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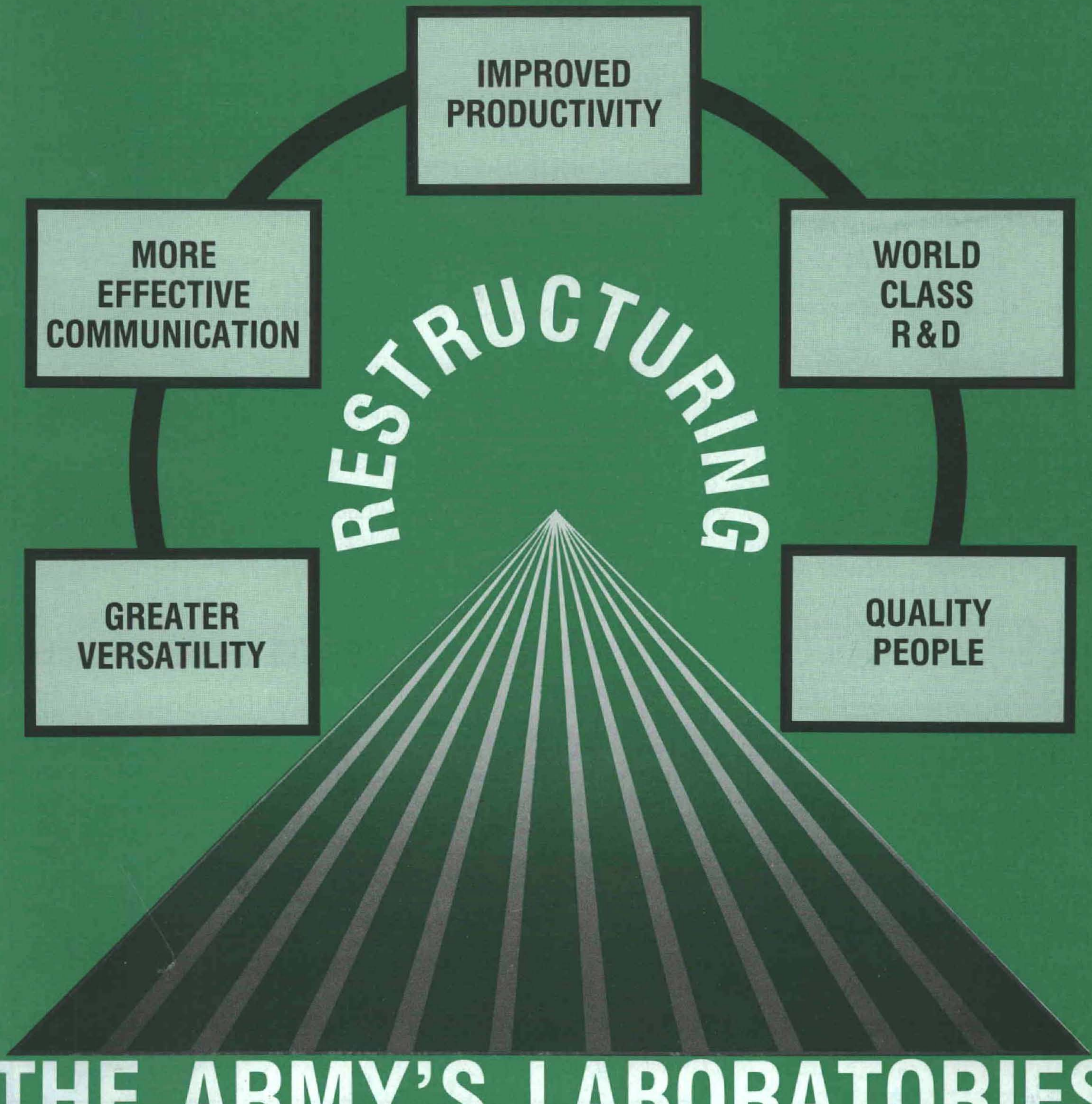

THE ARMY'S LABORATORIES

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ARMY RD&A BULLETIN

Research Development Acquisition

Professional Bulletin of the RD&A Community

FEATURES

DEPARTMENTS

COVER

Featured in this issue is a discussion of new organizational management initiatives currently ongoing or planned to improve the Army's research and development efforts. The cumulative effect is to enhance productivity and quality.

ARMY LABORATORY RESTRUCTURING AND ENHANCEMENT PLANS

By Jerry L. Stahl

In President Bush's 1991 State of the Union address in January, he spoke of the remarkable military technological advances being successfully employed in Operation Desert Storm. He said: "The quality of American technology, thanks to the American worker, has enabled us to successfully deal with difficult military conditions and help minimize precious loss of life. We have given our men and women the very best. And they deserve it." The primary goal of Army research and technology is to continue to provide our future military forces with the very best.

The Army's technology base is the genesis of a large portion of the high technology tools employed so successfully by our forces in Operation Desert Storm. For example, infrared and night vision technology let us own the night and saved many soldiers' lives. The Army's "Big 5" weapon systems started two decades ago proved themselves: the Apache and Blackhawk helicopters, Abrams tank, Patriot missile system, and Bradley Fighting Vehicle System. Operation Desert Storm demonstrated that certain weapon system capabilities are essential for success with minimum friendly losses on the modern day battlefield: stealth, anti-tactical ballistic missiles; smart weapons/munitions; air mobility; chemical/biological detection and protection; countermine; airland battle management; and exploitation of space.

The role of our Army laboratories and centers has undergone significant change from the 1940s and 1950s. Today, the Army has 42 separate laboratories and research, development and engineering centers (RDECs) distributed throughout the continental United States. Such a diffuse system complicates communication, coordination, and technology transfer. Furthermore, these organizations need a critical mass of resources, including quality scientific and engineering talent, if they are to produce worthwhile research. Continued process and organizational improvements are even more important today as we face a declining defense budget (see Figure 1), reduced force structure, and the worldwide proliferation of high technology conventional arms. Correspondingly, the Army has undertaken a number of new management initiatives to make the Army's 21st century research and development efforts more efficient and effective.

These initiatives represent the results of two years of extensive Army analyses and countless numbers of information and decision briefings through the Department of the Army, the Department of Defense, the Defense Base Closure and Realignment Commission, the Advisory Commission on Consolidation and Conversion of Defense Research and Development Laboratories, and Congress. They complement the initiatives that were implemented several years ago as a result of recommendations by the Packard Commission, as well as those directed by the Goldwater-Nichols Act. Thus, when the Defense Management Report was issued in July 1989, the Army was well-poised to make further improvements to our existing R&D management structure and processes.

The Army initiated the LAB 21 study in November 1989 to focus on consolidating and streamlining our laboratories and RDECs. Approval by the deputy secretary of Defense of the Defense Management Report Decision (DMRD) 922, Consolidation of R&D Laboratories and T&E facilities, authorized the Army to proceed with our LAB 21 concept and detailed planning.

The basic premise behind the LAB 21 deliberations was the need for a "world class" research and development system for the challenges of the 21st century. A productive, efficient research environment, consisting of quality people and modernized facilities, is needed.

Productivity will improve with the quick assembly of creative blends of talent and technology, more effective communication and coordination, and ease of technology transfer. Efficiency improvements result from reducing overhead, reducing management layering, and eliminating duplication of effort.

A productive and efficient research environment requires quality facilities conducive to attracting and retaining the scientists and engineers who will provide the "critical mass" of talent fundamental to "world class" research. It is not surprising that we can best describe the Army R&D establishment of the 21st century like the 21st century Army — a smaller, more versatile, higher technology force.

A set of uniform guiding principles was applied to our existing organizational structure of labs and centers. All proposals emanating from the study were placed into one of two categories: (1) those involving organizational realignments, closures, and construction which require environmental impact analysis; and (2) those involving management changes which can be implemented as quickly as supporting policies, procedures, goals and methods to measure effectiveness can be put in place. Regardless of the category, each and every proposal had to pass the test of improving efficiency and effectiveness while positioning our R&D organizations to satisfy Army research needs for the 21st century.

The Army included our LAB 21 program under our Base Closure and Realignment Act of 1990 submission. This six-year program is designed to improve the quality, productivity and efficiency of Army research and development organizations, while increasing their ability to attract and retain high quality scientists and engineers.

One of the key elements of LAB 21 is the creation of a world class "flagship" laboratory called the Combat Materiel Research Laboratory (CMRL). The CMRL would be headquartered at Adelphi, MD, home for the following directorates: Signatures, Sensors and Signal (S3) Processing; Battlefield Environmental Effects; Electronics and Power Sources; and Directed Energy.

Lethality, Materials, Life Sciences and Simulation/Modeling/Assessment Directorates of CMRL would be located at Aberdeen Proving Ground, MD, where extensive test and range capabilities already exist.

Specific realignments for the CMRL follow:

- Move the Army Research Institute (ARI) MANPRINT function from Alexandria, VA, to CMRL, Aberdeen Proving Ground, MD.
- Move the basic and applied materials research elements from the Belvoir Research and Development Center, VA, to CMRL, Aberdeen Proving Ground, MD.
- Move the Army Materials Technology Laboratory (AMTL) (less structures element) from Watertown, MA, to CMRL, Aberdeen Proving Ground, MD.
- Move and combine the AMTL structures element with the Army Aerostructures Directorate collocated at NASA-Langley Research Center at Hampton, VA. Expand the mission at that site to form a CMRL Structures Directorate.
- Move the directed energy and sensors basic and applied research element of the Center for Night Vision and Electro-Optics at Fort Belvoir, VA, to CMRL, Adelphi, MD.
- Move the Electronics Technology and Devices Laboratory from Fort Monmouth, NJ, to CMRL, Adelphi, MD.
- Move the battlefield environment effects element of the Atmospheric Sciences Laboratory at White Sands Missile Range, NM, to CMRL, Adelphi, MD.
- Move ground vehicle propulsion basic and applied research from Warren, MI, and combine with the Army Aviation Propulsion Directorate collocated at the NASA-Lewis Research Center in Cleveland, OH, to form the CMRL Propulsion Directorate.
- Move the Harry Diamond Laboratories Woodbridge Research Facility element to CMRL, Adelphi, MD, and close/dispose of the Woodbridge, VA, facility.
- Move the fuze development and production mission (armament related) from Harry Diamond Laboratories, Adelphi, MD, to Picatinny Arsenal, NJ.
- Move the fuze development and production mission (missile related) from Harry Diamond Laboratories, Adelphi, MD, to Redstone Arsenal, AL.

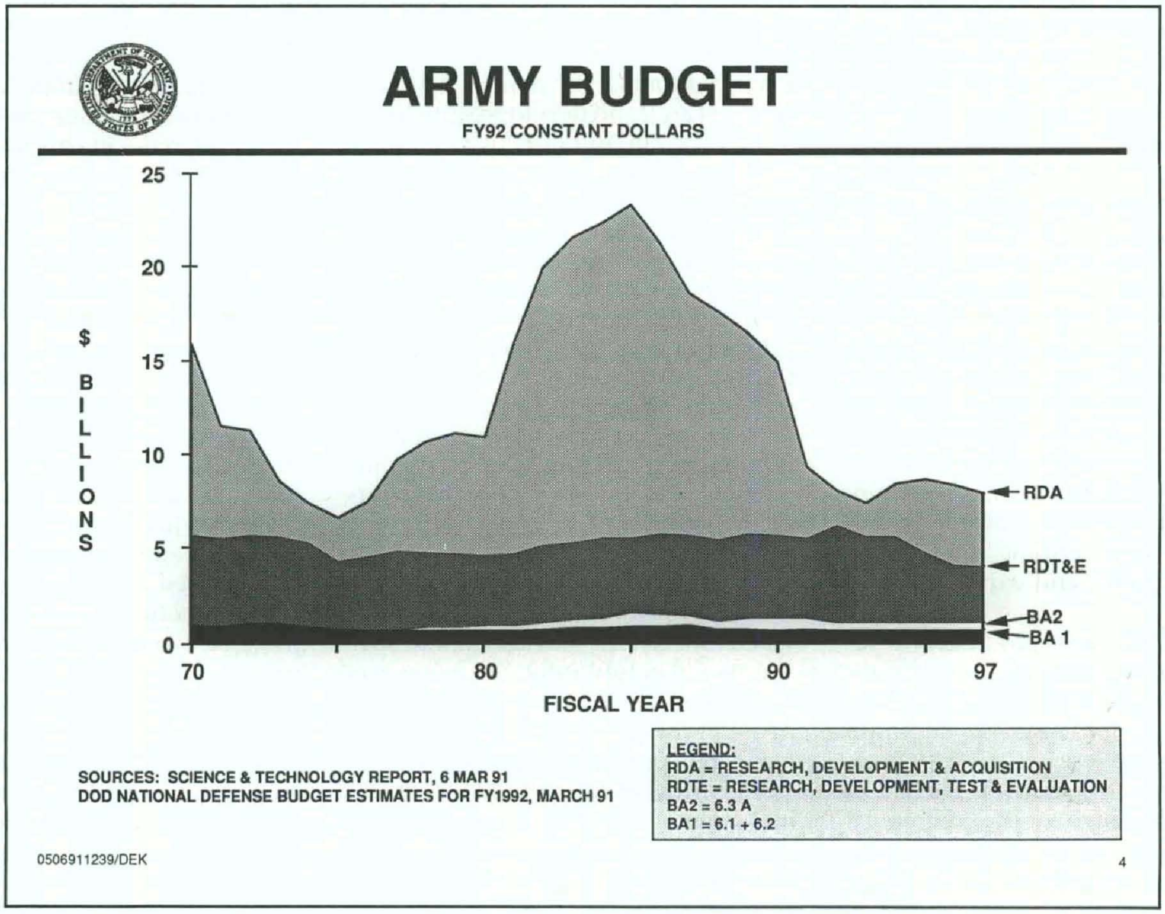

Figure 1

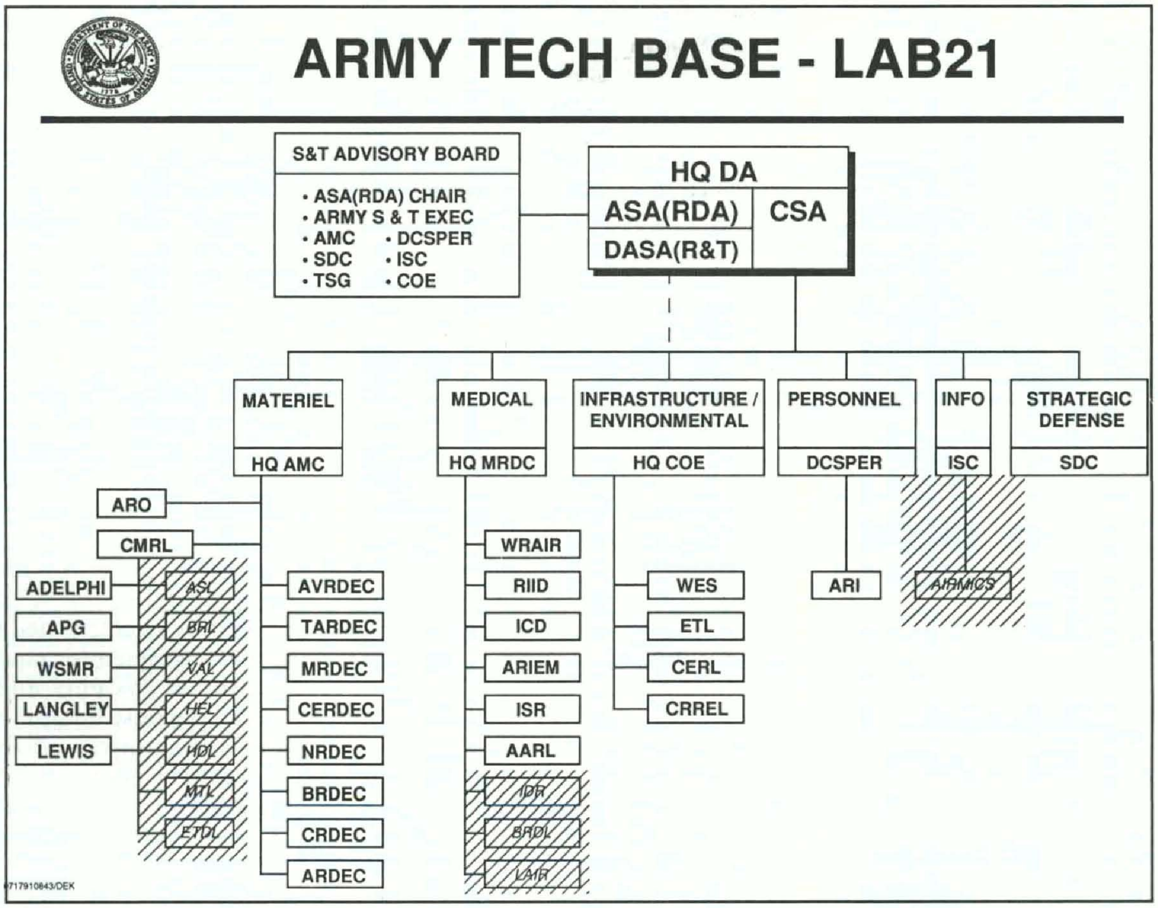

Figure 2

• Move the Information Mission Area related research from the U.S. Army Institute for Research in Management Information, Communications, and Computer Sciences (AIRMICS) to the CMRL and close leased office at Georgia Institute of Technology in Atlanta, GA.

Under the Tri-Service Project Reliance study, the number of Army medical research labs would be reduced from nine to six, while seven tri-service medical programs would be collocated at single service sites. Realigning medical research laboratories and programs achieves efficiencies through inter-department consolidations, transfers and reliance on technology.

Specific realignments follow:

• Disestablish the Letterman Army Institute of Research (LAIR) as part of the closure of the Presidio of San Francisco, cancel the design and construction of the replacement laboratory at Fort Detrick, MD, and realign LAIR's research programs in the following manner:

—Move trauma research to the U.S. Army Institute of Surgical Research, Fort Sam Houston, TX.

—Move blood research and collocate with the Naval Medical Research Institute (NMRI), Bethesda, MD.

—Move laser bioeffects research and collocate with the U.S. Air Force School of Aerospace Medicine (USAFSAM), Brooks Air Force Base, TX.

• Disestablish U.S. Army Biomedical Research and Development Laboratory at Fort Detrick, MD, and transfer medical materiel research to the U.S. Army Medical Materiel and Development Activity at Fort Detrick and collocate environmental and occupational toxicology research with the Armstrong Laboratory at Wright-Patterson Air Force Base, OH.

• Disestablish the U.S. Army Institute of Dental Research, Washington, DC, and collocate combat dentistry research with the Naval Dental Research Institute at Great Lakes Naval Base, IL.

• Move microwave bioeffects research from Walter Reed Army Institute of Research (WRAIR), Washington, DC, and collocate with USAFSAM.

• Move infectious disease research from NMRI and collocate with WRAIR.

• Move biodynamics research from U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL, and collocate with the Armstrong Laboratory.

• Move heat physiology research from USAFSAM and collocate with U.S. Army Research Institute of Environmental Medicine (USARIEM), Natick, MA.

Our organizational design for the laboratories was driven by our modernization vision, strategy, and action plan as documented in the Army Technology Base Master Plan (ATBMP). Extensive analyses of numerous alternatives were conducted using a uniform set of evaluation factors and attributes. The LAB 21 factors used were consistent with and complementary of those used for the 1991 Base Realignment and Closure analyses, and represent those considerations which are critical to increased productivity and quality of products and services. Figure 2 outlines the organizational changes associated with LAB 21.

The LAB 21 and Tri-Service Project Reliance programs will strengthen the Army's laboratories and assure the

The Army is responding to worldwide political, economic, and technological change by making fundamental improvements in its organizational management and philosophy across the entire spectrum of its responsibilities.

Army has the needed technology to address 21st century challenges. This program has been guided by the fact that today's soldier benefits from the world's best technology and tomorrow's soldier deserves no less.

The Army is also participating extensively in the Defense Laboratory Demonstration program. Army demonstration laboratories and centers are: all seven Army Laboratory Command corporate laboratories; the AMC Missile Research, Development and Engineering Center; the Corps of Engineers Waterways Experiment Station; and all laboratories of The Surgeon Generals' Medical Research and Development Command. Army initiatives fall into the following categories and reflect the underlying philosophy of the Office of Technology Assessment report "Holding the Edge."

In the area of management authority:

- We have transferred support organizations (civilian personnel, procurement, general counsel and facilities maintenance) to the operational control of the laboratory and center directors. While specific implementation varies from organization to organization and function to function, in all cases the ability of the corporate leadership to execute its research and development mission has been strengthened;
- Civilian directors have been appointed for a minimum of four years, with subsequent renewal possible if deemed desirable. The nine Medical Research and Development Command laboratories have military directors/commanders, but will institutionalize a four year tenure.

In the area of personnel:

- We have extended the career track for world-class scientists to the Scientific/Technical (ST) Corps (equivalent to GS-16 through GS-18 in pay). This year, 22 additional ST positions were approved by the Office of Personnel Management, bringing the Army's authorized ST strength to 29. Twelve of these 29 ST positions are in the Army's demonstration laboratories.
- We are participating in the testing of automated personnel documentation systems as part of the effort to delegate personnel classification authority to managers.
- We have obtained authority to direct-hire PhDs for the GS-9/11/12 levels for all demonstration laboratories. Since July 1990, the demonstration laboratories have appointed 16 PhDs using this direct hire authority. This accelerates the recruiting process by three to five months.

