with a clean memory bank—i.e., no preconceived bias about how the item will perform. This sounds tidy, scientific, and conservative. It supposedly minimizes consumer risk, but it is very, very expensive! If valid data from prior testing exists, it should be used, either to reduce or eliminate duplicative testing.

Validity of the data seems to be a major obstacle as testers seldom trust data gathered on tests they are unable to conduct themselves. Creative use of such prior data, establishing probabilities for parameter estimates using Bayesian statistics or other suitable small sample techniques, could result in reduced test time and expense. Valid data, from any source, should be used to reduce test costs. Nearly everyone agrees with this, but duplicative testing continues to be done every day throughout the test community.

Testing the Part Instead of The Whole

Component testing is important, but not sufficient. At some point during development, the entire system should be tested. Because different people and organizations develop different components, it is easy to have a test item composed of good components but making up a poor system. As mentioned previously, the human is part of the system, and so is the environment. Only system tests will identify system problems. Yet, how many tests have been conducted on partial systems, without appropriate manuals, without representative operators and maintainers and in unrealistic environments? There are always good reasons for the shortcuts: costs, schedules, contract delays, convenience, etc. But it is always more expensive and less convenient to find and correct a problem after an item is fielded than it is during development. Testers should insist on testing systems, not parts.

Treating All Tests Alike

Some testers want to treat all tests alike. There are dozens of types of tests and each type has its own purpose. The test methods and evaluation should be tailored to the purpose. Thus, different tests should be tested differently. A technical feasibility test should differ from an operational test. Reliability growth principles should be applied. Tester attitudes and orientation should likewise shift as an item goes from early development to production (see Figure 2). Thus, in the early exploratory type tests, the tester should view himself as a part of the development team. His role isn't simply to make a judgement on the adequacy of the item, but is also to identify improvements, and suggest changes. As the test item progresses through the cycle, the tester focus should become more judgmental, until finally for production testing, it's too late for further development and the test is strictly judgmental.

Protecting the Test Item

Occasionally a tester will become so enamored with his test item that he tries to protect it. Again, he may refuse to terminate a test that is clearly failing. Both actions reflect a loss of objectivity that every tester must guard against. If a test item is likely to fail a certain type test, that test should be conducted first. In tester's jargon this is called "front-end loading." I'm not advocating destructive or unrealistic tests; I'm only suggesting that the high risk tests be conducted first. Then, if failures occur, the test can be terminated early. The tester should protect test resources, including funds, instead of protecting the test item.

Separating the Tester From The Evaluator

In an effort to avoid the mistake just discussed and to gain increased objectivity, sometimes the tester is separated from the evaluator. Under this concept the tester becomes the data gatherer (see mistake four) and the data are then analyzed by another, separate evaluator. This is called an "independent evaluation." If more than one test agency is involved in testing an item, then an independent evaluator may serve a useful role by integrating and analyzing the different tests and presenting an independent evaluation of the several tests. However, the role of the independent evaluator is often expanded beyond this reasonable function to the extent that the tester is effectively removed from the design and analysis of his own tests. In my opinion, this is a serious mistake.

First, separating the tester from the test design leads to several mistakes previously discussed. If the design is taken out of the hands of the tester, he feels less responsible for the test, and this is natural, since he *is* less responsible. If the tester differs with the test design proposed by the evaluator, it then becomes necessary to negotiate compromises, *if* the tester is given the opportunity. All of this is wasteful and unnecessary.

If the evaluator has some special skill that the tester does not, it would be more efficient to obtain those skills at the test agency and let one organization design, conduct and evaluate the tests. This not only improves efficiency, but also accountability. With too many chefs, nobody is responsible for the stew. When it comes to the analysis of the test, who is in a better position to evaluate the results of a test; the tester or an independent evaluator?

It seems fundamental to me that the one closest to the test should be best qualified to evaluate the results. Who is better equipped to evaluate a vibration test than a vibration test engineer? Who is better qualified to evaluate a missile test than a missile test organization? Can an independent evaluator located in a temperate climate better evaluate a natural environment test than those testers who live and test every day in that environment? I think not.

On large tests, an organization may be needed to independently evaluate test results from many sources, but they should, in the process, evaluate complete tests that were designed, tested and analyzed by the test agencies instead of separating the design and analysis from the testers. The quest for objectivity is admirable, but I have not seen any convincing evidence that the independent evaluators are any more independent or objective than the test agencies.

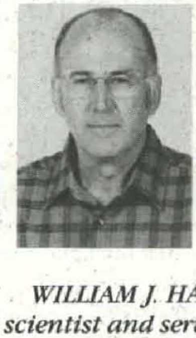
Trying to Force Uniform Test Results

When several test agencies are testing the same item, it frequently happens that very different results are obtained. For instance a prototype item may receive developmental testing at a contractor's facility, at one or more government proving grounds, at three environmental test centers, and at an operational test activity. Because of different environments, test methods, and test items, it is highly likely that test results will also differ. Differing test results are hard to explain and are embarrassing to higher management.

A desire for uniformity and consistency may motivate higher management or the independent evaluator to try to force the test agencies into agreement. This is highly irresponsible. Most test agencies will resist outright pressure of this nature, but if the tester is not careful he can be influenced to tone down negative findings or to explain away failures. Test integrity is of vital importance, especially during report preparation. Higher management and independent evaluators should accept the fact that there will be differences in test results from different test agencies and try to analyze why these differences exist, rather than try to force agreement among the test agencies.

Summary

Testers do occasionally make mistakes, as do philosophers. The above list of mistakes is not exhaustive. I'm sure other testers could add to the list. Self criticism is a hallmark of any true profession, and through self criticism we may identify and analyze those mistakes that our testing profession is prone to make and perhaps avoid them in the future. I hope my brief attempt in this article will stimulate others to identify, analyze and find ways of avoiding these and similar tester mistakes.



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Nuclear Weapons Officers Needed

Most officers are aware of the importance of selecting an appropriate functional area as a career field. Currently, Functional Area 52 (FA52) is "underaligned" at the field grade ranks. This underalignment or shortage means that there are a number of unfilled authorized positions where senior majors and lieutenant colonels can be assigned. Consequently, FA52 is recruiting and accepting a limited number of additional field grade officers to fill its ranks. Additionally, FA52 is always interested in accessing competent and qualified captains and junior majors from the combat arms branches.

FA52 trains and develops commissioned officers for assignments in the nuclear weapons field. FA52 is divided into two Areas of Concentration (AOCs): AOC 52A, nuclear weapons operations staff officer and AOC 52B, nuclear weapons research specialist.

FA52 officers assist in formulating national, Army and theater-level strategy, plans, and policies regarding nuclear weapons; planning and employment of nuclear weapons supporting tactical, theater, and strategic operations; training of nuclear-capable units and nuclear weapons personnel; nuclear surety; and management of the Nonstrategic Nuclear Force Survivability, Security and Safety Program.

Some officers are also involved in the various aspects of nuclear weapons life cycle management. They establish requirements; participate in the development, testing, and production of nuclear components and finished systems; manage nuclear weapons acquisition programs; develop integrated logistics systems; conduct research to predict the effects of nuclear weapons on materiel; recommend nuclear effects levels for survivability of battlefield equipment; manage the nuclear weapons stockpile; and oversee weapon retirements.

The employment of nuclear weapons has the potential to dramatically alter the balance between firepower and maneuver, accelerate the tempo and destructiveness of operations, and tends to enlarge the geographic area of conflict. Decisive battles could last hours instead of days or weeks. The course of campaigns could be radically altered or accelerated by nuclear strikes. The challenge is to be prepared to fight and win with nuclear weapons on the battlefield.