In the area of contracting:

- We have authorized demonstration laboratory and center directors to use alternatives to the Army's supply system for small purchases (under $25,000). Using this discretionary authority, we have seen significant improvement in the timeliness and efficiency of small purchases. We have seen specific examples where the waiting time from request to receipt of equipment has dropped from 100 days to a week or less.
- Scientists and engineers at nine of our demonstration laboratories have been given limited ordering authority for small purchases (under $2,500). This has been achieved through use of the Government-wide commercial credit card service. Our test sites using this card report great success and satisfaction with this initiative. Critical supplies and materials are often obtained in one to two days, thus reducing downtime on priority technology projects. Harry Diamond Laboratories estimates that this has saved $3.6M - $5M per year in engineer and scientist downtime alone for fiscal years 1989 and 1990.
- We have encouraged the maximum use of grants, Broad Agency Announcements and Small Business Innovation Research Contracts which take one-third the time of the normal contract action process.

In the area of facilities and equipment:

We have strengthened the authority to purchase scientific equipment, computational systems and laboratory special purpose equipment. All of the AMC laboratories and the Waterways Experiment Station are now using a laboratory overhead account to purchase modern equipment.

In summary, the Army is responding to worldwide political, economic, and technological change by making fundamental improvements in its organizational management and philosophy across the entire spectrum of its responsibilities. The cumulative effect of these actions is a major institutional change to enhance productivity and quality. Maintaining a strong Army technology base in the face of declining budgets is indeed a real challenge; but the science and technology initiatives and proposals outlined above are designed to meet this challenge head-on.

JERRY L. STAHL is the assistant deputy chief of staff for product assurance at AMC Headquarters, but is currently on a special assignment as chief of the DMRD 922 Coordination Office in the Office of the ASA(RDA). He holds a bachelor's degree in electronics engineering from the University of South Florida and a master's degree in industrial engineering from Texas A&M University. Stahl is a 1980 graduate of DSMC's Program Management Course and a 1986 graduate of the Industrial College of the Armed Forces.

By Dr. Jagdish Chandra, Dr. Gerald J. Iafrate and Dr. Robert W. Shaw

THE ARMY RESEARCH OFFICE: SHAPING THE FUTURE THROUGH MATHEMATICS

. . . the Language of Science and Engineering

Introduction

This year the Army Research Office (ARO) celebrates its 40th anniversary. This article, which is part of a continuing series on current and future ARO efforts, is a brief description of research supported by the Division of Mathematical and Computer Sciences.

Mathematics is the language of science and engineering. It enables us to make clear and precise statements about objects and processes. Mathematics plays an essential role in the analysis and modeling of a variety of problems that arise in Army science, engineering and operations. It provides the necessary framework for development of computational procedures that can be implemented, using modern computers, in the design, analysis and control of physical phenomena and complex systems.

Because of the all-pervasive nature of mathematical techniques, the technical drivers and requirements for this field are distributed over several laboratories within and outside of the Army Materiel Command (AMC). In various degrees, the work performed under this program responds to almost all Training and Doctrine Command (TRADOC) mission areas and Army critical technologies.

In order to respond to these diverse requirements, the research program is organized into several subfields. These include analysis and physical mathematics, computational mathematics, probability and statistics, system theory and control, and computer science.

The program in analysis and physical mathematics is concerned primarily with modeling and understanding of nonlinear phenomena such as the motion of complex structures and platforms composed of many parts, transonic fluid flow, combustion, neural networks, and many other systems.

Computational mathematics provide the essential tools that complement theory and experimentation for both scientific discovery and engineering design and implementation. For instance, efficient computational methods are needed to understand complex shock wave patterns in blast and explosion.

Statistical methods have widespread applications. Statistics interpret measurements and the analysis of statistical significance, and errors in field and laboratory data. Research in statistics provides us with tools to draw conclusions from experimental data—to determine, for example, from a series of test firings which of several different propellant formulations is best. Often, the experiments are complicated and conditions in the field cannot be closely controlled; in these cases the data may be messy and special techniques necessary.

Probabilistic tools are needed to model uncertainties in model structures or imprecision in data. Stochastic modeling has proved to be very successful in reliability theory, quality control, simulation, and signal processing. The program in system and control theory is the cornerstone for a broad range of Army applications, such as automation and robotics, aided or automatic target recognition, and distributed command, control and communication. The program in computer science includes work in artificial intelligence, neural networks, databases and database management, real-time computation, and software systems.

A recently established block effort at Carnegie Mellon University is directed at mathematics of nonlinear continua with special emphasis on mathematics of material sciences.

Past Accomplishments

From its beginning, ARO has supported basic research in the mathematical sciences. Even before ARO was founded, the commanding officer of its predecessor organization—the Office of Ordnance Research (OOR)—served as chairman of the U.S. Army Mathematics Steering Committee which planned and supervised mathematics research interests in the Army. For example, the OOR supported an annual series of Conferences on the Design of Experiments. Army mathematicians and others who participated in these meetings had a very practical goal—to ensure that expensive tests and experiments were carried out to yield the maximum amount of useful data.

The OOR also supported work in statistics, operations research, and numerical analysis and ARO continued support of basic research in these fields. For instance, the work supported at Princeton University under the stewardship of Professor John Tukey led in 1965 to the discovery of the Fast Fourier Transform (FFT).

FFT is a fast computational procedure to analyze complex signals and is the basis today for many applications ranging from speech analysis to guidance and control. Successful use of such methods has been key in the design of antiballistic defense systems, such as the Patriot Missile.

During the 1960s, while working at the Army Mathematics Research Center, University of Wisconsin, Professor I. Schoenberg and Professor Carl de Boor developed the theory of spline functions. This revolutionary method for fitting data and smoothing is now used everywhere throughout the Army. Computer-aided design packages based on spline functions are commonly used in vulnerability analysis and structural mechanics.

Interestingly, the earliest work on splines was done at the Army Ballistic Research Lab by Schoenberg during World War II when he had the problem of smoothing ballistic tables. The later development of computers made their application possible. Professor Carl de Boor, also of the Mathematics Research Center, later wrote a book, *Practical Guide to Splines*, which was based on lectures he gave at Army labs including the Atmospheric Sciences Lab, the Missile Command, and the Natick RD&E Center.

Current Program/ Investment Strategy

The impact of the mathematics program is not limited to 6.1 (basic) research. Indeed, many 6.2 (exploratory development) and 6.3 (advanced development) activities, as well as logistics, testing, evaluation and simulation activities give rise to important and often difficult mathematical and computational problems for which much research remains to be done. The program under this division is a two-pronged approach; namely, systematically to advance fundamental knowledge in those subfields of mathematics and computer sciences which offer significant promise for meeting both the present and the anticipated Army needs (for instance, as described in the Army Technology Master Plan), and at the same time to foster a structured technology transfer program of workshop, study groups, Army-wide conferences, tutorials, and other didactic activities to disseminate results of the research program and to aid in the solution of the present problems.

The advance in fundamental knowledge is carried out by principal investigators and their students. Many of these efforts are individual ones, other problems require cooperative efforts. With this in view, there are some carefully selected block efforts in the program involving multiple investigators collaborating in well-chosen research areas. A recently established block effort at Carnegie Mellon University is directed at mathematics of nonlinear continua with special emphasis on mathematics of material sciences. This work is needed to understand phenomena such as

In various degrees, the work performed under this program responds to almost all Training and Doctrine Command mission areas and Army critical technologies.

delamination, local stability, and shock formation and propagation.

Technology transfer occurs at all levels in this program, but large centers with faculty, students, and visiting scientists cooperating on a wide range of problems have been particularly effective in interacting with the Army.

Army Mathematics Centers

In 1956, OOR initiated a contract for the Army Mathematics Research Center at the University of Wisconsin. When ARO was founded, it assumed oversight of the center which has continued, though not at the same location. The Center is now at Cornell where, since 1986, more than 50 students have received their Ph.D.s and interactions have occurred with 48 different Army agencies. This center emphasizes high risk/high return projects.

The Army High Performance Computing Research Center was established in 1989. It has two principal goals: basic research into new computational methods that use new computer designs and technology transfer to the Army. The program of technology transfer is an aggressive one with support personnel located at numerous Army sites. The program also includes workshops and tutorials tailored for Army scientists, and short-term and long-term collaborative research between the center and Army scientists.

Examples of technology transfer and collaborative efforts include work at the U.S. Army Armament RD&E Center (ARDEC) on real time control design and at the Ballistic Research Laboratory (BRL) on visualization and animation. The center is composed of the University of Minnesota, Purdue, Jackson State and Howard Universities (the latter two are historically prominent black institutions of higher learning) and the Computer Science Corporation.

The Artificial Intelligence Center at the University of Pennsylvania is one of the major national activities in this field. Research includes language processing, computer vision, computer graphics, database systems, and reasoning. Several dozens of Army scientists and engineers have been trained under this program. In addition, significant interaction has occurred with the Army Human Engineering Lab, Natick RD&E Center, the Tank-Automotive Command, and the Artificial Intelligence Center at TRADOC.

Examples of technology transfer and collaborative efforts include work at the U.S. Army Armament RD&E Center on real time control design and at the Ballistic Research Laboratory on visualization and animation.

Finally, the Center on Intelligent Control Systems (a consortium of Brown, Harvard and Massachusetts Institute of Technology), established under the DOD University Research Initiative, has done pioneering work on foundations of intelligent systems with a potentially major impact on technologies such as Automatic Target Recognition, distributed command, control and communication, and automation and robotics.

Mathematics for the Future Army

Nonlinear Analysis: We need better understanding of nonlinear waves in two and three space dimensions to improve our predictions of performance of materials and both rigid and flexible structures under ultra high rates of impulsive loading and the vulnerability of these structures to high energy radiation. We also want to predict propagation of waves and beams through perturbed, inhomogeneous atmospheres. We need to extend our modeling of composite and novel materials to understand delamination and shock formation and propagation.

Computational Geometry: Progress in robotics and autonomous systems will extend available manpower and provide alternatives in performance of hazardous and high risk duties. This work is necessary for describing and computing the motion of robotic manipulators and the navigation of mobile autonomous systems.

Interactive Data Analysis: We need improved coordination of modern computer graphics and data base tools. This work aims for fast treatment of large amounts of data from various sensors to provide the operator useful information in real time. Modern techniques would take advantage of the enormously successful capability of the human eye/hand coordination along with the speed and accuracy of the computer in finding useful structure in complex data.

Intelligent Systems: There is an increasing move toward robot data collection, fire control and computer-aided decision making. This work seeks to blend control theory and signal processing with artificial intelligence.

Conclusion

The mathematics of material modeling will enable more effective armor, robotics will remove the soldier from some high-risk areas, data analysis and control systems will give the soldier information about how to direct weapons. These modern tools of mathematics may appear abstract. However, they are being used to achieve specific, concrete goals. As part of the ARO research program, these goals are to arm and protect the soldier. We at ARO look forward to increasing our effectiveness in accomplishing that mission.

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INTERVIEW WITH LTG AUGUST M. CIANCIOLO

Director of Acquisition Career Management

Q. For those not familiar with the Army Acquisition Corps (AAC), could you briefly describe its primary purpose?

A. The objective and purpose of the Acquisition Corps is to create a pool of highly qualified experts, both military and civilian, for assignments to what we call "critical acquisition positions." The Corps now has legitimacy in law with the November 1990 passage of the Defense Acquisition Workforce Improvement Act. This law mandates the establishment of acquisition corps in each of the services and at least one corps for DOD agencies. The Corps came about as a result of perceptions—in some cases valid ones—that we did indeed need to improve the competency of the folks involved in the acquisition process, not only in the Army but the entire Department of Defense.

Photo by SGT Debra E. Troell

Q. Are any special qualifications or degrees required for someone to apply for membership in the Army Acquisition Corps?

A. The Acquisition Corps is an integrated corps—it includes both military and civilians. On the military side of the house, an officer is accessed into what we call "candidate development" after eight years of service and achieves full corps membership at grade of Major. On the civilian side of the workforce, an individual must be at least at grade level 13 to seek membership. Both military and civilians are required to have four years of experience in acquisition positions. All military officers will already have a baccalaureate degree. Many will have advanced degrees. We would prefer that all of our civilians have completed their undergraduate education. The Acquisition Workforce Improvement Act requires that individuals also have 24 semester credit hours in business disciplines or 12 hours in business disciplines and 24 in one's field of study.

Q. Although the AAC is still relatively new, how would you assess progress to date?

A. I think we are doing very well. We are now 18 months old and have made steady progress. For the military, we previously had the 6T MAM Program. Therefore, we were relatively established in an institutionalization of material acquisition skills and training. However, the civilian side is where most of our focus is now being directed for the Acquisition Corps. We had to start from scratch. We had to decide which career fields, which series, what positions, develop a management concept and then capture data on people. We have identified over 1,700 critical acquisition positions. We have issued a recruitment announcement to start to build our candidate development pool. We are in the process of accessing critical position incumbents into the Corps. In addition, we are developing a central referral system that will be the only way that corps position vacancies will be filled. At the same time, we are putting into place the training and development pieces that will enable us to lift up the overall professional competence of our people. I think we have come quite a ways with regard to the institutionalization of the Army Acquisition Corps, but obviously the job is not finished.

Q. Do you believe the AAC will be affected by the current Army build down?

A. All the elements of the Army will be affected by the build down. Therefore, we are conducting continuous analysis of the structure. We will see how all of this comes out over time.

Q. Could you briefly explain what is meant by the term "critical acquisition positions?"

A. The critical acquisition positions are now defined in the law. The Defense Acquisition Workforce Improvement Act says that all lieutenant colonel and above positions in the acquisition business are critical. On the civilian side, all GS-14 and above positions that are acquisition related are critical positions. Critical acquisition positions are those that require special knowledge, experience and have significant responsibilities related to the acquisition of material.

Q. Is the AAC limited to individuals in specific functional areas or career programs?

A. For the military we currently have three functional areas and a special area of one of the branches. These are Research, Development and Acquisition (FA 51); Procurement (FA 97); Aviation/Intelligence (15/35); and ADP (FA 53). On the civilian side, there are 11 career program fields included in the Army Acquisition Corps.

Q. What are some of the enhancements that are or will be available for Acquisition Corps members?

A. One of the major enhancements is the fully-funded advanced degree program for both military and civilian members of the Acquisition Corps. We have already implemented the program for the officers. We will select a small number of civilians to participate in the program this fiscal year and then expand in FY 92. Additionally, we are offering our civilians the opportunity to participate in senior management training at some of the country's most prestigious universities. The Acquisition Workforce Improvement Act mandates the establishment of scholarship programs, intern programs, payment of relocation expenses and tuition reimbursement all only for members of this segment of the workforce.

There are also some other enhancements in the program. For example, in terms of assignments, only those individuals who are members of the Acquisition Corps can be assigned to critical acquisition positions. This enhancement reflects what our intent was in the beginning—to have a pool of experts in acquisition and to insure that that pool is recognized as being technically and professionally competent in what they do. Recognizing the professional expertise of this group is important because it can allow, for example, a GS-13 member of the Acquisition Corps to be the only person eligible to compete for a position vacancy that comes open for promotion. So this opportunity is not open to everybody. This, to me, is an incentive and a statement by the Army to the individual members of the Corps that we are serious about maintaining professionalism and recognizing the investment that has been made by the Service in the individual and their training and assignments. We are doing this because we want to insure that we have only high quality people working in this business. We want to provide the best material for our soldiers and do it in a timely, cost-effective, and more bang-for-the-buck way.

Q. Military officers in the Acquisition Corps are routinely given the opportunity to get an advanced degree. Will this same opportunity be made available to civilians in the Acquisition Corps?

Photo by SGT Debra E. Troell

A. Earlier, I said that we have provided funds in 91 for a few and we will expand opportunities in 92. For members of the Acquisition Corps who want to know when these opportunities are available, I say stay tuned-in to the *Army RD&A Bulletin*. We will make announcements in this magazine about these educational opportunities and we will let folks know what they have to do to apply. We will also communicate with the acquisition community in other ways. I am very encouraged by the commitment of the Army to offering opportunities to the members of the Acquisition Corps that were previously unavailable, especially to the civilian members of the workforce.

Q. What advice would you offer to someone considering a career in Army Acquisition?

A. First of all, I think it's the sound choice. It's an exciting program and it's an exciting field to be in. The effectiveness of the combat equipment developed for our soldiers was evidenced in Desert Storm. I think we all can be proud of how well that equipment performed when used by competently trained soldiers.

If you are a member of the Acquisition Corps, you will be able to achieve significant levels of responsibility and can contribute to our Army of the future so that our soldiers are always the best equipped in the world. There will be many, many opportunities for professional development—including the graduate programs we discussed earlier—and special leadership development programs. Leadership is a very important part of this program and members of the Acquisition Corps are expected to occupy the top leadership and management positions. If I were someone thinking about the Acquisition Corps, I would seriously consider all of the positive aspects of the program. This includes the opportunity to deal with industry, the opportunity to deal with new technology, and the opportunity to see to it that the skills and knowledge I have can be brought to bear in a manner that enhances the defense mechanisms of the United States and particularly the Army. I would also look at the opportunity to be at the leading edge of things that are happening. I am high on the Acquisition Corps and I think it's going to get better as we progress over time.

CONCEPT ENGINEERING

Building a Firmer Foundation For Tomorrow's Acquisition

By LTC Kenneth H. Rose

The Army credits the validity of its materiel item acquisitions to a concept based requirements system. Such a system is intended to reserve scarce procurement dollars for only need-justified items and avoid the willy-nilly purchase of every new widget that springs to life with its own four color brochure. In practice, this prescribed paradigm of first the concept, then the item has all the certainty of the age old chicken-and-the-egg controversy. A better understanding today of what concepts are and how they are developed may provide a firmer foundation for tomorrow's acquisitions.

The difficulty starts with concepts themselves. They are things abstract, not concrete. Concepts are built in the mind, not in the workshop. The evolution of a materiel item from the drawing board to the loading dock is a matter of engineering; we know how we build things. But, the evolution of a concept from a spark of insight to coherent articulation is a matter of psychology and philosophy; we simply don't know how we think.

While these seem to be poles apart, it may be that application of some of the discipline of the engineering domain to concept development is both possible and practical. This may give some needed form to the concept process that will illuminate it and provide a bit of glue that will bind the larger concept-materiel process together.

First, it is useful to understand that the materiel developer and materiel user communities possess different views of the world—how it is made up and how it works. These are not distinct, mutually exclusive views, but rather parallel hierarchies that reflect the tools of the community trade. Developers tend to think in terms of science, technology, systems and items. Users are oriented toward ideas, concepts, requirements and fielding. Additionally, these progressive hierarchies are supported by specific documents of the Army materiel acquisition management system. The relationships among these elements are shown in Figure 1.

At the front end of the process, developers do research at a basic science level. At the same time, users are tossing around a lot of different ideas. If all works well, the result should be some kind of informal need statement based on analysis of threats and deficiencies or some kind of capability statement based on a technical opportunity. As this process percolates, a concept begins to coalesce in the user community and developers begin to think in terms of technologies that will support the concept. The result is a Mission Need Statement, which initiates the acquisition process.

Next, concepts grow into requirements and technologies are refined into systems through the concept formulation process. Technologies are traded off against each other, they are analyzed vis-a-vis the elements of the concept, a best technical approach is selected and then analyzed in terms of cost and operational effectiveness. The product is an Operational Requirements Document to be used in developing and selecting a prototype. Further engineering development, followed by full scale production, yields an item ready for fielding, with full specifications documented in a technical data package.

Developer interests are easily understood since they are action or object oriented. An example of the developer's hierarchy is shown in Figure 2.

User interests are less clearly stated, but also easily understood. Somewhere, someone comes up with a bright idea in response to a perceived deficiency or opportunity. This is probably first stated with a musing, "Wouldn't it be nice if we could . . . (do something)." These thoughts grow and are eventually codified in a concept that gets to the heart of what we would like to do and how this would fit into the Army structure. This is further narrowed to specific, testable performance characteristics. And, after the item has been produced, it is placed in the hands of troops.

The formal structure for doing all of this is prescribed by the Army Life Cycle System Management Model. Its phases, processes and products are all well defined as an ideal road map. The problem is that the road map does not start until the Mission Need Statement is approved at Milestone Zero. Everything that occurs before that is a little sketchy—and that is the domain of the concept developer.

How does all this percolating and coalescing occur? It is usually depicted as a flow chart in which boxes representing the threat, capabilities, technology, doctrine and perhaps other influencing elements all join into one arrow leading to a box labelled "concept." Without explanation, the arrow may be taken to indicate "something magic happens."

Concepts are not magic. They are not conceived by the mysterious mixing of several ingredients and do not then leap into existence fully formed. They are the product of an evolutionary process that may not be too different from the engineering design process, and that, therefore, may be called appropriately "concept engineering." In this new view, the concept development process can be conveniently divided into three progressive phases that parallel the development of engineering drawings.

As a quick review of engineering drawings, consider a project to build a bookcase for your home. A Level 1 drawing is a rough sketch that shows general configuration and dimensions. If you are building the bookcase in your workshop, this is all you need since you will be buying the materials and can fine-tune construction as you go.