The two FA52 AOCs have different accession requirements. Although not mandatory, it is preferred that the nuclear weapons operations staff officer (AOC 52A), have formal training at the baccalaureate level in a scientific or engineering-related discipline. These positions are operationally oriented. Therefore, the primary consideration is the officer's field experience. In this regard, it is desired that a majority of the FA52 officers come from these combat arms branches (infantry, armor, field artillery, air defense artillery, and engineer).

The nuclear weapons research specialist (AOC 52B), requires formal training at the master's or doctorate level in a scientific or engineering-related discipline, such as nuclear physics, nuclear engineering, nuclear effects engineering or physics engineering.

There are numerous opportunities for formal military training in the nuclear weapons field. One example of these courses is The Nuclear Weapons Officer Orientation Course, the Army's entry-level course, which provides a newly-designated FA52 with the necessary background to fulfill the duties of an FA52. Another example of formal training is The Nuclear and Chemical Target Analyst Course, which prepares officers to perform nuclear and chemical target analysis and vulnerability assessments for which a Skill Identifier of 5H is awarded. Other complementary courses are taught to provide the officer with the background necessary for various higher Army and joint-level staff assignments. Functionally specific courses are also available to familiarize FA52 officers with the Army's stockpile of nuclear weapons. Consult DA Pam 351-4 (Army Formal Schools Catalog) for more details.

Graduate schooling in the disciplines of nuclear effects engineering, nuclear engineering, nuclear physics, physics, physics engineering, and strategic and tactical sciences are available on a highly competitive basis to selected officers, usually upon the officer's completion of the branch's advanced course.

Approximately 50 percent of all FA52 positions are supported for master's and doctorate degrees by the Army Educational Requirements Board (AERB) in accordance with AR 621-108 (Military Personnel Requirements for Civilian Education).

Upon graduation from the fully-funded Army Civil Schooling Program, officers will be assigned to an AERB validated position consistent with their grade and the academic discipline studied. Immediately after graduation, officers are normally given an initial 36-month tour, which is followed by at least one more tour to an AERB position during their careers. AERB positions are normally found at the higher echelons of the military and the government.

Nuclear weapons officers perform duties at most higher levels of the military and government ranging from the Corps to the Departments of Defense, Army, and Energy. FA52 officers are assigned to these commands, organizations, and activities throughout the United States and overseas. Examples of where FA52 officers serve are Office of the Deputy Chief of Staff for Operations and Plans at HQDA, which has responsibility as the focal point for nuclear matters within the Army; the Defense Nuclear Agency; the Combined Arms Center, which has responsibility for nuclear proponency within the Training and Doctrine Command; and the Department of Energy's national laboratories.

FA52 officers also may be assigned to overseas locations such as Belgium, Federal Republic of Germany, Italy, Korea, Netherlands and Norway.

If you are interested in choosing the nuclear weapons field as your functional area, or if you are interested in transferring in from another career field, contact your branch assignment officer at MILPERCEN.

For more information on this functional area please write or call the FA52 Proponency Manager, MAJ Johnie Wright. Write to Cdr, CAC, ATTN: ATZL-CAP, Ft. Leavenworth, KS 66027-5300, or call AUTOVON 552-2724/5183 or Commercial (913)684-2724/5183.

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From The Field . . .

Smoke Generator Gets Fielding Approval

An improved smoke generator system, managed by the Office of the Project Manager for Smoke/Obscurants, Aberdeen Proving, MD, has been approved for fielding to U.S. Army units worldwide.

Designated the M3A4 Smoke Generator, the system gives chemical smoke units the capability to provide large area screening of troops and installations. It will replace the M3A3 Smoke Generator, used since the 1950s, and will fill unit shortages and equip newly activated smoke generating units, which are part of the increased chemical force structure.

The Office of PM Smoke was responsible for managing the product improvement program for the smoke generator system and for fielding of the system to Army field units. Modifications consisted mainly of redesigning and replacing components to improve the starting system and engine fuel delivery system. This specific effort was directed by the Smoke Division, Munitions Directorate, U.S. Army Chemical Research, Development and Engineering Center.

Letterkenny Army Depot in Chambersburg, PA, will apply the modifications work order to M3A3 Smoke Generators in the United States. Mainz Army Depot, Mainz, Germany, will apply the modifications program for Army smoke generators in Europe.

The Army Chemical School, Fort McClellan, AL, and the Army Ordnance Center and School, Aberdeen Proving Ground, MD, will be the first Training and Doctrine Command activities to receive the new smoke generators and to train operators and maintenance workers. The 9th Infantry Division, Fort Lewis, WA, will be the first Army Forces Command unit to be equipped with the new generators.

Awards . . .

ADPA Cites Defense Achievements

Awards for achievements in weapons design and for scientific research were presented earlier this year to government and industry employees during an American Defense Preparedness Association (ADPA) National Defense Seminar in Washington, DC.

Dr. William C. McCorkle, technical director of the U.S. Army Missile Command, and Victor Lindner, technical director of the U.S. Army Armament Research, Development and Engineering Center, are recipients of MG Leslie E. Simon Awards for Technical Excellence in Weapons Systems Design. The Simon Award consists of a $1500 check and a framed certificate. MG Simon was a noted R&D leader during World War II and the Korean War.

McCorkle was recognized for his significant contributions to the advanced development of most rocket and missile systems currently in use by the Army. He developed the directional control-automet guidance system for the Lance artillery missile as well as a major autopilot improvement for the Improved Hawk Missile. He is also credited with pioneering the use of fiber-optics as a missile-to-ground data link.

Lindner received the Simon Award for major contributions which significantly increased the combat effectiveness of a broad spectrum of munitions for the armed forces. His leadership, according to the citation, was instrumental in providing nine high performance anti-tank munitions, six new extended range mortar projectiles, multiple unique warheads for rockets, a 40mm grenade launcher, six artillery projectiles with extended range and lethality, and at least four weapons for tactical and rotary wing aircraft.

Also presented by ADPA was the Crozier Prize, consisting of a $1,500 award and a framed certificate. The Crozier Prize is given in recognition of outstanding achievements in scientific research related to weapons progress in the United States. It is named in honor of the late MG William Crozier, chief of ordnance of the U.S. Army from 1901 to 1918.

The principle winner of the Crozier Prize was Dr. David W. Kerr, an employee at the U.S. Naval Research Laboratory. He was recognized for his work in developing Inverse Synthetic Aperture Radar for the imaging and classification of ship targets.

A second Crozier Prize Honorable Mention was also presented to Dr. Donald R. Shoffstall. Employed at Boeing Aerospace Co., he was cited for his commitment to advancing state-of-the-art knowledge of free electron lasers.

Career Programs . . .

MAM Board Selects 228 Officers

The 1986 Materiel Acquisition Management (MAM) Certification Board has selected 228 officers out of 727 considered. MAM certified officers are qualified to exercise central management over the planning, direction and control of acquisition functions such as research, development, testing, procurement, production, and support for Army weapons and equipment. The board selected 22 colonels, 109 lieutenant colonels and 97 promotable majors.

The goal of the MAM program is to develop commissioned officers with expertise related to the total acquisition process thus enabling them to lead a government (military and civilian) and industry team in accomplishing the program objectives within time, cost and performance constraints.

Captains who have at least 5 1/2 years of active commissioned service may apply for the MAM program as outlined in DA PAM 600-3. Officers selected for participation in the program are awarded the MAM 6T skill code.

The success of the meeting in facilitating management teamwork to solve problems, has sparked interest in planning future production engineering executive meetings.

Dr. Francis S. Knox, III

Knox Gets Fellowship

Dr. Francis S. Knox, III, research physiologist at the U.S. Army Aeromedical Research Laboratory (USAARL), has been selected as a Secretary of the Army Fellow in the Army Science and Engineering Fellowship Program.