If, however, you don't have a home workshop and are asking a friend to build the bookcase, a Level 2 drawing is required. This specifies greater detail: possible component configurations, more exact measurements, types of joints used, materials and so on. Since your friend can always ask you questions, extreme detail is not necessary. That degree of detail is found in Level 3 drawings. These are the production blueprints that could be used by anyone, any time to produce a bookcase indistinguishable from any other one produced using the same drawing.

To make the concept engineering comparison to engineering drawings, three levels of concept development are defined: notional, descriptive and application. See Figure 3.

A notional concept is that initial, amorphous ball of bright ideas that is probably a little non-traditional, and maybe even a little outrageous. It adds the "r" to evolution and provides the essential break from the past. If the materiel world were simply a matter of thicker armor and bigger guns, there would be no need for such concepts. But, not every problem leans toward a "more/better" solution. Some problems demand a great leap: applying new technical opportunities often requires the same. This adds another problem to highly structured organizations: the signal—and worst—characteristic of great leaps is that they require change.

This, though, is not a problem, but rather the real role of notional concepts: to be an agent for change—to gain the willingness of senior leadership to listen further and to allow and support further development. The writers of these concepts are creators—they make something from nothing. They must approach the task with a view that all things are possible. Their supervisors must posses both vision and courage. They must be comfortable with uncertainty. They must accept things that, on the surface, may not make a lot of sense. Supervisors must have the courage to stay the course when under fire from those who demand short-term delivery, but also to prune unpromising efforts without penalty to the writers.

A descriptive concept brings things down to earth. The practical "how to" questions are addressed here. Capabilities, constraints and relationships are all mapped out in limited detail as the final structure takes shape. If materiel developers have not been included up to this point, they must be added now. In spite of earlier optimism, we do not live in a world where all things are possible, or one where all possible things are affordable or wise.

The role of a descriptive concept is to fit the new piece into the old puzzle. Neither a concept nor its result exists as a distinct entity. Concepts are interrelated under umbrella concepts; items are elements of systems and systems of systems. As autoloader for an artillery system does not just feed the gun faster, it increases potential consumption, which, if uncontrolled, could bring the war to a screeching halt in a very short time for want of ammunition. A good descriptive concept will prevent us from doing things wrong as we are trying to do things right.

Finally, an application concept is the execution document. It may fall into one of several classes. A doctrinal concept will influence how we fight. An organizational concept will describe potential Army structures. A training concept will address how we prepare soldiers to do the various jobs required by a ready force. Of direct interest here, a materiel concept will modify the tool we take to war. These classes, though described separately, are also related in a rather complex way—

DEVELOPER/USER RELATIONSHIP

DEVELOPER	USER	DOCUMENT
Science	Idea	Need or Capability Statement
Technology	Concepts	Mission Need Statement
Systems	Requirements	Operational Requirements Document
Items	Fielding	Specifications (TDP)

Figure 1.

EXAMPLE OF A DEVELOPER'S HIERARCHY

SCIENCE: Information processing, mathematics, electronics.

TECHNOLOGY: Data bases, knowledge representation, microprocessors, video displays.

SYSTEMS: Knowledge-based systems, protable computers.

ITEM: Flight line troubleshooting system for F-16 avionics maintenance.

Figure 2

CONCEPT AND ENGINERING DRAWING COMPARISON

CONCEPT	ENGINEERING DRAWING
Notional	Level 1
Descriptive	Level 2
Application	Level 3

Figure 3

one in which there is no clear start and exit point. A materiel concept will generate a demand for new training on new equipment. It may generate a need for new support structures or suggest modifications to units that use it. And, its use may require doctrinal changes that optimize its effectiveness. The application concept—an end of one process—is only the beginning. It feeds the Mission Need Statement that initiates the acquisition process through which all of these issues, and many more, are systematically addressed and resolved.

Good concepts are critical to good Army acquisitions. One reason is cost. It is estimated that 90 percent of an item's life cycle costs are determined by the time Milestone Two is reached; that is, the conclusion of the Demonstration and Validation Phase. We simply can't afford to fish around at the front end of program development and hope that things will work themselves out later or plan to fix an item after it has been fielded and any problems have become more visible. While it is not necessary to cast a concept in concrete early on, it is essential that we ask the hard questions and answer them as best we can as soon as possible. Materiel items without solid requirements and requirements without solid concepts have all the permanence of sand castles when the tide comes in.

But, there is a more important reason for good concepts than mere money. The success of ground operations in the Persian Gulf was not a fortunate accident; it was the direct result of Army forces being prepared with the right operational doctrine, the right organizational structure, the right training and the right materiel. The keys to these elements are good concepts, which, too, are not fortunate accidents. They come from an imaginative spark made real by broad expertise, complete coordination and hard work—all through a creative, but disciplined process of concept engineering.

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THE LONG ARM OF SOVIET ARTILLERY

By John C. Macier

The ground forces of the Soviet Union have, at their disposal, direct and general support fire from some of the world's best and longest-ranged cannon and rocket artillery systems. Soviet artillery design and development boasts a rich heritage dating to the reign of Tsar Peter the Great (1682-1725). While Soviet methodologies at times appear crude and "low-tech" to Westerners, their production and employment techniques are proven by exceptional reliability and consistent performance.

The introduction of their first full-tracked, self-propelled (SP) artillery system in the early 1970s marked the beginning of a modernization era that continues today. While the 152-mm SP Howitzer 2S3 uses an existing cannon that provides no improvement in range, the introduction of a tracked SP system was necessitated by the growing mechanization of Soviet ground forces. The 2S3 provides general and direct fire support at echelons of division and above.

Introduced one year later, the 122-mm SP Howitzer 2S1 provides direct fire support to maneuver elements at the regimental level. The 2S1 also uses an existing cannon. For the first time, however, the Soviet regimental commander possesses direct fire support which can keep pace with his fast moving mechanized forces.

Rounding out the Soviet inventory of first generation SP artillery are the 240-mm SP Mortar 2S4, 152-mm SP Gun 2S5, 203-mm SP gun 2S7 and 120-mm SP Howitzer 2S9. As this generation of weapons ages, replacements should soon be on the horizon.

Indeed, one system has already been introduced. The 152-mm SP Gun-Howitzer 2S19 represents the latest in modern SP artillery design. This system should incorporate such modern advances as an approximate 45 caliber length cannon, maximum range of nearly 27 kilometers, automated ammunition handling and onboard ballistics computation capability. The 2S19 will likely replace the 2S3 and 2S5 in echelons from division through front.

Self-propelled artillery is not the only area in which Soviet modernization efforts are ongoing. Soviet towed artillery systems, particularly the 122-mm Howitzer D-30, 130-mm Field Gun M-46 and 152-mm Gun-Howitzer D-20, have long provided standards by which other systems were measured, and have been widely exported. Their stalwart performance and dependable, no-frills muscle make these systems favorites with countries who lack their

152-mm SP HOWITZER 2S3

The 2S3 marked the beginning of the era of modern Soviet artillery when it was first introduced in 1973. Drawing from proven components such as the D-20 cannon and a hybridized chassis, the 2S3 has proved an effective and venerable system. Reaching the end of its production run only last year, it is widely deployed with Soviet forces and in-service with many armies around the globe.

122-mm SP HOWITZER 2S1

Introduced in 1974, one year after the 2S3, the 2S1 is basically a smaller caliber version of its larger cousin. The 2S1, however, with its 122-mm ordnance is specifically designed for employment at the maneuver regiment level.

203-mm SP GUN 2S7

Able to accurately fire a full range of munitions to a distance bordering on 40 kilometers, the 2S7 is a weapon not to be taken lightly. While it is not believed to be deployed in great numbers, the deadly accuracy of the 2S7 makes it a threat to moderately deep targets such as Division TOCs, troop concentrations and resupply points.

240-mm SP MORTAR 2S4

Innovative design in the loading and emplacing of the 2S4 have allowed the Soviets to mount such a system on a highly mobile platform. Though short on range— probably nearly 10 kilometers maximum— the 2S4 is ideally suited to the task of destroying heavy fortifications, even those built of reinforced concrete.

120-mm SP HOWITZER 2S9

Conceived primarily for use by airborne forces, the 2S9 is one of the most unique and highly-specialized artillery systems in the world. The 120-mm ordnance serves a multi-role function unlike any other known cannon. The 2S9 is able to fire mortar bombs from the upper register, HE-FRAG rounds from the intermediate register and High Explosive Anti- Tank (HEAT) rounds in direct fire. Its unique multi-role capability is particularly suited to the needs of airborne forces in the establishment of an airhead.

own production capability, or can not afford costlier Western systems.

Advances in Western cannon technology, however, eventually produced systems which out-ranged and outperformed their Soviet counterparts. Western 155-mm cannons with an approximate 43 to 45 caliber length became the standard by the 1980's. Soviet developments in this arena were soon evident with the introduction of the 152-mm Gun-Howitzer 2A65. The 2A65, believed to be the towed counterpart and ballistically similar to the 2S19, is comparable to modern Western systems. With the use of extended-range, full-bore, base-bleed ammunition, the 2A65 probably outranges the best comparable Western systems by nearly three to five kilometers.

The U.S. Multiple Launch Rocket System (MLRS) is also not without its Soviet counterpart. The Soviets have long depended on Multiple Rocket Launchers (MRL) as a primary ingredient in their artillery mix. Soviet MRL systems are deployed from regiment to front level and encompass a caliber range from 122-mm to 300-mm. The 122-mm (40-Tube) MRL BM-21 is probably the most successful and popular MRL system in history. Providing direct support, a battalion of BM-21 can deliver 720 rockets carrying high explosive fragmentation (HE-FRAG), smoke, incendiary or chemical warheads to a range of probably 18 kilometers. The end effect is devastating.

The newest Soviet entry in MRLs, and that most comparable to the U.S. MLRS, is the 300-mm (12-Tube) MRL SMERCH. Photographs and technical data of SMERCH were first seen at the Defense Services Asia exhibition in Kuala Lumpur, Malaysia in early 1990. While the SMERCH system does not appear—on the surface, at least—to incorporate any surprising technological advances, it boasts a maximum range of 70 kilometers carrying an Improved Conventional Munition warhead loaded with 72 HE-FRAG bomblets. This munition is ideally suited for attacking soft targets in an enemy's rear area when deep penetration air strikes are not possible

122-mm (40-Tube) MRL BM-21

Simplistic in design, yet reliable and accurate, the BM-21 has formed the backbone of Soviet MRL assets since the 1960s. While there have been several modifications to its chassis and the rockets which it fires, the system remains basically unchanged since its introduction. The BM-21 is probably the most widely used MRL system in the world today. Few systems can match its favorable cost/effectiveness ratio.

300-mm (12-Tube) MRL SMERCH

Recently unveiled at an international exhibition, SMERCH is the Soviet's newest and longest ranged MRL. Its capability to deliver ICM warheads to a range of 70 kilometers is unequaled in any other comparable MRL system. Though it is a new system, the Soviets are evidently ready to enter their newest and best systems in an already crowded and competitive arms market.

or desirable.

In order to achieve consistent accuracy, the Soviets have developed the Artillery Command and Reconnaissance Vehicle (ACRV) systems. The ACRVs are tailored for either towed or SP cannon or MRL artillery and provide target acquisition, survey, ballistic computation and Command, Control and Communications at the battery and battalion level. The ACRVs function as an integral part of the artillery formation and are essential to mission accomplishment.

Artillery has long been an essential element in Soviet military doctrine. The Soviets rely heavily on massed artillery fires to weaken an objective prior to an offensive strike by ground forces, or to break the back of any opposing ground force moving against Soviet defensive positions. The recent deployment of second generation systems will insure the Soviets an effective means of putting steel on target into the year 2000 and beyond.

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ARTILLERY COMMAND and RECONNAISSANCE VEHICLE

The ACRV shown here is one of a series that would be assigned to an artillery battalion. Vehicles are designed to serve the functions of battery or battalion observation posts and battery or battalion fire direction centers. This particular series utilizes a modified MT-LBu chassis; one which has proven reliability.

DEVELOPING MANAGEMENT STRATEGIES FOR RD&A PROGRAMS

Improving Productivity and Efficiency

By CPT James R. Hann

Introduction

The widely diversified nature of Department of the Army (DA) research activities often makes it difficult for managers to relate their efforts to the overall goals of the Army. Consequently, the strategies used to accomplish these goals are often unclear and, in some cases unsound. All managers and leaders would agree that there is no one plan or program to handle every situation. Highly successful managers develop methodologies for problem solving that are tailored to the culture of the organization and combine proven management principles with individual program and personnel requirements. The purpose of this article is to identify several key issues or parameters that should be considered by the manager when developing this methodology.

This article is based on the research conducted by the author as part of his graduate degree work under the Army Advanced Civil Schooling Program at the Ceramic Engineering Department of the University of Missouri-Rolla. The original research consisted of an extensive literature review and an attitude survey of 204 research professionals. The response rate for the questionnaire was 48 percent. All the respondents were affiliated with the ceramic or advanced materiel technology field and were selected from the commercial, government and university research communities. It was evident from the survey that it would be difficult to quantify, in any meaningful way, the relationship between the Army's goals, Army research objectives and the strategies used to achieve them. We could only quantify the relationship between the attitudes researchers have about DA strategies and the effect of those strategies on the objectives.

Current Management Thrusts

Public Law 100-456, the National Defense Authorization Act for FY 1989, was enacted to provide Congress with a Critical Technologies Plan for the Department of Defense. While compiling this plan, defense officials clearly were not going to abandon the DOD Science and Technology Program, which had formed all the long-range strategic planning to date.

The Army also has a series of 10 technological thrusts, known as fields of technical endeavor (FOTEs), which are tailored to the Army's specific role and are managed by the Army's Laboratory Command (LABCOM) in Adelphi, MD. All of these thrusts may have the tendency to dull the focus of managers who want to meet all the requirements but are unable to obtain a clear, concise view of what is truly critical.

One of the most practical methods for improving management efficiency is to learn from those who have been successful. The 1986 President's Blue Ribbon Commission analyzed a number of successful commercial programs and found six features common to all of them: clear command channels; program stability; limited reporting requirements; small, high-quality staffs; communication with users; and prototyping and testing.

Most of the commission's recommendations were adopted in full or part between 1986 and 1988. The success of any program is measured relative to the conditions prior to its implementation. In this case, management conditions have improved dramatically, but respondents to the survey still imply that problems exist with command channels, stability and reporting requirements.

Other weaknesses identified by various authors writing on the subject include the educational system, strategic raw materiel reserves, civil service employment procedures, funding, dependence on foreign technology, and unnecessarily regulated specifications for government programs. Managing this potpourri of variables is challenging, but not impossible.

The first step for a successful manager is to determine which issues are important to his or her employees and then plan to implement policies to ensure that those areas are constantly improved. The identification of some of those key issues is one of the goals of this research. A military or civil service professional who manages a widely diversified program involving personnel from commercial, government and university backgrounds is at a distinct disadvantage when trying to ascertain these key issues. One might expect significant differences in the way these three basic groups interpret the effects of current federal strategies on their research efforts. These differences are based on varying backgrounds, ages, organizational environments, salary schedules and a myriad of other details. The purpose for this study was to uncover these differences within a controlled context, establish where the groups differ, and propose how one might better manage assets based on this information.

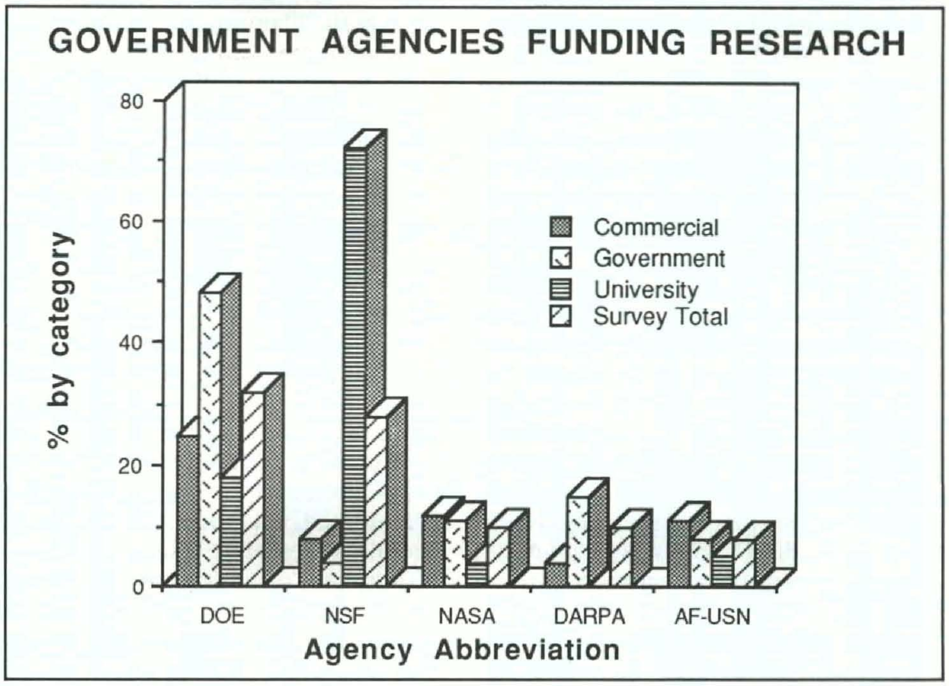

Figure 1.
Which government agencies have provided you with research funding?

Survey Analysis

The target group for our survey was active scientists and researchers, as opposed to managers, executives and government leaders. This allowed the author to obtain feedback from individuals in middle management positions. This article concentrates on responses that were statistically significant and other responses that are important based solely on the response distributions.

The first five questions in the survey were designed to establish the respondents' relationship to the research topic and whether they had sufficient practical experience to provide valid responses. If the respondents did not have experience with DOD, DA or other federal agencies, their interpretation of federal policies in the remaining survey questions would be suspect.

All of the respondents claimed experience with government funded research, although several were not actively engaged in funded work at the time they completed the questionnaire. Forty-three percent had experience with DOD/DA funded projects. Figure 1 shows the top five government agencies, without considering DOD/DA levels, with which respondents had previous experience. Clearly, our nation's universities continue to depend heavily on federal funding, especially from the National Science Foundation, for their ceramics and advanced materials research.

Results

The percentage of research work currently funded by government agencies is shown in Figure 2. Several analogies to previously published work can be drawn from these data. First, the extremely low percentage of government funding activity in the commercial sector is based on many diverse factors. The added expense of reporting procedures required by the government hinders many small laboratories from competing for these funds. Based on the written responses and the low response rate (34.7 percent) of the commercial group for this survey, there appears to be a general mistrust of government programs and policies. Second, the 25 percent of government researchers who are funded, in part, by other than government sources is a departure from past policies. There is an increasing amount of contractual work being done for both private industry and state and local agencies. In many cases, as typified by the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), the top researchers in a given field are located at a government facility. Their expertise is made available to the public through a variety of flexible arrangements. Third, our nation's higher education facilities continue to depend on government sources for research funding. Any significant cutbacks in DOD, DOE or NSF funding would immediately impact more than 80 percent of the university researchers surveyed.

Another area of concern for managers is their employees' perception of the process of long-range planning and budgeting. While most managers conduct extensive long-range planning and budgeting, the information is not being passed down effectively to researchers in the field. Researchers in the larger facilities appeared to be more affected by this phenomenon, where program analysts manage the budgets and there is no direct day-to-day accounting of expenses by the researcher conducting the work. Figure 3 shows the number of respondents who reported having a long-range plan and the number who reported that their long-range plan is tied into the annual budget process.

While a relatively large percentage of the survey total acknowledge the existence of a long-range R&D plan, a significant number believe their long-range plan is not connected to the budgeting process. This is true even in the government researcher category where the Planning, Programming and Budgeting System (PPBS) provides extensive justification for every project and task in the Research, Development, Test and Evaluation (RDTE) functional area. The RDTE activities are multiple-year appropriations, available for obligation for two fiscal years. Any RDTE project funded by DOD must have been through this process unless either national security or some other emergency dictated otherwise.

A majority of the statistical effort in this study was directed at finding the parameters which differed between the commercial, government and university communities. The parameters investigated included the following: quality of research, research efficiency, equipment procurement, information access/availability, information data bases, funding support, professional development, professional standards, researcher productivity, employee retention, raw material availability, technical guidance, research facilities, entry-level education, and advancement potential.

The three groups differed in their attitudes in only two of the areas, researcher productivity and equipment procurement. Figure 4 shows the results for the researcher productivity response. The variance between groups was significant at the 95 percent level and was due to the difference in responses between the university and the government groups. The government group believed that current government policies had a negative effect on productivity, while the university group believed there was a positive effect from these policies. Neither the government nor university group differed significantly from the commercial group. The difference can be attributed, in part, to the higher volume of administration required by government workers which they feel detracts from their primary research mission.

Research equipment procurement responses also varied significantly at the 95 percent level, as shown in Figure 5. This variance is attributable to the university group assigning it as a positive influence, while both the commercial and government groups responded in a more normally distributed manner. One could deduce from this dichotomy, along with other sources, that university researchers are procuring new equipment with government funding while government researchers in certain segments may be experiencing budget cutbacks due to

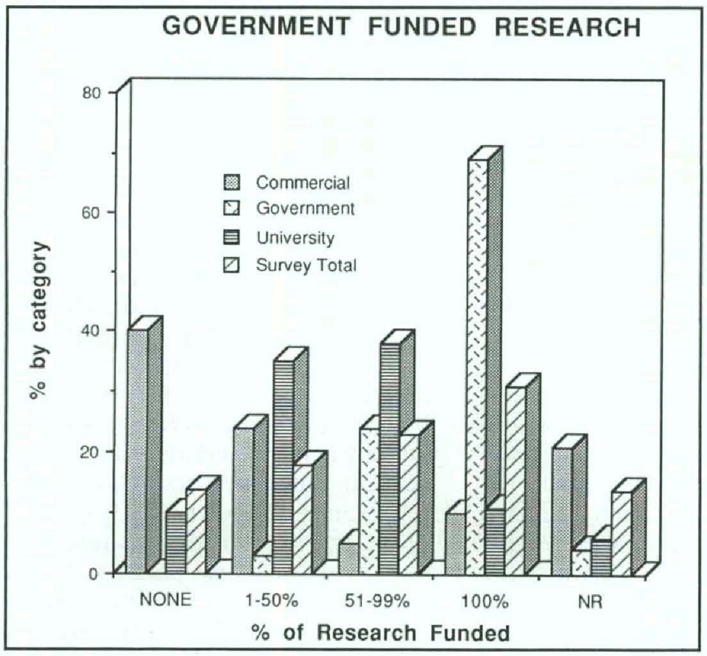

Figure 2.
What percentage of your current research is funded by a government agency?

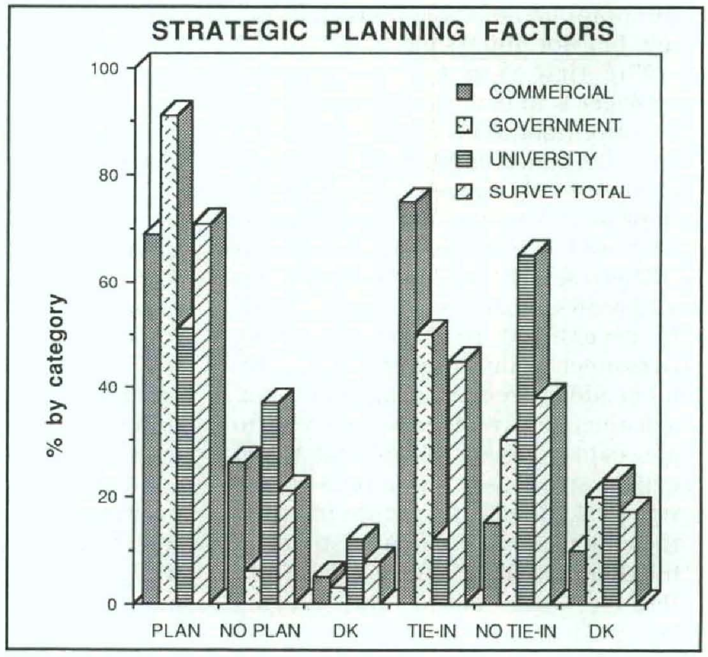

Figure 3.
Does your work unit have a long-range plan for R&D activities? (1st three data sets) Is your annual budget tied to the plan at the next higher budget level? (second and third data sets) [No response recorded as DK (don't know)]

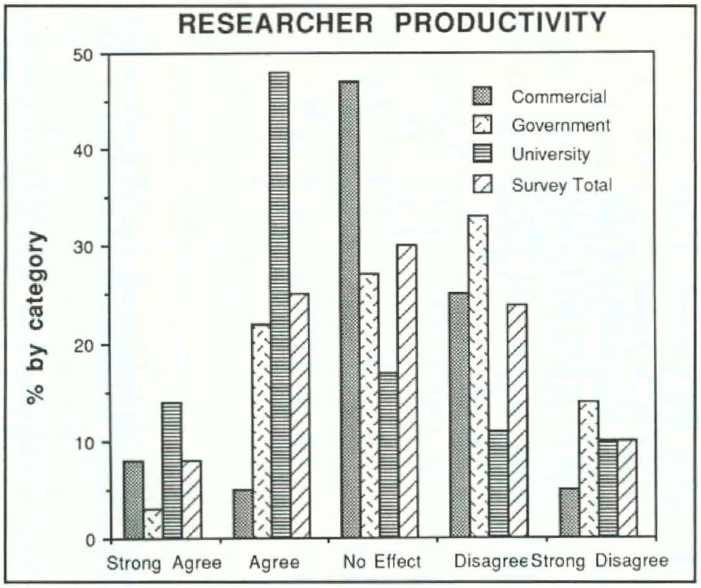

Figure 4.
Would you agree or disagree that current federal strategies and policies, as you interpret them, have a positive effect on researcher productivity?

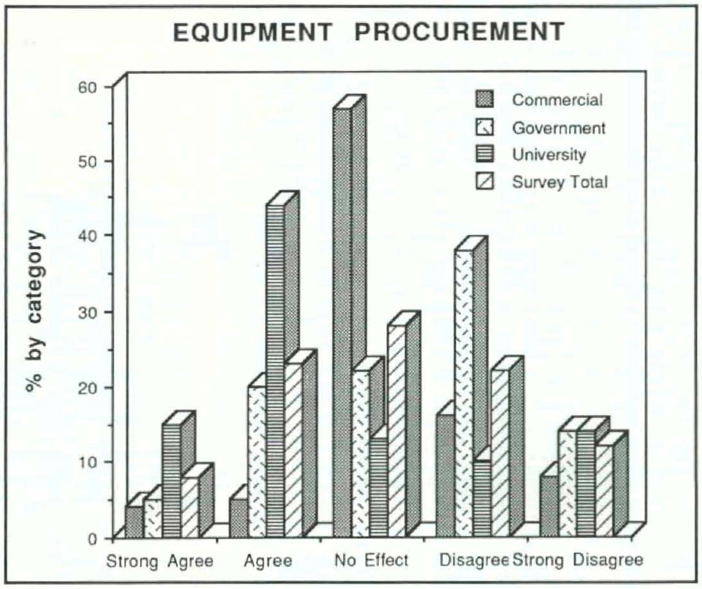

Figure 5.
Would you agree or disagree that current federal strategies and policies, as you interpret them, have a positive effect on equipment procurement?

the federal deficit reduction efforts. There was a negative response by the university group to a similar question on whether or not there are sufficient levels of support for research equipment to maintain national defense and technical superiority. This indicates that, while current policies are productive for university groups, they feel there is a need for an increased effort for the U.S. to maintain its initiative.

The strongest response came from the funding support question. Forty-four percent of the survey total disagreed that there are sufficient levels of funding, and 18 percent, the largest percentage for this response in the survey, strongly disagreed. There was little difference between the groups regarding this parameter. The final survey question asked respondents to rank the top three research issues that are critical to the success of their research efforts. The top four responses, based on summing first, second, and third choices, were funding support, research facilities, research equipment, and quality of research.

Summary and Recommendations

From a management perspective, there appears to be little evidence to cause managers of multidisciplinary projects to tailor their program differently for each of these groups. From the survey analysis and results, the following are recommended:

- A priority of effort on securing consistent, multiyear funding support at adequate levels would appear to be the best overall first step in any project. While this may be obvious to the veteran manager, it is often not quite so clear to a new manager or to subordinates whose work guarantees the continued flow of funding.

- Plans to improve and maintain research equipment and facilities should be incorporated in this funding and the entire plan communicated to subordinates as soon as it is finalized.

- Research team members should be aware of changes in the plan and, in turn, advise their superiors on significant advances or setbacks that could impact the program.

- Managers should emphasize quality and productivity by eliminating administrative distractions and unnecessary reports.

- The organization's objectives must be clearly stated and the necessary resources must be provided to achieve the technical solutions that support those objectives.

- Finally, managers must instill in their researchers, and all employees, the belief that they are important to the organization. Only then will they become productive, efficient contributors to the Army's research effort and to the community in which they live.

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A NEW TOOL FOR THE COMBAT DEVELOPER

By CPT Douglas Sena

Introduction

What Is The Best "Scout" Aircraft For The Future? Finding the solution to an issue like this one is a typical combat development concern. Combat developments is the process within the Training and Doctrine Command (TRADOC) whereby the Army establishes requirements leading to new or improved systems or organizations to improve the Army's capability to carry out its mission. Since many possibilities for future scout helicopters are still on the drawing board, how is a reasonable person able to accurately compare and evaluate the many different alternatives? One answer is to simulate the attributes of each helicopter with a model.

A model is a representation which attempts to imitate the real world. Computer models are able to perform events which are impossible, environmentally unacceptable, too expensive, too unsafe, or impractical to perform in the real world. Using a model, one is able to simulate events and change any characteristic, present or future, friendly or threat, of any weapon system, sensor, organization, tactic, etc. At the same time, a computer records the output data, called measures of effectiveness (MOEs). One is then able to analyze this output data to determine the effect of Scout alternatives.

A New System

A new modeling system called ADST, Advanced Distributed Simulation Technology (previously known as AIRNET/SIMNET), is an evolutionary advancement in the combat development modeling of combined arms operations and conflicts.

Models

Basically, no model is "real" since all models depart to some degree from actual combat. The amount and quality of information, degree of realism, time and resource requirements of models varies with different categories of modeling systems. These categories, from best to worst and longest to shortest, are combat, field tests and experiments, manual war games, computer war games, probabilistic war games, and finally mathematical models. ADST is a field test that uses real soldiers who fly in visual cockpit simulators instead of aircraft.

ADST provides a large scale network of fully interactive and integrated vehicle and aircraft simulators. It displays human and materiel resources on a computer-generated battlefield, providing real-time synchronized execution of collective warfighting skills in the combined arms and joint arena. In addition to a tremendous collective training capability, ADST has a potential for combat development modeling.

JANUS and CASTFOREM are the present day accredited systems in high resolution modeling devices. They are combat simulators with dynamic representation of maneuver elements meeting each other in conflict.

Validation

The Army considers JANUS and CASTFOREM valid models, while many analysts in the combat developments field are critical of ADST since it is not a "valid" model. Validation is a process to determine whether or not a simulation model is an accurate representation of the real world system being modeled. Since all models are always only an approximation of an actual system, absolute validity is an impossibility.

ADST is still in the infancy of its development, and capability, so the Army has yet to realize its full potential. As the Army focuses attention on fine tuning ADST, validation of it is a probable outcome.

Measures of Effectiveness

In addition to being valid, models must be able to record Measures of Effectiveness (MOEs) for the decision maker. JANUS, CASTFOREM, and ADST are able to simulate and measure "hard" MOEs, which are items that a computer is able to easily count, such as red losses, blue losses, red losses inflicted by blue helicopters, etc.

Additionally, JANUS, CASTFOREM, and ADST are able to simulate "soft" MOEs, which are items that a computer is unable to count, such as, leadership, pure cavalry functions, etc. Table 1 shows a more complete list of soft MOEs.

Although JANUS and CASTFOREM are able to model soft MOEs, as computerized war games, they are unable to observe and measure most soft MOEs. On the other hand, ADST is capable of modeling, observing and measuring most soft MOEs. Using ADST, analysts are now able to evaluate soft MOEs that are difficult or impossible to determine with JANUS or CASTFOREM.

For illustration purposes, suppose the Army is trying to determine what is the best size organization for the Air Cavalry Troop. Assume JANUS or CASTFOREM modeling efforts reveal a rank order (from best to worst) of 14, 12, 10, and 8 Scout helicopters. Ideally, the Army should field the highest ranking number, 14. However, some senior officials might question if a young captain troop commander is able to command effectively 14 helicopters on the battlefield. Using ADST, analysts are able to determine analytically what the maximum number of helicopters a typical troop commander is able to control. In other words, analysts are now able to provide the decision maker with analytical information on the soft MOE called "leadership."

Partial List of Soft MOEs

- Leadership
- Morale
- Discipline
- Suppression
- Why fratricide occurs
- Collective tasks
- Accidents (an aircraft crashing due to pilot fixation on the target)
- The fog of war (getting lost, incorrect weapon system selection, incorrect target identification)
- Command, control and communications
- Tactical Operations Center operations
- Administrative/Logistical Operations Center operations
- Ability to adapt, change and think
- Cavalry operations
- Value of negative situation reports (a report of nothing found, etc.)

Table 1

Measuring Soft MOEs

For illustration purposes, combat developers might address the Air Cavalry Troop task of executing a zone reconnaissance.

Although JANUS and CASTFOREM are able to simulate soft MOEs, as computerized war games, they are unable to observe and measure most soft MOEs. Using the Air Cavalry Troop example, JANUS and CASTFOREM are able to model a troop performing the zone reconnaissance, but they are unable to evaluate the troop's ability to check all major man-made and natural key terrain features.

The problem with computerized war games is that the computers are unable to observe intangible actions. On the other hand, evaluators watching real soldiers run through an ADST exercise are able to observe the intangibles through the system's fully interactive and networked visual simulators. In the example, evaluators are able to observe the troop performing all aspects of the zone reconnaissance.

The basic framework for observing and evaluating the intangibles of Army operations is the Army's Training and Evaluation Program (ARTEP). An ARTEP includes evaluation guidelines that provide the task, conditions, and standards of actual combat missions, collective tasks, and subtasks that Army units must perform to survive and win on the battlefield.

One method of collecting the data is to evaluate externally the ARTEP subtasks in the field test environment. Using the same disciplined evaluators insures standardized observation and objectivity.

During a zone reconnaissance, the troop either checks all key terrain or it does not. In other words, evaluating an ADST scenario with ARTEP subtasks allows for the quantification of important battlefield events that were previously unquantifiable.

Conclusions and Summary

The zone reconnaissance mission of an Air Cavalry Troop is just one example. The methodology applies to any weapon system or mission that ADST is able to model with manned simulators.

ADST enables the evaluation of intangible actions (soft MOEs), such as checking all key terrain while executing a zone reconnaissance mission.

ADST does not replace the JANUS and CASTFOREM models. However, it does provide an additional tool for the combat developer. ADST allows analysts to measure MOEs that were once unmeasurable. An additional benefit of ADST for combat developments is the immense potential for a substantial cost reduction in the development of new weapon systems.

CPT DOUGLAS SENA is an R&D staff officer at the U.S. Army Aviation Center, Fort Rucker, AL. He has a B.S. degree in mechanical engineering from the U.S. Military Academy.

PEO AVIATION

BG Dewitt T. Irby, Jr.

BG Dewitt T. Irby Jr. received a bachelor's degree from the University of Southern Mississippi in 1962 where he was named the distinguished military graduate. His military education includes: the Armor Basic Course, the Transportation Officer Advanced Course, Command and General Staff College, and the Industrial College of the Armed Forces. Listed among his previous key assignments are: project manager for the CH-47D Modernization Program; aviation programs control officer, Office, Deputy Chief of Staff for Logistics, Department of the Army; battalion commander for the 205th Transportation Aircraft Intermediate Maintenance Battalion; commander of the 593rd Area Support Group; and deputy commanding general, U.S. Army Aviation Systems Command.

"The PEO is about to enter a new era. Our management philosophy must evolve to meet the demands and challenges of the uncertain future foretold by the shrinking budget for all of DOD. The Program Executive Office for Aviation must be streamlined to facilitate responsive decision making on the development and acquisition of all major and non-major programs. The continuous improvement of this process is our number one priority," Irby said.

"Our task is to put the highest quality materiel in the hands of the soldier for use in combat. We will not provide weapons systems to the soldier unless we are confident that they will perform as advertised. It is a given that we must do more with our equipment, dollars, people, and force structure. Additionally, the world of Army aviation faces unique challenges. Over the past years, this mission area has evolved out of the aviation world of airframes, engines, transmissions, rotorblades, and gear boxes into a world of highly complex, avionics intensive weapons systems. These highly technical mission packages and weapons systems must be acquired and managed by the PEO organization quite differently from the way we have in the past. I look forward to achieving our objective to institutionalize continuous improvement and all its essential components of leadership, team work, customer satisfaction, common goals, quality products and services. . . and most importantly. . .vision," Irby said.

Missions and Organization

The PEO provides executive-level management of the assigned major acquisition programs, while providing overall direction and integration of weapons system programs, and assures the effective interface with Headquarters, Department of the Army, other services, combat developers, and supporting commands and activities. The PEO also exercises executive-level authority and responsibility for the program management, technical and quality management, logistics support and readiness management activities of the assigned weapons systems. These weapons systems include: the RAH-66 Comanche, AH-64 A/B/C Apache, OH-58D Kiowa Warrior, CH-47D Chinook, UH-60 A/L Black Hawk, MH-47E and MH-60K Special Operations Aircraft.

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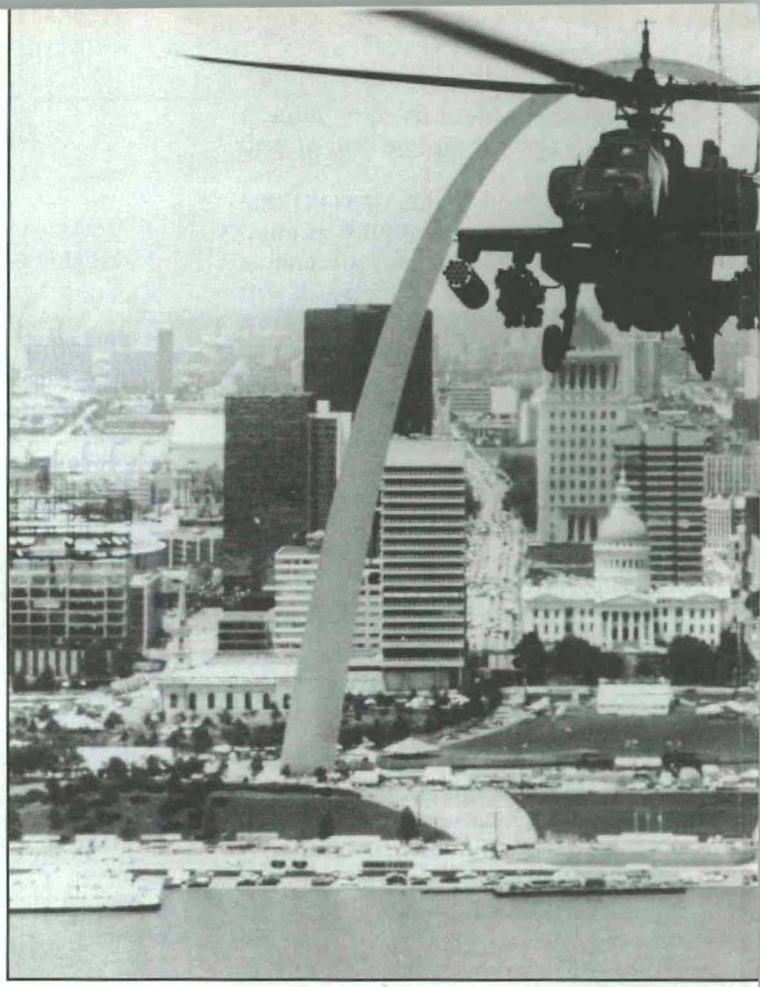
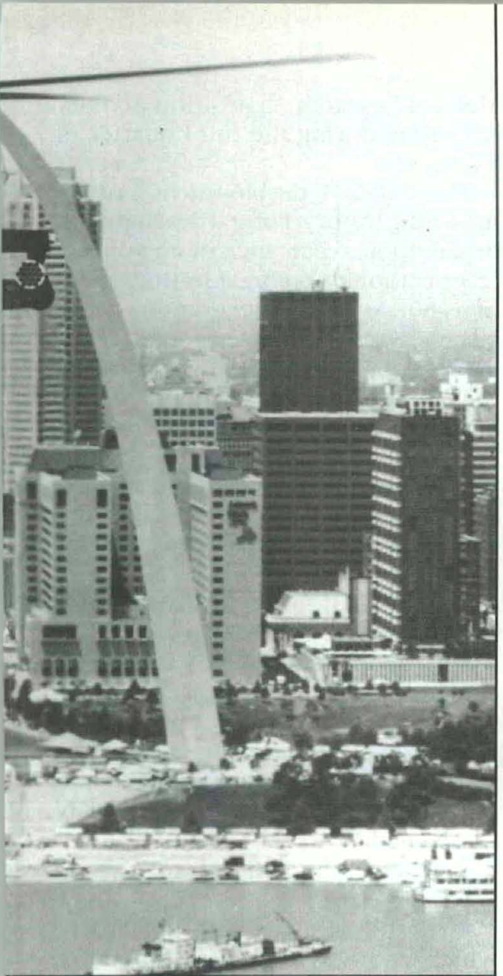


APACHE (AH-64A

After Operation Desert Storm, the AH-64A, better known as the Apac[h] Gateway Arch is of St. Louis. The Apache made its debut in 1985 and [t] attack helicopter fleet proved its versatility during the Gulf War.