Under this program, Knox will study at the AT&T Bell Laboratories at Holmdel, NJ, from June 1986 to June 1987. In his research, Knox will be studying ways to analyze physiological time-series data. He will be measuring the heart rate of subjects while they are active all day and presenting this data in various forms.

A civilian employee at USAARL since 1980, Knox previously worked at USAARL from 1970 to 1973 while serving in the U.S. Army Medical Service Corps. Knox also served as a professor of physiology and biophysics at the Louisiana State University School of Medicine in Shreveport.

Knox received his bachelor of arts degree in biology from Brown University in 1963, his master of science degree in physiology from Iowa State University in 1966, and his doctoral degree in physiology-biomedical engineering from the University of Illinois at the Medical Center in Chicago.

Conferences & Symposia . . .

MICOM Hosts Production Engineering Meeting

Earlier this year, the U.S. Army Missile Command hosted a production engineering executive meeting at Redstone Arsenal, AL. Attended by high-level production engineering managers from Army Materiel Command (AMC) Headquarters, the Industrial Base Engineering Activity, all AMC major subordinate commands and several research, development and engineering centers, the meeting provided a first-time opportunity to discuss, in a direct and open forum, production problems of mutual concern.

Personnel Actions . . .

Callahan is Deputy PM For Smoke/Obscurants

Joseph C. Callahan has been selected as the deputy project manager for smoke/obscurants (PM Smoke) at the Office of the Project Manager in Aberdeen Proving Ground, MD.

Callahan has been employed at PM Smoke since August 1976, when he was assigned as an engineer on the Armed Vehicle Smoke Programs. He was involved with the fielding of the M239 Launcher/L8A1 Grenade in Europe and the development of the Vehicle Engine Exhaust Smoke System. He also served as chief of the Materiel Development Division.

Callahan received a bachelor's degree in electrical engineering from the Johns Hopkins University in Baltimore in 1964. He also received a master's degree in management engineering from the George Washington University in Washington, DC in 1973.

PM Smoke is a managerial activity of the U.S. Army Armament, Munitions, and Chemical Command (AMCCOM) at APG.

Frasier Assumes Duties As BRL Director

Dr. John T. Frasier has assumed duties as director of the Ballistic Research Laboratory (BRL). He succeeds Dr. Robert J. Eichelberger who has retired after serving as BRL's director since October 1967.

Frasier served formerly as head of the Weapons Systems Department at the Naval Surface Weapons Center in Dahlgren, VA. From 1962 until 1971 he was employed at BRL as a scientist and engineer and then served as chief of BRL's Terminal Ballistics Laboratory until he transferred to the Armament R&D Center (now RDE) in 1977.

Following seven years employment at the Armament R&D Center, he joined the Naval Surface Weapons Center, initially as head of the Research and Technology Department.

Frasier received a bachelor's degree in civil engineering from Virginia Polytechnic Institute and a master's degree and doctorate in engineering mechanics from Pennsylvania State University. His awards include a 1972 Army R&D Achievement Award, a 1980 American Institute of Aeronautics and Astronautics Man of the Year Award, and BRL's 1971 R.H. Kent Award.

Army Recognizes 1985 Laboratory Achievements

Outstanding technical, managerial and fiscal achievements during 1985 were recognized recently with presentation of Department of the Army awards for Laboratory of the Year, Most Improved Laboratory, and for Laboratory Excellence.

The U.S. Army Missile Command's Missile Research, Development and Engineering Center, Redstone Arsenal, AL, was named Laboratory of the Year. In 1981, the Missile RD&E Center was also named Laboratory of the Year and in 1982, 1983, and 1984 was selected for Laboratory Excellence Awards.

Dual awards for Most Improved Laboratory and for Laboratory Excellence went to the U.S. Army Aviation Research and Technology Activity, an element of the U.S. Army Aviation Systems Command located at the NASA-Ames Research Center, Moffett Field, CA.

Other 1985 recipients of awards for Laboratory Excellence are the U.S. Army Medical Research Institute for Infectious Diseases, the U.S. Army Chemical Research, Development and Engineering Center, the U.S. Army Engineer Topographic Laboratory, the U.S. Army Electronics Technology and Devices Laboratory, and the U.S. Army Research Institute for the Behavioral and Social Sciences.

Assistant Secretary of the Army for Research, Development and Acquisition Dr. Jay R. Sculley presented the Laboratory of the Year Award during ceremonies earlier this year at the U.S. Army Missile Command. Winners of both the Laboratory of the Year and Most Improved Laboratory are chosen annually by a special awards evaluation committee appointed by Dr. Sculley.

Members of the 1985 awards evaluation committee were: Dr. Louis M. Cameron, director of Army research and technology; Dr. Joseph P. Sattler, acting deputy for technology and requirements, Office of the Assistant Secretary of the Army for Research, Development and Acquisition; Dr. Richard L. Haley, Army Materiel Command assistant deputy for science and technology; Dr. James Choromokos, director of research and development, U.S. Army Corps of Engineers; and COL Philip Z. Sobocinski, deputy commander, U.S. Army Medical R&D Command.

Laboratory of the Year

Justification for selecting the U.S. Army Missile RD&E Center as Laboratory of the Year was based on a number of key accomplishments, including five highly successful man-in-the-loop guided flight tests which demonstrated many of the program objectives of the Fiber Optic Guided Missile (FOG-M). These demonstrated objectives included the ability of the gunner/operator to manually control the missile trajectory during the missile cruise mode, the ability to lock-on in flight and engage moving tank targets, and the utility of a digital multimode target tracker. The center also did substantial work on the fully autonomous Setter technology demonstrator, a candidate for the light air defense system. Other accomplishments of the Missile RD&E Center included:

- development and demonstration of a very high speed integrated circuit automatic tracker which virtually eliminates human error in laser command-to-line-of-sight missile guidance schemes;
- development of a novel, low-cost spatial light modulator for transforming real-time two-dimensional imagery into a form suitable for processing by an optical correlator guidance system;
- demonstration of a new, highly flexible radar antenna and system concept which enables the instantaneous formation and positioning of multiple radar beams and/or nulls in radar target space;
- establishment of a Smart Munitions Center to coordinate all smart munitions technology and programs in the Army;
- formation of a University Affairs Office to facilitate interaction between the center and universities throughout the southeast region of the United States;
- support to other Army and DOD agencies, including simulation support, sensitivity propulsion analyses, vulnerability analyses, materiel systems analyses; and
- successful achievement of goals related to obligation of budget funds and the Small Business Program.

Most Improved Laboratory

The U.S. Army Research and Technology Activity (ARTA) was also recognized for a number of noteworthy contributions to the Army's mission. For example, ARTA achieved dramatic success in solving computational fluid dynamics problems relating to rotor aerodynamics. In another effort, ARTA's researchers defined the critical wind azimuth angle for the Advanced Helicopter Improvement Program and were able to thoroughly evaluate the region where abrupt loss of tail rotor control effectiveness was most likely to occur.

ARTA also completed a major milestone in development of a highly flexible computer software system designed to perform a broad range of helicopter interdisciplinary analyses. Other significant ARTA achievements included:

- development of a new turbine shroud seal;
- completion of flight tests of the world's first all composite airframe helicopter;
- substantial progress in development of a third generation helicopter gas turbine engine fuel control system;
- development of a multi-application armor blanket for protecting the Black Hawk helicopter against small arms fire;
- initiation of a program to construct a rational predictive methodology for designing helicopter cockpits and associated training approaches;
- successful participation in cooperative efforts with Germany France and Italy in the fields of rotorcraft aerodynamics, acoustics handling qualities, and composite structures; and
- maintenance of a well-balanced program despite continued austere budgets.

Assistant Secretary of the Army (RDA) Dr. Jay R. Sculley (right) presents the Army's Laboratory of the Year Award to Dr. William C. McCorkle, technical director of the U.S. Army Missile Command and director of the Missile RDE Center.

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