BLACK HAWK (UH-60A)

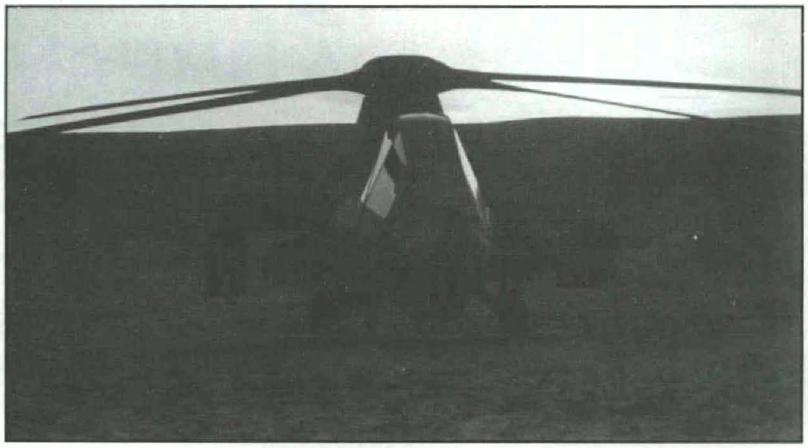
During Operation Desert Storm, UH-60A Black Hawk aircraft flew a missions, including troop and artillery movements, medical evacuati and rescue, forward area resupply, and command and control. The B proved extremely reliable during the operation, accounting for over 6 flown while maintaining a fleet mission-capable rate average of over



is as much a symbol of Army Aviation as the
evolving. This seasoned member of the Army's

PROGRAM EXECUTIVE OFFICER AVIATION

A Continuing Series to Familiarize Our Readers with Key Army RD&A Organizations and Leaders



BOEING SIKORSKY RAH-66 COMANCHE

A full-scale mockup of the Boeing Sikorsky RAH-66 Comanche is shown. Boeing Sikorsky's RAH-66 will provide the U.S. Army with a new light helicopter that will be more capable and easier to maintain than the current fleet of Vietnam-era light helicopters. The RAH-66 quickly converts from its stealthy scout role into an attack helicopter that can engage ground targets and enemy aircraft. The RAH-66 is armed with a two-barreled 20mm cannon and missiles or rockets carried in internal weapons bays that retract into the fuselage to reduce the helicopter's radar signature.

KIOWA WARRIOR (OH-58D)

Coupled with an extremely accurate inertial navigation system, the digital Airborne Target Handover System of the OH-58D Kiowa Warrior enables the engagement of six conventional artillery targets in the same amount of time it takes to accomplish one artillery mission using other engagement means. Delivery began in May 1991 for OH-58Ds with provisions to accept Air-to-Air Stinger missiles and combinations of 70mm Hydra Rockets, 50-caliber machine guns and Hellfire missiles.

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DENTAL IMAGING SYSTEM: A DREAM COME TRUE

By MAJ Jean P. Vreuls Jr.

Decisions from a Milestone I/II program review conducted in the spring of 1990 marked a major step toward fielding the next generation diagnostic imaging system. The product, the X-Ray System, Dental, Miniature (XRSDM), is under development to increase clinical and operational capabilities (dental and medical) throughout the theater of operations while reducing the logistics burden associated with the large, bulky X-ray and film processing systems which are currently used. Current systems are not designed for field use and require wet chemistry to produce an image for clinical diagnosis.

The XRSDM is the first imaging system specifically designed and developed to eliminate wet chemistry and incorporate modern digital imagery as a subsystem to a very lightweight, hand-held X-ray machine for battlefield health care.

Key issues were:

- Should the Army stop the full development program and pursue a modified off-the-shelf item?
- How can the Army ensure that the item, which is determined acceptable during technical and operational testing, is in fact the item procured?
- How can the Army reduce the procurement time required to gain modern technology for today's systems, rather than fielding old technology due to a long transition and procurement process?

Through cooperative efforts between the U.S. Army Medical Materiel Development Activity (USAMMDA) and two contractors, technological needs were recognized. In addition, nondevelopmental (NDI) and developmental items were identified for testing.

User and technical tests proved the operational and technical concept, however supportability of the system remains the unanswered question. Operator safety is a significant concern as is radiation safety. All field tests indicate that exposures by the operator are below the detection threshold for individual dosimeters. This is achieved by shielding the backscatter radiation at the point of origin—at the dense structures of the jaw bone and teeth. The clear circular end of the dental collimator, which is 6 inches in diameter and 1/4-inch thick, is leaded plastic which provides operator radiation protection.

The decision was made to continue with a level two (modified) NDI developmental effort and structure the follow-on contract to give the government an option to buy production items. Taking advantage of an NDI through a cooperative effort saves time, labor, and provides the least technical risk to the government. A contract should be awarded by the U.S. Army Medical Research Acquisition Activity sometime during the third quarter of FY 91.

The XRSDM development project has a long history. Formal development began upon acceptance of an approved operational and organizational plan in 1986. As the project matured and became known, the user community expressed more interest in it. Initially, the device was seen as a purely dental X-ray, however the system is now sought by the Quartermaster for Graves Registration Teams to collect post mortem identification data, by the Special Forces for the Forward Area Support Team, and the most recent interest is by orthopedic surgeons for far forward triage. There is even some interest from explosive ordnance disposal teams for letter bomb and plastic fuse analysis. A Joint Services Operational Requirements document was approved in December 1989, and is now under revision to further clarify these needs.

Currently, the XRSDM consists of two subsystems:

- a Hand-held Dental X-ray (HDX), which is a 10-pound, battery-operated, dental X-ray, complete with a ruggedized case which can fit under an airline passenger seat; and
- a Filmless Dental Imager (FDI), which is a computer-based digital imager that requires no chemistry to provide instantaneous dental images to the treating dentist on a high resolution video screen. Battery-operated and configured to fit in its own ruggedized case identical to the HDX, this subsystem is under development as a Pre-Planned Product Improvement (P3I). Each subsystem will weigh approximately 25 pounds.

The HDX is a dental X-ray system and will be fielded for that mission. However, with the use of a Medical Support Kit (MSK), the forward deployed surgeon could have medical imaging capabilities. The MSK would supplement the HDX by providing a complete medical imaging system certifiable under the Code of Federal Regulation using two portable suitcase-size equipment cases having a total weight of 50-60 pounds.

The MSK incorporates 8-by-10-inch self-developing film, a dry 8-by-10-inch film processor, cassettes, a tripod, and a medical collimating device. This kit supplements the HDX for medical ap-

For emergency dental care, the miniature dental x-ray system can use a vehicle battery as a power source. (U.S. Army Institute of Dental Research photo.)

plications and it supplements the XRSDM for both medical and dental applications.

The medical collimating device simplifies radiograph procedures by using a new hardware design developed by USAMMDA. It also incorporates an aim-and-shoot approach. The collimator will provide X-ray field and cassette alignment as well as source-to-image distance determination, critical for 8-by-10-inch, 10-by-12-inch, and 14-by-17-inch radiographs, all within a five-pound package. This effort is a P3I and will compete equally against other small, lightweight medical imaging systems.

Today, no imaging capability exists for medical applications in forward deployed units. This is a significant shortfall, according to COL Jimmie Coy, deputy surgeon, 1st Special Operations Command (Individual Mobilization Augmentee). In November 1989, COL Coy submitted an article to the *Journal of Military Medicine* which stated that a need exists for a compact X-ray machine weighing approximately 25-30 pounds. Also in November 1989, the Academy of Health Sciences (AHS) Radiology Department conducted an informal study on use of the HDX for medical radiographs, indicating acceptance of this device.

In a March 1991 report to the surgeon general, MAJ Joseph Erpelding, Medical Corps (Officer in Charge, 5th MASH Forward Support Team during Operation Just Cause) indicated that 75 percent of all injuries during Operation Just Cause were extremity injuries and orthopedic in nature. Lack of an imaging capability far forward represents a significant clinical deficiency which seriously frustrates the battlefield clinician. Erpelding cited the unnecessary evacuation of patients with minor injuries. A small X-ray, like the HDX, could prevent unnecessary catastrophic medical intervention like loss of limb due to infection from missed foreign bodies.

With the decision to continue a modified NDI, USAMMDA is pursuing a program to develop and test 25 HDX units with a Low Rate Initial Production option—all within the next 18 months. Refurbishment of old test units to like-new condition will save the Army millions of dollars in procurement costs and will accelerate the Army Medical Department fielding process to meet the Army's dental needs.

MAJ JEAN P. VREULS JR., OD, recently served as product manager for the X-Ray System, Dental, Miniature at the U.S. Army Medical Materiel Development Activity in Fort Detrick, MD. In April 1991, he was assigned to the U.S. Army Strategic Defense Command in Huntsville, AL. Vreuls holds a B.S. degree with a concentration in engineering from the U.S. Military Academy, and an M.S. degree in nuclear engineering from Texas A&M University.

THE MARRIAGE OF TECHNOLOGY AND DOCTRINE

Evolution of the Air Assault Concept

By CPT Kevin Dougherty

The brilliant success of the 101st Airborne Division's air assault into the Tigris-Euphrates Valley during Operation Desert Storm invites a study of the development of the air assault concept. This evolution is a good example of how technological advancements supported an emerging doctrine and how technology and doctrine need to work hand in hand.

The current capabilities of the 101st are the result of an evolutionary process that began before the end of World War II and was tested in combat during the Korean War. In 1946, the Marines began experimenting with helicopters as a supplement to their amphibious operations and, by the end of the year, Marine Corps Commandant General Alexander Vandegrift had authorized the creation of a test helicopter squadron. Even earlier, the Army had begun its own tests.

Veterans of the World War II airborne units were especially impressed by the helicopter's potential and, by 1945, the Army had purchased 222 of the R-6 large utility helicopters to be used for rescue, courier service, medical evacuation, and observation. Both the Army and the Marines also bought several YR-13s, a two seat helicopter. The problem was that even as late as 1947 there was no helicopter capable of carrying more than a couple of combat loaded passengers.

Perhaps for this reason and because of difficulty in coordinating with the Air Force for helicopter development, the Army focused its aerial intentions on the airborne divisions. The Marine Corps on the other hand continued its experiments with the helicopter and, when the Provisional Marine Brigade deployed to Korea in August 1950, it had with it seven utility helicopters. LTG Lemel Shepherd, commander of Fleet Marine Force Pacific, cabled Washington at the time of the Inchon landing that "No effort should be spared to get helicopters . . . helicopters in any form, to the theater at once, and on a priority higher than any other weapon."

While the Army was willing to experiment with helicopters in Vietnam, it was not prepared to accept Howze's call for a massive revision of its force structure.

Helicopters were primarily being used for casualty evacuation when the first transport squadron, Squadron 161, reported to Korea in the summer of 1951 for service with the 1st Marine Division. The squadron included 15 H-19 Chicksaw aircraft capable of carrying six fully equipped troops. The squadron progressed from resupply operations (Windmill I and II in September 1951) to troop transport (Operation Bumblebee in October 1951) to embryo air cavalry in anti-guerrilla operations.

Observing these successes, the Army stepped up its helicopter operations and formed the 6th Transportation Company (Helicopter) which reported to Korea in December 1952 with 20 helicopters. In March 1953, the company flew its first emergency resupply mission, and by May it had conducted its first major troop haul. By the end of the war, the Army fielded two helicopter companies organized as a light battalion, and the Marines had created 10 helicopter squadrons.

After the armistice, both the Army and the Marines continued to refine their use of helicopters. The Marines believed their primary mission was to put a large, heavily armed force onto a position that the enemy would defend. This would require a preponderance of large transport helicopters that could land a relatively self sufficient force quickly on the objective. Accordingly, the Marines built their helicopter force around a large Sikorski single rotor type with front clamshell doors, later to be followed by a turbine driven twin rotor model.

The Army on the other hand emphasized the helicopter's air cavalry role and began using the smaller turbine driven UH-1 or Huey. The Army hoped to use its helicopters as a supplement to a strong ground force maneuver by mechanized and armored units. The Army and the Marines were taking different paths with the new technology.

On Dec. 7, 1961, the Army began a study of the suitability of airmobile operations as a means of combatting irregular forces. Under the chairmanship of General Hamilton Howze, the board recommended on Aug. 22, 1962, that five of the Army's ROAD (Reorganization Objective Army Divisions) be replaced with air assault divisions. Howze saw the main advantages of the airmobile forces as being mobility, utility in delay operations, ability to "ambush" conventional forces, and direct firepower capability. The month after this report, the U.S. deployed 15 armed UH-1 helicopters to Vietnam as well as a concept team to evaluate their effectiveness in counterinsurgency operations.

While the Army was willing to experiment with helicopters in Vietnam, it was not prepared to accept Howze's call for a massive revision of its force structure. However, the running feud with the Air Force over control of close air support necessitated some concrete action, and in January 1963, the Army began forming and testing the 11th Air Assault Division.

The test program quickly gained momentum and, in September, the Army conducted Air Assault I which tested an air assault battalion at Fort Stewart, GA. The results were promising enough to warrant further testing and, by January 1964, the Army was actively contemplating the inclusion of an airmobile division in its force structure. One flaw in the testing program, however, was that it was geared towards conventional warfare rather than the counterinsurgency type warfare that was waiting in Vietnam.

The first Cavalry proved to be a valuable asset in Vietnam and, on June 28, 1968, the Army initiated the conversion of the 101st Airborne Division to an airmobile configuration.

The 11th Air Assault Division was formally activated at Fort Benning on Feb. 11, 1964 to expand the test program. BG Harry Kinnard, who served with the 101st Airborne during World War II, was designated the commander.

Under Kinnard's leadership, the division conducted its second test, Air Assault II, which demonstrated that the "advantages of increased mobility and maneuverability inherent to the air assault division offers a potential combat effectiveness that can be decisive in tactical operations." Based on this success, Secretary of Defense Robert McNamara authorized the origination of the 1st Cavalry Division (Airmobile) on July 15, 1965. The division was activated on July 1 and was made up of resources from the 11th Air Assault and the 2nd Infantry Divisions. The division's advanced party arrived in Vietnam on Aug. 25.

The 1st Cavalry proved to be a valuable asset in Vietnam and, on June 28, 1968, the Army initiated the conversion of the 101st Airborne Division to an airmobile configuration. On July 1, the 101st was redesignated as the 101st Air Cavalry Division and, at the same time, the 1st Cavalry became the 1st Air Cavalry Division. This terminology however, was short lived, and on Aug. 26, the divisions were renamed the 101st Airborne Division (Airmobile) and the 1st Cavalry Division (Airmobile).

With the steady withdrawal of U.S. involvement in Vietnam, the lst Cavalry was reorganized as a "triple capability" or tricap division on May 5, 1971, combining armor, airmobile, and air cavalry brigades. The tricap experiment was destined to be mired in bureaucratic incompetence, and by Aug. 1, 1980, the 1st Cavalry was transformed into a heavy armored division.

In the meantime however, the 101st was steadily refining the air assault concept. On Oct. 4, 1974, the division dropped its parenthetical "airmobile" identifier in favor of "air assault" and accepted the doctrinal change implicit in such a transformation. The airmobile concept sought to fuse manpower, weapons, and aerial transport with cavalry doctrine.

Air assault on the other hand would integrate attack, transport, and observation aircraft with the fighting elements of the division. By maintaining organic helicopter assets, the air assault division insures the continuous availability of proficient aviation responsive to its unique tactical requirements and fostered by habitual relationships.

The wisdom of such an organization was once again confirmed during Operation Desert Storm. The story of how the air assault concept evolved is a good case study for researchers and developers interested in observing the interrelationship of technology and doctrine. The various ways in which the military used the helicopter, initially in very humble circumstances and today as part of decisive maneuvers, and the differences in the Army and Marine Corps' early approaches to the helicopter's possibilities show how technology impacts on doctrine. This marriage of technology and doctrine has been very successful in the case of the helicopter. We should strive to follow this 'pattern in all our developments.

CPT KEVIN DOUGHERTY is the scout platoon observer/controller at the Joint Readiness Training Center, Little Rock Air Force Base, AR. He is a 1983 graduate of the U.S Military Academy, the Infantry Officer Advanced Course, and the Airborne, Air Assault, and Ranger Schools.

EXPERT SYSTEMS AT THE ORDNANCE MISSILE AND MUNITIONS CENTER

By CPT Thomas R. Knutilla

Introduction

One of the missions of the U.S. Army Ordnance Missile and Munitions Center and School (USAOMMCS) is to train officers, warrant officers and enlisted personnel in missile system maintenance. While performing this mission, we at OMMCS have discovered a number of training deficiencies which, in conjunction with forced cost reductions, are challenging us to seek ways to perform our training mission more efficiently. Consequently, we have been investigating emerging technologies to address some of these deficiencies and challenges. One method that is being pursued is to use an artificial intelligence technology known as expert systems for training and diagnostics aids. The purpose of this article is to discuss why and how expert systems are being used at OMMCS.

Missile Maintenance

The deficiencies experienced within the missile system maintenance arena are many. Missile maintenance soldiers often cannot sustain the training they receive during Advanced Individual Training (AIT) at OMMCS. During AIT, the soldier is trained on a myriad of tasks, yet, once he arrives at his unit, he is typically assigned to perform only one or two of those tasks on a repetitive basis. That soldier suffers a skill degradation in the other tasks necessary to be qualified in his Military Occupation Specialty (MOS). Additionally, the diagnostician is overwhelmed with voluminous reference material, some of which contains maintenance procedures which are confusing or incomplete. Consequently, the soldier may not have enough information available at his unit to remain proficient in all the tasks required in his MOS.

Another deficiency is the nonstandard test equipment the soldiers are required to use. Because of the different makes and models of test, measurement and diagnostic equipment in the Army inventory, the equipment available for use in the field may not be the same as what he used during AIT or what is called for in the technical manual. Thus, the soldier may not know how to use the field test equipment required to perform his maintenance function.

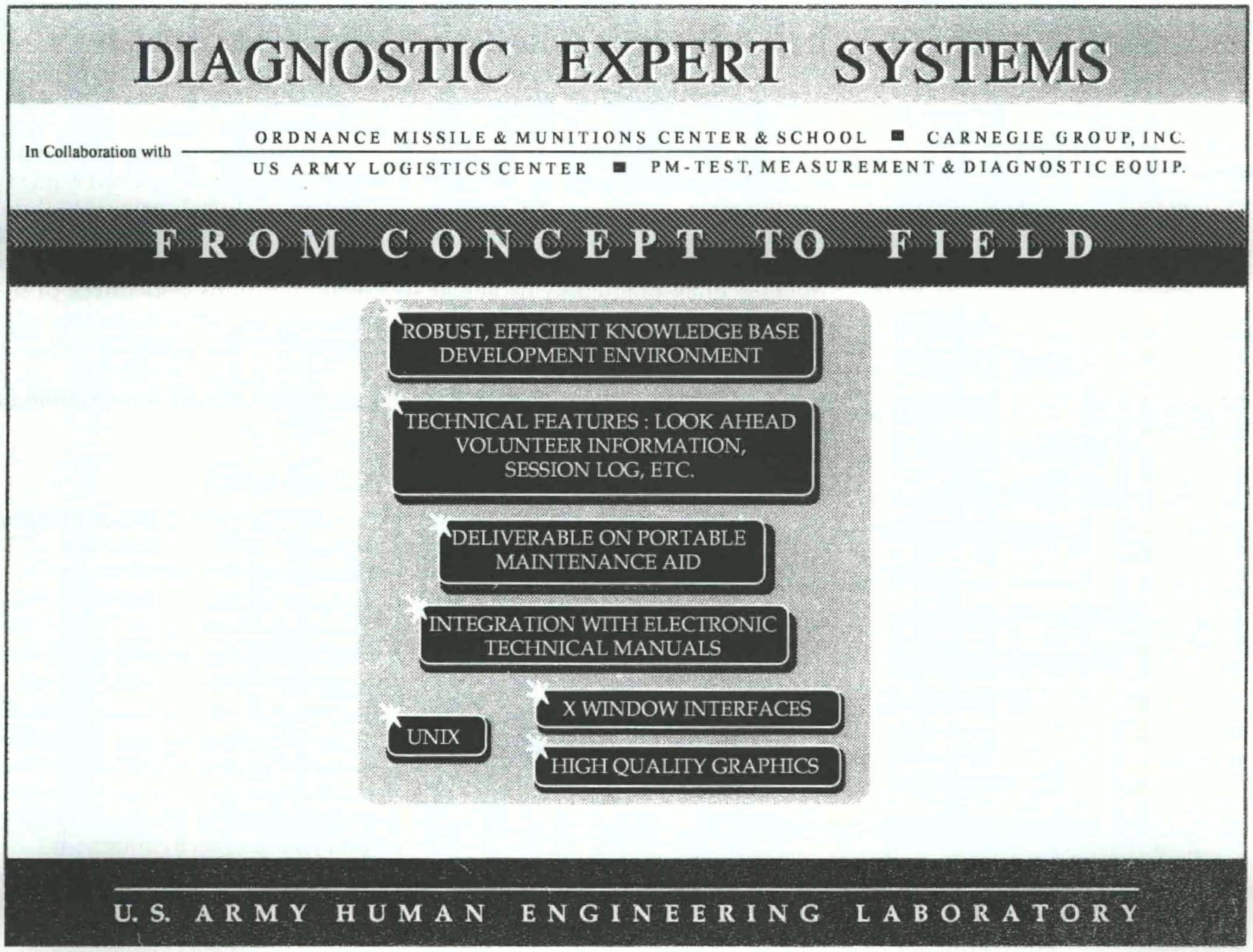
The result of these and other deficiencies is that the soldier is not performing his maintenance functions at an optimal level thus, the chances of performing faulty diagnoses is unacceptably high. Equipment availability is reduced and many components are thrown away or repaired even though they are fully operational, significantly increasing costs.

We at OMMCS are also faced with the realities of reduced future resources. One way to save money is to reduce the amount of school training time for our soldiers. One initiative to reduce institutional training time is to consolidate the numerous missile maintenance MOSs that are offered at OMMCS. The ultimate goal is to have a generic mechanic capable of fixing every missile system in the Army inventory with one training course taught at OMMCS. Coupled with a second initiative of standardizing system components and developing standardized TMDE and electronic technical manuals, it is hoped that OMMCS can produce a better mechanic more economically than is currently done. An artificial intelligence technology known as expert systems has the potential to perform many of the tasks needed to address these challenges.

Expert Systems

Expert systems are one of the first usable products developed through artificial intelligence research. An expert system is a computer program that mimics human problem solving. Expert systems offer a number of advantages to both programmers and users. Programming expert system tools is easier, faster and usually less expensive than traditional programming languages.

Expert system programs are easier to



modify than traditional programs. Users of expert system programs find them to be easy, logical to use, and much less cumbersome than using traditional methods to perform their tasks. Users can get to the information they need faster which allows them to do their job more rapidly and accurately. The biggest advantage is that a computer specialist is not needed to write the programs; therefore, development times can be described in months rather than years.

Electronic Technical Manual

Expert systems technology can be directly applied to a number of tools that would help solve our problems. A smart electronic technical manual (ETM) can be developed which will allow the soldier to get needed information faster and thus be able to work more efficiently. The soldier would only have to carry a laptop size device rather than a library of manuals. Additionally, diagnostic troubleshooting aids can be developed that will communicate directly with the equipment to find the fault and give the correct repair procedures. This allows the ETM to serve as test equipment while giving expert diagnostic advice and eliminating the need for the soldier to use many different pieces of test equipment.

Lastly, expert systems can be used as sustainment training software that the soldier can have at his unit and refer to while preparing for self development tests, etc. With all required information loaded in the software, there will be less need for formal training to prepare the soldier to do his job once he gets to his unit. By incorporating expert systems technology into these types of tools, the magnitude of many of the deficiencies and challenges, we at OMMCS are facing, will be reduced.

Pulse Acquisition Radar

The first expert system program developed at OMMCS is the Pulse Acquisition Radar Intelligent Diagnostic Environment or PRIDE. PRIDE is an expert system program for the Pulse Acquisition Radar (PAR) which is part of the HAWK air defense missile system. PRIDE was built to assist the direct support level mechanic troubleshoot and repair the PAR. The expert knowledge was acquired through a series of interviews with five PAR mechanics located at OMMCS. During these interviews, the experts were asked to explain the problems they had faced on the PAR and how they solved them. This information was then programmed and tested first with the experts and then with newly trained PAR mechanics.

After the software was tested, it was fielded to the HAWK units that still use the PAR, including units that went to Saudi Arabia as a part of Operation Desert Storm. The software is being maintained using feedback on PRIDE from the units and to provide updates to the software on a monthly basis.

PRIDE took approximately six months to develop and test. The expert's knowledge was programmed on a SUN workstation using an expert systems software package known as TestBench. It was built by a team made up of representatives from OMMCS, the U.S. Army Human Engineering Laboratory and Carnegie Group Inc. PRIDE was delivered to the HAWK units on ruggedized IBM compatible laptop computers.

In its fielded version, PRIDE covers approximately 80 percent of those symptoms commonly experienced by direct support level mechanics. The project was funded by the Department of Defense Productivity Enhancing Capital Investment Fund.

Because of the different makes and models of test, measurement and diagnostic equipment in the Army inventory, the equipment available for use in the field may not be the same as that used during AIT or what is called for in the technical manual.

Lessons Learned

There are many lessons learned from the PRIDE Project and from trying to get expert systems technology integrated into other programs within the Army. The expert systems technology is not readily understood or accepted by most people. In an effort to spread the news about the benefits of expert systems, OMMCS has begun to share its experiences with those organizations that can best use the technology to benefit the Army.

Since PRIDE is a response to a missile logistics issue, we have begun a dialogue with the Army Missile Command's Missile Logistics Center. The Missile Logistics Center may benefit by looking at expert systems for the organization's future software developments in diagnostics and technical manuals. Since requirements documents are written by TRADOC schools, we are now sharing our lessons learned with other schools. Additionally, as we review other schools' requirements documents we ask that those schools include a requirement to use expert systems and electronic technical manuals as part of the new system's development and deployment.

We have also discussed our experiences with the individual program executive offices and program management offices and suggested ways expert systems could be incorporated into the development of their systems. This education effort includes briefings, demonstrations and offers of assistance. Lastly, we are sharing our experiences and lessons learned, through briefings and published articles, with the military and technical community at large.

Conclusions

The PRIDE effort has encouraged enthusiasm for expert systems at OMMCS. Other projects have been started. One is called HIPRIDE, for the HAWK High Power Illuminator Radar (HIPIR) that PRIDE is doing for the PAR. Another is a sustainment training device for mechanics working on the TOW missile subsystem mounted on a Bradley Fighting Vehicle. This sustainment trainer is being built to overcome problems with inadequate manuals and non-standard test equipment.

A third project is a software package that will lay out field ammunition storage areas on digitized maps. This software is being developed to consolidate the vast library of regulations, manuals and resident expertise that a soldier is required to know when laying out a field ammunition storage area. The bottom line is that expert systems technology is useful and OMMCS will continue to develop and deploy expert system programs built by soldiers for soldiers.

CPT THOMAS R. KNUTILLA is an artificial intelligence/robotics officer for the U.S. Army Ordnance Missile and Munitions Center and School. He received a B.S. degree from the U.S. Military Academy in 1980 and has an M.S. degree from Georgia Institute of Technology.

CECOM DEVELOPS FIREFINDER SOFTWARE

Even if the Gulf War didn't pan out as Saddam Hussein's "Mother of all Battles," it did prove to be the mother of invention.

The stories filtered out of the Gulf, at first whispers, then louder—about how scores of allied lives were saved and how allied casualties were kept low because Iraqi artillery gunners simply refused to fire their weapons.

Iraqi prisoners of war told their captors how every time they made the foolish move of firing at the allies, it only served to bring back, within minutes, a ferocious and massive counterfire. Improved conventional munitions (ICM) would explode in the air over them, drenching them with steel bomblets—'steel rain,' the captured Iraqis called it, still quaking in fear at the memory.

That immobilizing steel rain was able to shower Iraqi artillery so quickly because of the technology employed by U.S. forces. When Iraqi artillery fired, Firefinder radar would compute the origination points and send the information to fire control, which would compute return coordinates for the U.S. artillery. This was no tit-for-tat—for every shell the Iraqis fired, they were saturated with steel rain. No wonder the Iraqis wouldn't fire.

Chief warrant officer Michael Courson of the Radar Division of the Army Communications-Electronics Command's (CECOM) Center for Electronic Warfare/Reconnaissance, Surveillance and Target Acquisition (EW/RSTA), is proud of the part Firefinder radar played as a weapons-locator, and unexpectedly, as a deterrent to enemy fire. But he is equally proud of a capability of Firefinder that was never used because the thunder and lightening of the Desert Storm was as ferocious and short in duration as a summer thunderstorm.

That was the capability of the short-range Firefinder to detect long range missiles, such as SCUDs, or Free Rockets Over Ground (FROGs) that intelligence sources expected the Iraqis to use if they deployed chemical warheads—a threat that never materialized. CECOM's Center for EW/RSTA and the Fort Monmouth-based project manager for radar pulled out all the stops to develop and field, in only one month, a software change that made Firefinder capable of detecting those long range missiles.

The change was needed because Firefinder was originally developed with a European battlefield in mind. "In Europe, the enemy would take an offensive posture," said Courson. "They would come in close, right up on top of you, and then shoot deep."

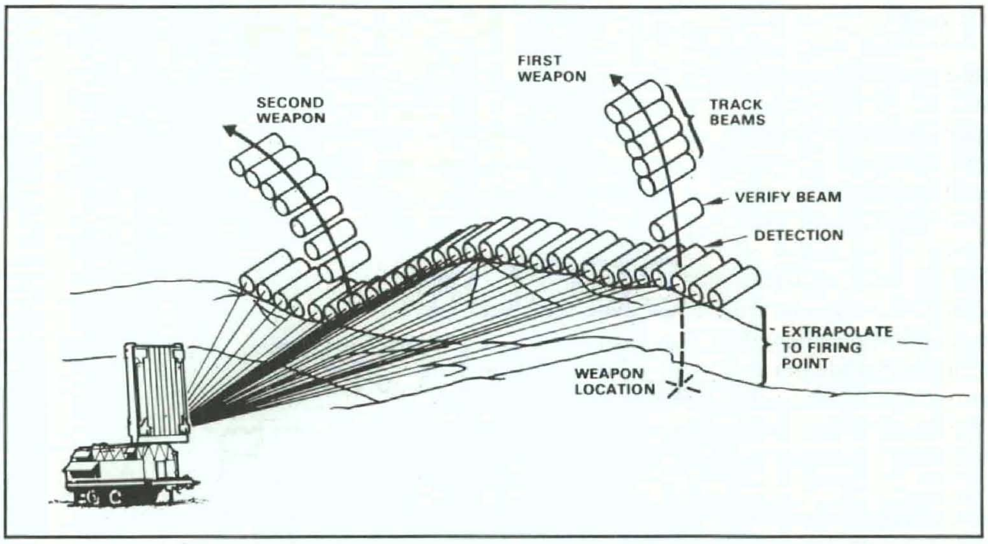
The Gulf War, he said, presented a different scenario.

"In the Gulf," said Courson, "Iraq stayed back, holding their assets out of range, and tried to draw us into the kill zone. Plus, there was another factor which wasn't totally planned for—the Iraqis were lobbing SCUDs from deep in Iraq at Saudi Arabia and Israel."

Although SCUDs weren't much of a military threat (GEN Schwarzkopf said he was more afraid of being hit by lightning during a Georgia thunderstorm than he was of being hit by a SCUD), they were a weapon of terror, and had to be stopped.

A bona fide military threat, Courson said, was the chance that Iraq would deploy chemical warheads via FROGs, and the way to detect such long-range missiles was relatively easy to conceptualize.

"Since the same radar energy that it takes to scan for smaller projectiles at a shorter distance can also scan for larger missiles at a longer distance, we knew we had to increase the instrumented range by adjusting the software parameters to accommodate new, bigger and longer range targets," Courson said.



Firefinder employs phase-phase electronic scanning to detect any object of designated parameters that breaks a "fence" in the sky.

Thus, Firefinder radar — which was designed to detect artillery and mortar rounds 18-30 inches long and 4-8 inches in diameter — was modified via new software to also scan for long range missiles two stories high and 2-3 feet in diameter, such as SCUDs.

How Firefinder Works

Courson explained how Firefinder employs phase-phase electronic scanning to detect any object of designated parameters that breaks a "fence" in the sky (see illustration). "If an object breaks the 'fence,' Firefinder looks above the fence and tracks the object," he said.

Firefinder's computer sorts out the object by type of path, matching parameters such as acceleration, angle of flight, and size of return blip. In the process, it ignores the dense clutter on a battlefield from jammers, aircraft, and even birds, and attempts to saturate the radar by multiple simultaneous barrage firings.

What are the differences to Firefinder in looking for long-range missiles vs. short-range artillery?

"Besides the size of the round, the angle of flight is different," said Courson. He explained that SCUDs are essentially intercontinental ballistic missiles that are fired straight up in the air, travel above the atmosphere for some 300-plus miles, and then fall straight down onto their targets. FROGs, on the other hand, are launched from rails at approximately 45-50 degree elevation and have a flight pattern more like a rifle bullet — not getting that high, then travelling relatively straight for a range in excess of 50 km (about 30 miles) to a target.

"The key for us was putting the new parameters on software vs. rewiring," said Courson. "That gave us a lot of acceptance from users who might get a little leery if you walked up to their Firefinder with a soldering gun to rewire it. With software you can just take the old software out and put the new software in."

The new software package "looks like a cassette tape you would use in your car"—but in a metal box. To the maximum extent possible, the changes are invisible to the operator. The documentation consists of both sides of one 8 1/2" by 11" sheet to supplement the existing operator's manual.

Given the urgency of the situation, the software was conditionally released. "The logical extension is to combine both (long and short range missile parameters) on one software package to make it quicker and easier for the operator," said Courson. In the mean time, though, commanders have a valuable tool—the option to choose between software packages that scan for either relatively small artillery rounds or large missiles.

Courson himself was in the Gulf from February 19th to March 10th to help field the software package that fortunately didn't have to be used. As a 17-year target acquisition radar technician in fielded military units, it was like old home week for him. One thing Courson took with him was a new appreciation for the materiel developer side of the combat developer/materiel developer equation.

"For a guy who comes in from the field, materiel developers can seem like a puzzle palace, a bureaucracy place," Courson said. But having worked here now, I can realize there's a reason for the way things work — and it's nice to see we can pull out the stops when we have to. We had a situation where things weren't totally planned for— such as SCUDs shot at Israel and Dahran. We had existing capabilities, and engineering know-how, and we pulled out the stops. We went, in a month's time, from start-to-finish — here's the product. Even though the threat didn't materialize, it showed us what this community can do in a short period of time.

All of this goes to prove one point: Even if the Gulf War didn't pan out as Saddam Hussein's "Mother of all Battles," it did prove to be "the mother of invention" for CECOM's Radar Division.

The preceding article was written by Stephen Larsen, a member of the U.S. Army Communications-Electronics Command Public Affairs Staff.

FROM INDUSTRY

THE ACQUISITION PROCESS

Facing New Realities

By Malcolm R. Currie

The following remarks were extracted from the keynote speech presented earlier this year at the 1991 Acquisition Research Symposium, sponsored by the Defense Systems Management College and the National Contract Management Association. Malcolm R. Currie is chairman and chief executive officer of Hughes Aircraft Company.

How can we improve the acquisition process and make it more efficient and make it work significantly better? It's a subject, of course, that has been studied and agonized over for several decades as the process became ever more lengthy and costly. The last thing we need is a still more complex wiring diagram for the acquisition management process. Complexity doesn't add intelligence, it just adds time and cost—that's not the answer. Rather, it seems to me that we need to get back to greater simplicity based on the successful experiences of the past and based on common business sense — and good business practices.

Recently, in connection with a policy advisory task force I am chairing for DOD, I wrote to 15 or so CEOs and asked them to think about several of the most successful programs their companies had worked on over the years and to distill the qualities that made them successful. Perhaps it's not surprising that in the thoughtful responses, which covered a tremendous range of types of products and program sizes, there was a common thread of those basic elements that made for success.

In other words, we know what are some of the basic principles leading to success. We know, for example, that successful programs have closely knit government-industry teams which work together hands-on in solving problems—as contrasted with programs that are managed by contract with lawyers and accountants as the management interface. Committed teamwork is essential.

We know that successful programs are ones in which the government program manager has authority to make decisions and where the contract type permits flexibility, balances the risk between government and industry, and incentivizes both parties. Authority must be returned to program managers and contracting officers. They have often been put in regulatory straightjackets to remove their discretionary judgment. This has led to loss of flexibility and much increased costs.

The A-12 is only one of the most visible examples of what happens when contractors and program managers are not allowed to make realistic trade-offs in the search for the best solution. In this connection, both parties have legitimate concerns which must be recognized. Industry must be protected against open-ended financial risks inherent in the kind of technology developments or demonstrations we must pursue to achieve required new levels of military capability. On the other hand, the government must be protected in some way against overt buy-ins, reckless optimism, exposure to massive overruns and schedule debacles—and loss of credibility.

The best way to satisfy both parties is the use of cost-award contracts in which the contractor is rewarded for excellent performance, is penalized financially for poor performance, but is ultimately protected against disaster by receiving a minimum or zero profit with large overruns, assuming the contract is not cancelled. I'm glad to see that DOD has recognized this and is moving in this direction. In an era when production will be smaller, companies must achieve profitability on R&D to remain viable.

We also know that the quality of the RFP often determines the success of the program in terms of the freedom it gives the contractor, the requirements that are specified in terms of broad functional goals on one hand, or detailed performance specifications on the other. We know how important it is to get programs started right—technology, schedule, funding, requirements—and yet we continue to try to beat the game. We're still doing it—premeditated failure.

We know from experience that competitive prototyping is extremely effective in mitigating risk, in allowing for the demonstration of different approaches to the same military problem and stimulating innovation and in predicting costs.

Contrary to many comments that I've heard on how competitive prototypes can no longer be afforded, I believe just the opposite is true based on past DOD experience. It can include the concept of "deployable prototypes" built from soft tooling rather than the costly full nine yards imposed by the typical enormously expensive full-scale development program. It does not have to include "milestone II" data, does not have to include a full technical data package or full logistics. It should have minimum oversight and the RFP can be no more than several pages in length. This approach simulates much of commercial practice—it permits "marketing" and testing with the user so that the final optimum product can be defined. In the long run, great time and cost savings are possible.

We know that milestone-driven program schedules rather than calendar-driven schedules are more successful and can be very efficient and motivating if planned that way from the beginning.

Finally, we know that excellent people on both sides are the most important ingredient of successful programs. It was people who won the Gulf War, not just technology. Source selections based on value and independent assessments of risks, costs and technical approach depend in the end on the quality of people making these judgments. Complex mechanisms and procedures will never substitute for excellent people. We must give more explicit attention to acquiring and training the best and brightest in both government and industry.

Now my main point in citing these is that if we can mutually agree on a set of such fundamental principles, I believe they can be used to effectively simplify and guide the acquisition process and cut through the vastly increased complexity which often substitutes for proven successful management practice and good business sense and which disguises itself in management mystique. I believe this kind of thinking will be absolutely necessary in the period ahead to re-build an acquisition process which clearly is no longer appropriate for the new environment we face.

Now I know that DOD is gradually trying to move in this direction and I applaud their efforts. It will require the buy-in and support of the entire procurement and contracting community as well as the support of industry or it will fail.

I also applaud the commitment of DOD to a continued robust research and technology development program, as pledged both by Secretary Cheney and Deputy Secretary Atwood. In the end, continued innovation in applying basic science and technology is fundamental to superior defense capability. In this connection, a robust independent R&D program in industry with the ceiling established only by competitive factors—and with protection of proprietary rights—and rejection of the technical leveling which has grown over the years—can do much to motivate private investment and to maintain an innovative and competitive industrial base in the face of the austere period ahead. If, in the process of restructuring, we lose these qualities of bold innovation and competitiveness, we're finished for sure.

With a strong continued program in defense R&D, an explicit emphasis on systems upgrades can also provide extremely valuable win-win returns for both industry and government in the half dozen years ahead. The systems deployed in the Gulf War have been shown to be the best in the world. With the very cost-effective injection of advanced technology, many of these systems can be brought to even much higher levels of performance, reliability and operability, still using the same logistics and production base which has already been developed at great expense. In addition to delivering very significant cost savings, this approach can help keep alive some core industrial design and manufacturing teams as industry builds down.

I believe DOD has re-established its credibility. It is vital to retain this hard-earned position by demonstrated performance in all areas of activity. As part of industry's role, the Defense Industry Initiative on Business Ethics and Conduct was formed in 1986 by members of industry. As our group has grown to encompass almost all top contractors, ethics programs have become a critical part of the way companies do business. Awareness of ethical considerations among our employees is higher than it's ever been. I know of no other industry that has devoted as much effort to policing itself. This will continue.

I have been addressing the acquisition and management environment and its potential for major improvement. Now, I'd like to touch on another essential ingredient for our continued military and economic security—namely, our nation's overall technological strength. In the global environment, we have slipped behind in some lynchpin technologies, most notably in electronics. Most of these technologies are dual purpose and increasingly will be the engines for competitive leadership and economic well-being in both the military and economic spheres. These are increasingly interlinked and interdependent.

I can only repeat what I have said in the past—that it is extremely important that a coherent technology strategy and policy be articulated at the highest national level. In my view the government must play a more active role in promoting and investing in certain advanced technologies and, particularly, in creating enabling processes for their translation into world competitive products and capabilities. I believe the recognition of this is growing and hopefully we are at least beginning to get our act together. Long range, along with education, perhaps nothing is more critical to our future.

CAREER DEVELOPMENT UPDATE

FY 92 PERSCOM Acquisition Accession Board Announcement

The date for the FY92 PERSCOM Acquisition Accession Board (PAAB) to convene is tentatively set for Oct. 15, 1991.

The target year group (YG) for the FY92 PAAB is 1984. The Office of the Assistant Secretary of the Army for Research, Development, and Acquisition (ASARDA) is in the process of defining specific requirements. These requirements will determine the accession targets for specific branch and functional area pairings. Officers in other YGs may apply against their basic branch's requirements for accession into the AAC.

To be eligible for accession, officers must:

- Be branch qualified at the company grade level.

• Possess functional area 51 (Research, Development, and Acquisition), 53 (Systems Automation), 97 (Contracting and Industrial Management), or 15/35 (Aviation/Intelligence).

• Possess a baccalaureate or master's degree in business, management, science, or engineering.

To apply for accession, officers must submit the following information to their basic branch no later than Sep. 30, 1991.

• Written request for consideration.

• Official copy of all college transcripts (if not already on file).

• Copy of current GRE and GMAT scores (less than five years old).

• Officers who wish to be considered by the PAAB should review their Official Military Personnel File (OMPF) and Officer Record Brief (ORB) prior to the convening of the board.

Military AAC Critical Position Review Panel

The second annual AAC military critical position review panel convened July 9-10, 1991. The purpose of the panel was to review the current critical positions (420) and recommended additions/deletions to determine if the positions comply with the requirements outlined in the Defense Acquisition Workforce Improvement Act. The panel has forwarded its recommendations to the Army Acquisition Executive (AAE) for approval. Panel results will be published in the next *Army RD&A Bulletin*.

Civilian Accession Board

An Army Acquisition Corps Selection Board for civilians convened July 29 through Aug. 2, 1991. This board reviewed the files of more than 1,000 individuals who applied for entrance into the Army Acquisition Corps under the December 1990 open announcement. Results of the board are expected to be released shortly. Applicants will be notified in writing of the board results.

Defense Acquisition Workforce Improvement Act

The intent of the Defense Acquisition Workforce Improvement Act is to enhance, improve and professionalize the total acquisition workforce; to include the establishment of an Acquisition Corps. The following are extracts of the new legislation. Others will be published in upcoming issues of *Army RD&A Bulletin*.

Section 1731. Acquisition Corps: in general

(a) ACQUISITION CORPS.—The Secretary of Defense shall ensure that an Acquisition Corps is established for each of the military departments and one or more Corps, as he considers appropriate, for the other components of the Department of Defense. A separate Acquisition Corps may be established for each of the Navy and the Marine Corps.

(b) PROMOTION RATE FOR OFFICERS IN ACQUISITION CORPS.—The Secretary of Defense shall ensure that the qualifications of commissioned officers selected for an Acquisition Corps are such that those officers are expected, as a group, to be promoted at a rate not less than the rate for all line (or the equivalent) officers of the same armed force (both in the zone and below the zone) in the same grade.

Section 1733. Critical acquisition positions

(a) REQUIREMENT FOR CORPS MEMBER.—On and after October 1, 1993, a critical acquisition position may be filled only by a member of an Acquisition Corps.

(b) DESIGNATION OF CRITICAL ACQUISITION POSITIONS.—(1) The Secretary of Defense shall designate the acquisition positions in the Department of Defense that are critical acquisition positions. Such positions shall include the following:

(A) Any acquisition position which—

(i) in the case of employees, is required to be filled by an employee in a position within grade GS-14 or above of the General Schedule (including an employee covered by chapter 54 of title 5), or in the Senior Executive Service; or

(ii) in the case of members of the armed forces, is required to be filled by a commissioned officer of the Army, Navy, Air Force or Marine Corps who is serving in the grade of lieutenant colonel, or, in the case of the Navy, commander, or a higher grade.

(B) Other selected acquisition positions not covered by subparagraph (A), including the following:

(i) Program executive officer.

(ii) Program manager of a major defense acquisition program (as defined in section 2430 of this title) or of a significant nonmajor defense acquisition program (as defined in section 1736(a)(3) of this title).

(iii) Deputy program manager of a major defense acquisition program.

(C) Any other acquisition position of significant responsibility in which the primary duties are supervisory or management duties.

(2) The Secretary shall periodically publish a list of the positions designated under this subsection.

Product Manager Selections

Thirty-three Army Acquisition Corps officers were selected as product managers by the FY 92 PM Board. Below is a list of the officers and the programs for which they were selected:

SELECTEE	FA/BR	PEO/PROGRAM
MAJ(P) Fred J. Allen Jr.	51/91	Mortars
LTC Alan J. Bacon	51/15	Commu Intel & EW
LTC Richard O. Bailer	51/13	Paladin
LTC Fred Brown	51/15	Air Traffic Control
MAJ(P) James D. Cambron	51/11	Small Arms
LTC Christopher V. Cardine	51/12	Block III Armaments
MAJ(P) Roger L. Carter	51/91	Msl & Sys Integr
LTC Herbert M. Carr	51/14	Air Def Int/CP Auto

MAJ(P) Mario A. Cervantes	53	Family of Munitions
LTC Scipio Dekanter	51/25	West Hem Trans Sys
LTC Anthony Dirienzo	51	Firefinder
MAJ(P) Lawrence C. Doton	53	Trans Coord ACCIS
MAJ(P) Andrew G. Ellis	51/13	Adv FA Sys Armts
MAJ(P) Andrew J. Green	51	Anti Tact Msl Def
LTC Walter B. Grimes	51/91	M1A2 Tank
LTC Jerry M. Henderson	53/15	Std Army Maint Sys
LTC Walter S. Horton	52	Special Projects Ofc-1
LTC Dennis J. Loeffelholz	51/13	Sys Int Sp Mgt Ofc
LTC Michael Mazzucchi	51/25	Tact Satellite Comm
MAJ(P) Richard D. Morris	51/91	Hellfire Opt Msl Sys
LTC Donald D. Newlin	51/12	Block III Com Chassis
LTC Randall G. Oliver	51/15	Fixed Wing
MAJ(P) Leon A. Parker	53/91	Std Army Ret Supl Sys
LTC Morris E. Price	51/11	Ad FA Sys Com Comp Chass
LTC Robert C. Railford	51/25	Fwd Sens Intrfc Ctrl
MAJ(P) Michael W. Rogers	51/15	Special Operations Acft
LTC Charles G. Schwoebel	53/15	Jnt Svs Computer Prgms
LTC Jack O. Shafer	51/15	Fire Control Radar
LTC Robert G. Shively	51/25	Std Army Cmd & Ctrl Sys
MAJ(P) Gregory H. Swanson	53/25	Defense Data Networks
LTC Edward M. Vigen	53/35	ASAS/ENSCE Interface Mod
LTC James A. Wank	51/21	Comm Cons Equip/Sel Mat
MAJ(P) William A. Weir	51/91	M1A1

Below is a list of FA 97 officers (Contracting and Industrial Management) who were selected by the FY 92 LTC command selection board for commands indicated.

SELECTEE	BR	FA
Forward Support Battalions		
MAJ(P) Lamont J. Wells	QM	92/97
MAJ(P) Derrel W. Greene	TC	88/97
Procurement Commands		
*LTC Robert K. Bohman		97
*MAJ(P) Anthony N. Love	OD	91/97
*LTC David J. Romancik		97
LTC Sheila C. Toner	QM	92/97
LTC James M. Washington	QM	92/97
MAJ(P) Donald R. Yates	QM	92/97
Ammo Plant Depot Activity		
MAJ(P) Everette B. Crumpler	OD	91/97
MAJ(P) David A. Hafale	OD	91/97
Multifunctional General Support Activities/Centers		
MAJ(P) Kimberley T. Smith	OD	91/97
Main Support Battalion Principals		
LTC Randolph C. Barta	QM	92/97
Multifunctional Support Battalions Nondivisional		
MAJ(P) Stephen B. Howard	TC	88/97
LTC Michael A. Hughes	TC	88/97

* Members of the Army Acquisition Corps

Engineer School Establishes Special Projects Office

A Special Projects Office (SPO) has been established within the Directorate of Combat Developments at the U.S. Army Engineer School. The primary mission of the SPO is to integrate new and emerging technologies more directly into the engineer and mine warfare (EMW) mission area.

The SPO will stay abreast of developing technologies by fostering close working relationships with national and Army laboratories; research, development and engineering centers; industry; academia; and others within the U.S. Army Training and Doctrine Command (TRADOC).

R&D initiatives can be focused more directly on solving battlefield deficiences by involving the eventual users earlier in the RD&A process. The SPO will act as that important link between R&D and the user.

TRADOC centers and schools represent the "user" in the Army RD&A process. As the TRADOC proponent for the EMW mission area, the Army Engineer School is responsible for identifying engineer related doctrine, training, leader development, organization and materiel deficiencies.

For proponent materiel deficiencies that can only be satisfied through R&D efforts, the USAES must prepare a series of materiel requirements documents which state concisely the minimum essential operational, technical, logistical, and cost information necessary to initiate the development and procurement of a materiel system.

These requirements documents drive the entire acquisition process. How they are written determines what will be delivered. If the user is not cognizant of what is happening within the R&D community, they are most likely not aware of the range of technological possibilities or available choices prior to finalizing the statement of requirements. It follows that writers of requirements documents need to be knowledgeable of systems technology.

For additional information on USAES activities, contact: Commandant, U.S. Army Engineer School, ATTN: ATSE-CDM (SPO), Fort Leonard Wood, MO 654730-6620 or call DSN 676-7357 or commercial (314) 563-7357.

56 Graduate from MAM Course

On May 24, 1991, 56 students graduated from the Materiel Acquisition Management Course held at the U.S. Army Logistics Management College, Fort Lee, VA. Some examples of the weapon system acquisition work assignments offered to these graduates are: research and development, testing, contracting, requirements generation, logistics and production management.

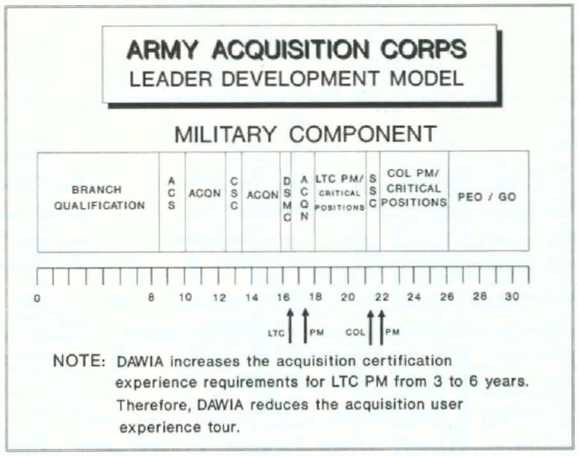
Gary L. Smith, program executive officer for aviation, St. Louis, MO, gave the graduation address and presented diplomas. CPT Charles Tangires, U.S. Army Tank-Automotive Command, Warren, MI, received the Distinguished Graduate Award, and MAJ Sharon Holmes, U.S. Army Personnel Command, Alexandria, VA, received the Outstanding Graduate Award.

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

Impact of the Acquisition Workforce Improvement Act

The Defense Acquisition Workforce Improvement Act (DAWIA), passed on Nov. 5, 1990 with the 1991 Defense Authorization Act, will impact some Army Acquisition Corps (AAC) personnel policies. One impact of DAWIA is a reduction in the time available for the acquisition user's tour (regreening).

When the Acquisition Corps leader development model was first designed, the requirement for selection to lieutenant colonel product manager (PM) was three years of acquisition experience. The old requirements allowed time for officers to attend graduate school and the Command and General Staff College, go to an acquisition assignment, and return to their basic branch for a "regreening" assignment prior to 4Z certification and selection for promotion to lieutenant colonel. Because of the requirement under DAWIA for a manager



of a significant non-major program to have six years of experience, the acquisition experience requirement for 4Z certification at the lieutenant colonel level will be adjusted accordingly.

The DAWIA also reduced the total allowable acquisition experience credit given for civilian and military education to 12 months.

The changes to the AAC program caused by the DAWIA reduce the amount of time an officer has with regard to assignments not directly related to the AAC developmental track.

Senior Officer Logistics Management Course

The Senior Officer Logistics Management Course (SOLMC) is specifically designed to update commanders and their primary staff at the battalion and brigade level in the logistics arena. The course encompasses maintenance, supply, and transportation procedures, as well as hands-on experience with vehicles, weapons, ammunition, medical, communications, NBC, and quartermaster equipment. SOLMC is open to officers in the grade of major or above in the active and reserve Army, U.S. Marine Corps, and allied nations, and DOD civilians in the grade of GS-11 or above. The one-week course is conducted 10 times each fiscal year at Fort Knox, KY. Class quotas may be obtained through normal Army Training and Doctrine Command channels. The schedule for classes during the remainder of FY 92 follows. For more information contact CPT Hammerle on AV 464-7133/3411 or Commercial (502)624-7133/3411.

SOLMC Schedule
(Course Number 8A - F23)

Class Number	Report Date	Start Date	End Date
2	5 Jan 92	6 Jan 92	10 Jan 92
3	26 Jan 92	27 Jan 92	31 Jan 92
4	1 Mar 92	2 Mar 92	6 Mar 92
5	29 Mar 92	30 Mar 92	3 Apr 92
6	5 Apr 92	6 Apr 92	10 Apr 92
7	26 Apr 92	27 Apr 92	1 May 92
8	10 May 92	11 May 92	15 May 92
9	14 Jun 92	15 Jun 92	19 Jun 92
10	20 Sep 92	21 Sep 92	25 Sep 92

- The Third International Seminar on Battery Waste Management will be held Nov. 4-6, 1991, in Deerfield Beach, FL. Sponsored by Dr. Sumner P. Wolsky, Ansum Enterprises, Inc., and BDT, Inc., the conference will include discussions of the important issues relating to the management of battery wastes. For further information, contact Dr. Wolsky at (407) 391-3544.
- The Army Aviation Association of America's (AAAA) Aircraft Survivability Equipment (ASE) Symposium will be held Nov. 5-6, 1991, in El Segundo, CA. Hosted by Hughes Aircraft Company, the symposium will explore the changing threat environment and its effects on aircraft survivability equipment. The ASE Symposium is open to all interested AAAA members who possess a minimum SECRET level clearance. For more information, contact Bill Harris at (203)226-8184.
- An International Seminar on Double Layer Capacitors and Similar Energy Storage Devices will be held Dec. 9-11, 1991, in Deerfield Beach, FL. Sponsored by Dr. Sumner P. Wolsky, Ansum Enterprises, Inc., and Dr. N. Marincic, Battery Engineering, Inc., the conference will bring together individuals and groups from around the world in a unique forum to discuss the research, development and application of double layer and similar energy storage devices. For more information, contact Dr. Wolsky at (407) 391-3544.
- The Fourth International Rechargeable Battery Seminar will be held Mar. 2-4, 1992, in Deerfield Beach, FL. Sponsored by Dr. Sumner P. Wolsky, Ansum Enterprises, Inc., and Dr. N. Marincic, Battery Engineering, Inc., the seminar will bring together battery manufacturers, materials and component suppliers, and battery users in a unique forum to discuss the important aspects of rechargeable battery R&D, engineering and application. For further information, contact Dr. Wolsky at (407)391-3544.

Correction

An AH-1W Marine Corps Cobra Helicopter shown on page 13 of the July-August issue of *Army RD&A Bulletin* was mistakenly identified as an AH-64 Apache. We apologize for the error.

30th Annual AORS Announced

The 30th Annual U.S. Army Operations Research Symposium (AORS XXX) will be held Nov. 13-14, 1991, at Fort Lee, VA. About 300 government, academic, and industrial leaders are expected to participate.

The theme of this year's symposium is "Army Analysis—The New Realities." It heralds the new analytic challenges brought about by Goldwater-Nichols, events in Europe and Operation Desert Storm. Challenges include the prospects of multi-national warfighting corps, increased emphasis on non-European contingency operations, down-sizing of the Army and other Services, the impact of reduced defense budgets on Army modernization, increased role of the Joint Chiefs of Staff (JCS) in programming, and the unpredictability of hastened change throughout the world. This year's AORS, more than any in the recent past, provides the stage for Army analysts to share what they are doing to meet these new challenges.

The symposium will allow an exchange of information and experiences on significant Army analyses, provide constructive critiques and, in general, broaden the perspective of the analysis community.

As in the past, attendance is limited to those presenting papers and those nominated as observing participants. Papers will be solicited which address the theme of the symposium. Selected papers and presentations will be published in the proceedings.

The U.S. Army TRADOC Analysis Command at Fort Lee (TRAC-LEE), directed by Robert A. Cameron Jr., is responsible for the overall planning and conduct of AORS XXX. For the 18th consecutive year, the U.S. Army Combined Arms Support Command and Fort Lee (Provisional), commanded by LTG Leon E. Salomon, and the U.S. Army Logistics Management College, commanded by COL Thomas C. Wakefield, will serve as co-hosts.

Inquiries pertaining to the symposium should be sent to: Director, U.S. Army TRADOC Analysis Command - Fort Lee, ATTN: ATRC-LS, Fort Lee, VA 23801-6140. Phone inquiries should be made to Alan Cunningham, DSN 687-3449, Commercial (804) 734-3449 or Sandra Hill, DSN 687-5640, Commercial (804) 734-5640.

LETTERS

Dear Sir:

Please continue the two most helpful features of RD&A Bulletin: Speaking Out and From the Army Acquisition Executive. They provide much needed insights for the army of acquisition personnel who are not in the mainstream of information.

Respectfully,
Paul A. Hays
Systems Engineering and Technical Assistance Contractor

Army RD&A Bulletin Responds:

Thank you for your letter. We welcome feedback from our readers, and we intend to continue these departments.

AWARDS

Army Recognizes R&D Accomplishments

Four Army R&D organizations were recently recognized for outstanding achievements during Fiscal Year 1990.

The U.S. Army Engineer Topographic Laboratories (ETL), Fort Belvoir, VA, was named the Army Research and Development Organization of the Year. Outstanding accomplishments in support of Operations Desert Shield and Desert Storm were a major factor in earning this award. ETL's support included 26 major initiatives related to expedient mapping, terrain analysis, positioning and navigation, digital image processing, and battlefield environment exploitation. The Army R&D Organization of the Year Award recognizes the most productive and best managed Army R&D organization. All Department of Army R&D organizations that perform or work in research and development are eligible for the award—more than 40 organizations in all.

Recipients of R&D Excellence Awards are:

• The Natick Research, Development and Engineering Center, Natick, MA, for the flameless ration heater, which requires one ounce of water to react with chemicals on a cardboard-like pad for heating meals-ready-to-eat; and for primaloft, a synthetic insulating material used in items such as jackets and sleeping bags;

•The Army Armament Research, Development and Engineering Center (ARDEC), at Picatinny Arsenal, NJ, also a recipient of this award last year, was cited for state-of-the-art technological advancements in areas such as advanced propulsion, smart munitions and anti-armor initiatives; for the type classification of 32 items including the 155mm self-propelled Howitzer and the release to the field of seven other items including the M119 105mm towed Howitzer; and for individual accomplishments of ARDEC engineers and scientists;

•The Communications-Electronics Command, Fort Monmouth, NJ, for accomplishments that include program initiatives in tactical space communications and the soldier's computer system; individual achievements of technical and management personnel; exceeding Army Materiel Command and DA goals for program execution; and support to Operations Desert Shield and Desert Storm.

The awards are presented each year to top research and development organizations whose achievements during the preceding year are considered the best within the Army R&D Community. Selection criteria include initiatives in personnel, program, and resource management, organizational effectiveness and mission impact, and special accomplishments.

RD&A NEWS BRIEFS

TACOM Eyes Armored Security Vehicle Concepts

The U.S. Army Tank-Automotive Command (TACOM) RDE Center is evaluating concepts for an armored security vehicle (ASV) that would enhance the capability of the U.S. Army Military Police Corps.

The ASV would escort convoys in a security role, and also serve as a reactionary force vehicle in response to rear-area threats during airland battle operations. Additionally, it would play a protective, or defensive role in low-intensity conflicts in lieu of sending in infantry or armored units. The Army currently has no vehicle designed specifically for these applications.

The military police currently use an M1026 HMMWV (High-Mobility Multipurpose Wheeled Vehicle) equipped with either an Mk-19, 40-mm grenade machine gun or a 50-caliber machine gun mounted to the vehicle's ring mount. But, according to RDE Center Weapon Systems Manager MAJ Donald Kotchman, the M1026 HMMWV in some cases has deficiencies because of changes in threats the ASV may be expected to encounter. "The biggest shortcoming that the Military Police Corps has identified with the HMMWV in this role is its lack of ballistic protection," MAJ Kotchman said. Kotchman added that another deficiency is the lack of night capabilities for target identification with the main weapon.

In an effort to correct these deficiencies, the Military Police School, Fort McClellan, AL, a TRADOC agency, developed an operational and organizational (O&O) plan for an ASV, and in 1989 asked TACOM to assist in formulating a vehicle concept, using the plan as a guideline.

TACOM began an NDI (non-developmental item) market survey in August of that year, asking industry to submit information on possible candidate vehicles by October 1990. Eleven foreign and domestic firms responded to the survey, and TACOM and the Military Police School are now evaluating the NDI approach, as well as others, to determine which one would best meet the ASV O&O plan from a cost and performance standpoint. MAJ Kotchman said this is expected to be completed by next August. He said a milestone review board will review the results of the concept formulation process and recommend one of the following five alternative ASV acquisition approaches: buy one of the proposed vehicles as an NDI item, buy a modified version of one of the proposed concepts, modify an already-existing military vehicle system, consolidate requirements with an existing program, and develop a new vehicle from scratch. MAJ Kotchman added that once the board makes its decision, it will then be up to the Department of Army to decide whether or not to fund ASV procurement.

Though specific ASV design details will not be known until the milestone review board decides which alternative to pursue, much is already known about it from a general standpoint. It will be an air-transportable, lightly armored vehicle weighing between 32,000 and 42,000 pounds. Its cruising range will be 300 miles, and it will be capable of traveling cross-country, fording water up to 40 inches deep and maintaining a maximum convoy speed of at least 45 mph. It will spend 85 percent of its time on paved and secondary roads, and 15 percent on cross-country terrain.

It will carry a three-member security team—a gunner, driver and assistant driver—and provide room for an extra passenger and storage space for up to 100 rounds of ammunition. The vehicle's main gun, an Mk-19, will be mounted to a turret that will provide ballistic protection from small-arms fire, and include an infrared nighttime target-acquisition system. The turret will be designed to facilitate easy dismounting of the gun for certain missions, where such a weapon is not needed.

MAJ Kotchman said that if an ASV concept is selected next summer, it is hoped that the Army will approve funds for vehicle production beginning in fiscal year 1996.

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

Repair Materials Database Aids in Product Selection

Choosing the proper repair material for a particular job has never been easy. Today, with a proliferation of products on the market, that task is even more challenging.

The U.S. Army Corps of Engineers, as one of the guardians of the nation's infrastructure, performs a great deal of concrete maintenance and repair work. To support the need for a central point of reliable product-performance information, the "Maintenance and Repair Materials Database" was developed.

Currently, the database holds information about more than 1,600 maintenance and repair materials. It was developed under a study conducted as part of the Corps' Repair, Evaluation, Maintenance and Rehabilitation (REMR) Research Program at the U.S. Army Engineer Waterways Experiment Station in Vicksburg, MS.

"We developed the database to give the people in the field a place to find answers to their questions about what might be the best product for their specific needs," said William F. (Bill) McCleese, the REMR program manager. "REMR technology is available in reports, bulletins, technical notes, and videos. But to be able to call up and have instant access to the latest Corps information on a commercial product and its use for a specific way to make a repair — that is of real value to the field."

Roy L. Campbell, the "Maintenance and Repair Materials Database" manager, shares these views. Campbell and Brian Hopkins, a contract student, have been fine-tuning the database to turn it into a useful tool. Campbell designed the database to identify products for use in concrete and steel structure maintenance and repair. Supplemental information is available from the manufacturer, from Corps tests and users, and from other sources. Information supplied addresses a product's uses, applications, limitations, and technical properties.

"The database identifies either end-use or additive products. End use means that the product bought for the repair will be used as purchased. An additive product is one that is used in combination with other materials to produce an end-use product, like a latex admixture for concrete," Campbell said.

The database can be accessed through a PC with a modem at (601) 634-4223. Telecommunications parameters are: baud rate — 1,200; parity — none; emulate — VT-100; duplex — full; data bits — 8; stop bits — 1. "All user operations are menu-driven and easily understood by even novice computer users," said Campbell. "Users can enter the database, search for information needed, display results, and exit the system. Data displayed can be printed or saved to disk. We have included help options that provide definitions of product categories and uses for end-use and additive products," added Campbell.

Additional information on the database is available from Roy L. Campbell, CEWES-SC-CG, U.S. Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199 or call (601) 634-2814.

TACOM Studies Robot Target Acquisition Concept

Odetics, Inc. of Anaheim, CA, is building a reconnaissance system for the U.S. Army Tank-Automotive Command's (TACOM) RDE Center that may someday lead to robot vehicles capable of enhancing troop survivability by performing high-risk battlefield missions.

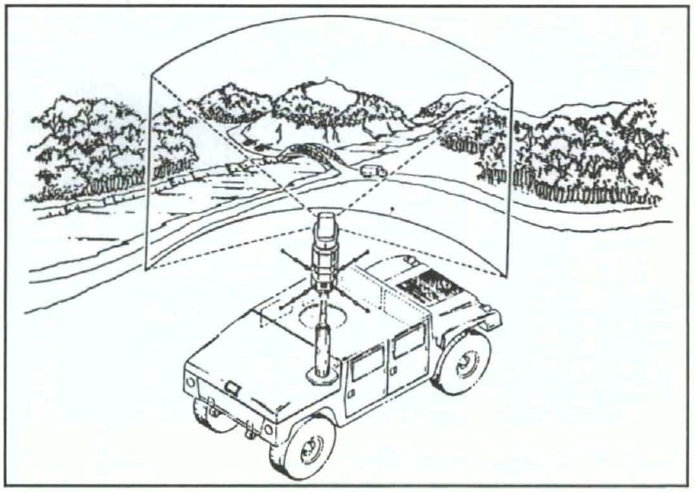
The system is a reconnaissance mission platform that is being specifically designed to ride atop a robotic vehicle and locate targets for the vehicle operator. Such a platform would be a component of the Battalion Targeting System concept now being developed by the Army's Field Artillery School at Fort Sill, OK.

Troops currently rely on manned vehicles to locate targets, sending Fire Support Team Vehicles and other reconnaissance vehicles several miles ahead of artillery units to find targets and radio their positions back to the units. Although this approach works, the possibility of enemy detection can place the observers at high risk. A robotized reconnaissance system would not only eliminate this risk, but, thanks to new technology, could also travel deeper into enemy territory—perhaps as much as 15 miles ahead of the artillery—and provide earlier warnings.

Known as the Forward Observation Remote Target Acquisition System (FORTAS), it is being designed as a modular test bed which can be readily adapted for use with new technology as it evolves. Two technologies to be evaluated are automated target acquisition and low bandwidth (military radio) communication techniques. Both are being developed in an effort involving TACOM, the Communications-Electronics Command (CECOM) and the Laboratory Command..

To complement TACOM robotic vehicle research objectives for a robotic reconnaissance test bed, FORTAS will contain only a daylight camera capable of producing images of the surrounding environment and a computer programmed to perform reconnaissance missions. But, according to RDE Center project engineer David Busse, TACOM, working jointly with the CECOM Center for Night Vision and Electro-Optics, eventually hopes to evaluate other surveillance components installed in FORTAS. He said among these are an infrared sensor for night observation. Such a sensor can locate and identify objects by measuring their infrared emissions. These emissions are always present in the environment, but they vary in intensity, depending upon whether their source is, say, a vehicle, a tree or a rock formation.

Busse said other features that could be added include a laser



The FORTAS mounted on a robotized HMMWV.

range finder to measure target distances, an acoustic sensor, a radar system and a high-resolution camera with a telescopic lens which can provide detailed images. "With all this flexibility," said Busse, "we will be able to expand the test bed enough to investigate virtually any technique that could assist in a target-acquisition role in a robotic vehicle.

The vehicle to carry the FORTAS will be a robotized HMMWV (High Mobility Multipurpose Wheeled Vehicle). This vehicle is one of three prepared earlier for TACOM by Kaman Sciences of Colorado Springs, CO, for use as test beds by RDE Center engineers to evaluate new robot-vehicle technology.

The modified HMMWV uses the same power-train components as the standard vehicle, but it includes a control system that allows an operator to drive it and perform tasks from a remote-control station. The vehicle also has communications equipment to handle two-way radio, video, data and remote-control signals, a computer to interpret the signals, and several computer-controlled actuators that control acceleration, braking and other driving functions.

The driver will remotely control the HMMWV and its surveillance platform from a control vehicle research test bed now being built for TACOM by FMC Corp. Known as the Multiple Vehicle Control Test Bed (MVCT), it is expected to be completed soon. It will consist of a module that will mount to a modified M109-series howitzer chassis.

The module will carry a commander and two robot operators, and a fourth crew member will drive the carrier vehicle. Each driver's station will allow an operator to control two robots simultaneously, and observe their progress through an array of TV monitors, which will display each robot and its surrounding environment. The commander's station will have the same driving capabilities as the driver's stations, plus additional equipment to allow the commander to perform route planning.

After the FORTAS-equipped HMMWV is completed, it will be sent to TACOM to participate in exercises with TACOM's other two HMMWV robots and the MVCT to demonstrate and evaluate a variety of robotic technologies.

The preceding article was written by George Taylor, a technical writer in the U.S. Army Tank-Automotive Command's RD&E Center.

AATD Provides Quick Support for Desert Storm

Because of the many environmental problems encountered by rotary and fixed wing aircraft in Saudi Arabia, the U.S. Army Aviation Systems Command's Aviation Applied Technology Directorate (AATD) at Fort Eustis, VA, has been active in searching for quick and affordable fixes.

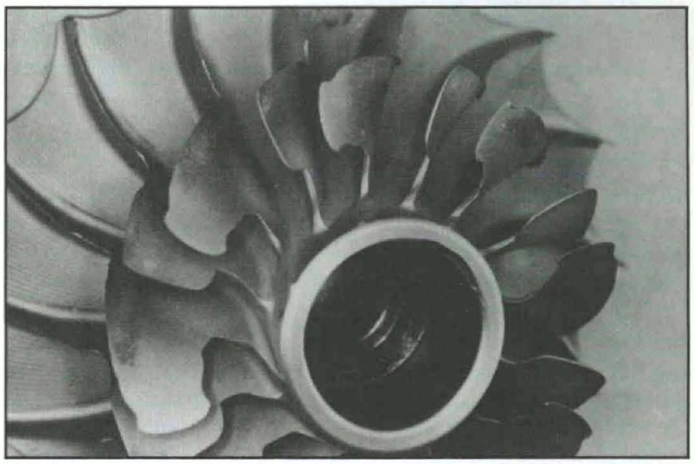
Initially, the most common problem was rotor blade erosion due to conditions caused by sand. The sand in Saudi Arabia ranges in size from talcum powder up to "small rocks" and has been reported at altitudes up to 14,000 feet by the Air Force.

Thus, there was virtually no way to avoid helicopter operations in a sand erosion environment. With rotor tip speeds approaching Mach .9, a little less than the speed of sound, the severity of the associated sand erosion limited aircraft operations to hundreds of hours before replacement of rotor blades was required.

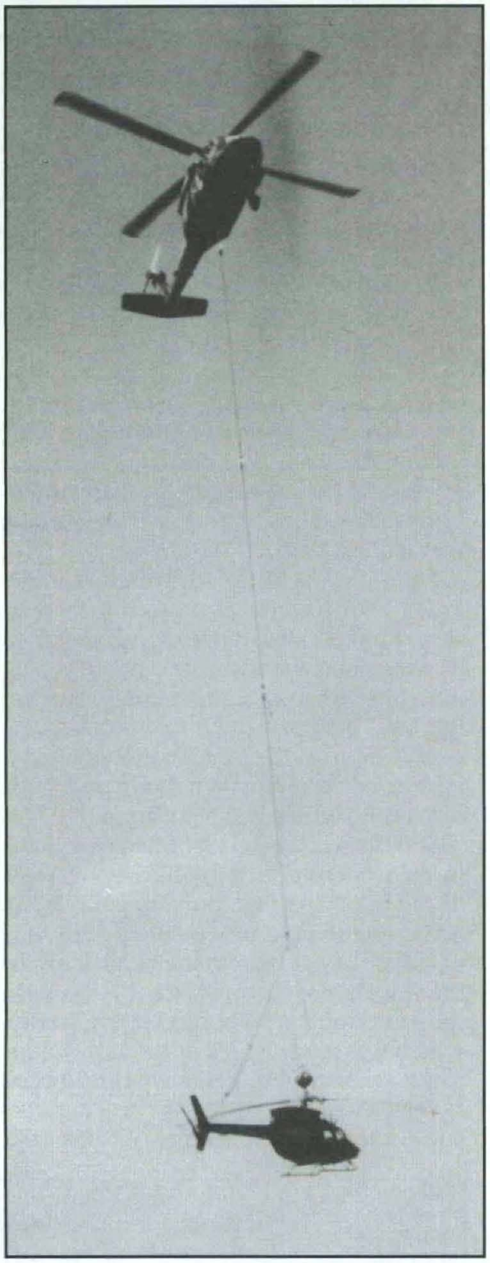
Solutions have been identified over the years, but to provide a fleet-wide fix requires protection from both sand and rain erosion. The best solution for sand erosion performed very poorly in the rain and those that worked well in rain did very poorly in a sandy environment. This is due to the very different micromechanical impact phenomena of water droplets and sand particles. The erosion problems in Saudi Arabia did not significantly include rain erosion; therefore, a protection system for sand erosion could be applied to all aircraft.

Solutions had been identified over the years, but very little effort had been applied to a fleet-wide fix. Working with soldiers of the U.S. Army Aviation Logistics School at Fort Eustis, VA, AATD engineers quickly validated the application procedures of Task L-100 polyurethane paint. This material was already in the system in kit form for the UH-60 and CH-47 aircraft. Later, the same validation began on a newer more durable material which was made by 3M and was developed in kit form for the Saudi Arabian Desert Hawk UH-60 aircraft.

Erosion also began to show in all turbine engine power plants. A quick fix of multiple types of barrier filters, improved engine



Sand erosion of gas turbine engine auxiliary power unit of a UH-60 helicopter.



Unit Maintenance Aerial Recovery Kit (UMARK).

compartment sealing and air particle separators was designed and applied across the rotary fleet.

Many ongoing projects were accelerated. These included a Division Aviation Intermediate Maintenance shop set, three battle damage repair kits (fluid line, electrical and fuel cell repair) and the unit maintenance aerial recovery kit. Beginning in October 1990, these systems were developed in multiple sets and shipped to forces in Saudi Arabia.

Sand and dirt accumulation in and around all exposed parts of the helicopter prompted quick reaction to buy off-the-shelf washing and air equipment. The requirement was for small, lightweight and self-contained units. A quick market survey found that the Aviation Pressure Washer/Decon System and the Pneumatic Aircraft Cleaning (PAC) kit performed satisfactorily.

A total of 39 PAC kits were shipped to Operation Desert

Battle Damage Repair Electrical Kit.

Shield. The Aviation Pressure Washer/Decon System provides complete washing capability of a utility helicopter with less than 50 gallons of water. Forty systems were shipped for the operation.

The real chemical threat faced in southwest Asia prompted considerable activity in all aspects of chemical and biological hardening requirements of all rotary winged aircraft. The NBC regenerative filter contract for the environmental control unit of the AH-1 was expanded to include the AH-64.

Additional work was started in areas of decontamination, chemical resistant materials and cockpit sealing techniques.

As a self-contained organization, AATD has the capability to design, fabricate, and demonstrate potential solutions to fielded fleet problems, and provide technical support to the aviation system developer and user.

AATD will continue to adjust its priorities in response to emerging tech base requirements to meet the needs of aviation systems operating worldwide in a responsive and affordable way.

The preceding article was written by COL David E. Sullivan, director/commander of the Aviation Applied Technology Directorate, one of four directorates under the U.S. Army Aviation Research and Technology Activity, Fort Eustis, VA.

In Memoriam

The staff of *Army RD&A Bulletin* is sad to inform the Army's acquisition community of the Aug. 15 death of Robert L. Michellon, former deputy director of the Army Acquisition Executive Support Agency. "Bob" Michellon, who retired from the Army in 1965 after more than 23 years of active military service had been employed as an Army civilian for more than 25 years prior to his retirement this past June.

Highly respected as a subject matter expert on the Army's project management system, Bob was, for many years, the chief of the Army Materiel Command's Project Management Office.

RD&A NEWS BRIEFS

Software Available to Facilitate TQM

Ensuring long-term success and producing continually improving products requires a change in the methods and tools which organizations traditionally have used for management. Because of a recognized need for both new philosophies and techniques in the workforce, many progressive organizations have adopted and implemented the Total Quality Management (TQM) concept. However, TQM encompasses much more than simply recognizing the importance of quality. It also necessitates an understanding of a number of analytical tools.

One cornerstone of TQM is the statistical interpretation of variability within the workplace. Whether in a manufacturing or "white collar" environment, statistical tools must be utilized to differentiate between common and special causes of variation. The knowledgeable use of these tools can transform decision making from an activity based largely on hunch to one based entirely on fact. The application of these statistical principles in the analysis and understanding of variation within an activity is known as Statistical Process Control (SPC).

The Production Engineering Division at the U.S. Army Missile Command in Huntsville, AL, has developed the SPC Toolbox to assist in facilitating TQM. The SPC Toolbox package, which is a product of the PE Tools program, includes both the software and support documentation to serve as a tutorial for the SPC concept and can also be used for real-world applications. The software was developed to run on an IBM PC XT or AT or compatible, and requires either CGA, EGA, or VGA graphics capabilities.

To obtain a free copy of the SPC Toolbox (5 1/4-inch format), please submit your request to: Commander, U.S. Army Missile Command, ATTN: AMSMI-RD-SE-PE (PE Tools), Redstone Arsenal, AL 35898-5270. Please limit your requests for one copy per organization. For further information, contact Gary Maddux at (205)895-6343.

BOOK REVIEWS

The Defense Revolution

By Kenneth Adelman and Norman Augustine
Institute for Contemporary Studies,
San Francisco, California, 1990

Reviewed by Richard Doyle, associate professor of public budgeting at the Naval Postgraduate School. He was senior analyst for Defense for the Committee on the Budget, U.S. Senate, from 1987 to 1990.

The Defense Revolution surveys the problem of allocating resources and managing the Department of Defense to meet threats to American security. The strongest sections concern the role of technology and its implications for U.S. defense strategy and budgets. Although the end of the Cold War has induced a fundamental shift in both the disposition and apparent value of military power, technological advances have introduced even more revolutionary potential uses for weaponry.

The capability to locate and destroy targets under adverse conditions has improved dramatically, which means that battle lines will be ragged, sanctuaries scarce, and attempts to confine military conflict in space and time fruitless. The transition from "smart" to "brilliant" weapons (the latter a term coined by one of the authors) is well underway, which depreciates the capital military systems of the countries that fail to keep pace in this competition.

The authors' real contribution lies with their discussion of the problem of budgeting for inflation. "Techflation" occurs when agencies such as DOD buy more equipment at the high end of the technology spectrum, where costs are above inflation. The higher the technology in each succeeding generation of weaponry, the greater the capability and the cost. Thus governments seeking to maintain "modern" forces at fixed levels must increase defense spending at rates above inflation. Defense budgets at zero real growth will result in a smaller force if the force is to be equipped with adequate defense technology. Using a calculus which assigns technology and inflation values, Augustine and Adelman allocate spending for a "balanced military force" and conclude that the cost of this force grows about 3.4 percent per year above inflation.

The implication is that even defense budgets that keep pace with inflation, not seen since 1985, will not permit us to keep pace with the competition (assuming that the competition is not similarly constrained). Constant buying power is not the same as constant military power. The critical premise underlying techflation is that security concerns will drive and defense budgets will support a continuation of intense global competition for military technology.

Clearly what is occurring in recent defense budgets is a set of exchanges between force size and the mix of weaponry. The 80,000 cut in troop strength required by Congress last year manifests this trade-off. To retain forces at their current levels and to equip them with the same number of weapons, each of which is better than its predecessor, requires increased defense budgets. Last fall's five year budget agreement will return DOD's real buying power by 1996 to the level it enjoyed in 1980. These reductions will exacerbate longstanding conflicts over the proper allocation of defense resources.

SPEAKING OUT

What Suggestions Do You Have for Improving RD&A Cooperative Efforts Between the Army and Industry?

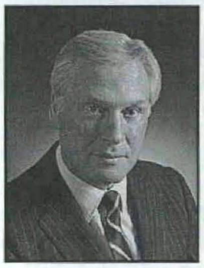
John D. Rittenhouse
Senior Vice President
GE Aerospace

The greatest cooperative improvement can come from both the Army and industry working jointly to reduce the acquisition cycle time. Today's acquisition process takes on an average 15+ years from concept to IOC which translates to 20+ years for full operational capability. It's unrealistic to assume operational planners can describe needs or technologists can project capabilities that far in the future. Currently, the cycle time for new electronics technology is under 10 years and approaching five years. **The technology base portion of DoD acquisition must provide real options for military planners to consider that can be fielded in five years or less.**

Complementary to this concept is the need to relearn how to jointly manage cost plus R&D contracts. We have in position a full generation of industry and government program managers who view themselves as adversaries as much as teammates. In addition, legal, political, and bureaucratic roadblocks have been added to the R&D process totally unbalancing the risk/reward ratio, especially for the government program manager. We need to define and remove these roadblocks, show supportive leadership at the top of the acquisition chain (the Services and OSD) and construct a one-week program managers' training course incorporating these concepts.

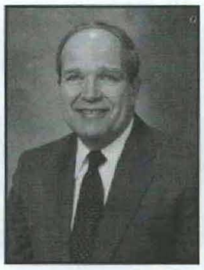
MG Joe W. Rigby
Deputy Chief of Staff for Development, Engineering and Acquistion
HQ, U.S. Army Materiel Command

The Army is dependent on the U.S. Industrial Base in times of surge/mobilization. We cannot allow our industrial base to erode away during peacetime. In order to sustain the industrial base during tight fiscal periods, the Army should undergo joint ventures with industry in two areas: (1) maintaining state-of-art technology that can meet the changing threats and (2) developing the manufacturing technologies on critical materials to allow the U.S. industrial base's capability to develop critical materials (i.e. semiconductors, composites, gears, and ball bearings). Leveraging resources through joint ventures between the Army and industry will be the best way to maintain the technological edge and sustain the industrial base.



Malcolm R. Currie
Chairman and CEO
Hughes Aircraft Company

We collectively face an extraordinarily serious challenge in the years ahead. The U.S. Army will emerge from the 90s smaller than it is today, but it must have even greater capability. At the same time, we must build down to a smaller, but even more innovative, competitive and vital industrial base. Our success in meeting this challenge will be our willingness to mentally put aside past concepts, past acquisition practices, past doctrine, past conventional wisdom and to attack the problem freshly from both the industry and Army sides. Each must get back to fundamentals of management and to think how we might best conduct the development of technologies and systems in this new era. We need leadership on both sides to bring about this change.



Dr. Robert B. Oswald
Director of R&D
U.S. Army Corps of Engineers

The bottom line for improved cooperative R&D efforts between the Army and industry is that both parties receive a better product from their partnership.

Increased emphasis is needed on using cooperative R&D agreements to move appropriate technology developed in Army laboratories into use in the civilian community. We need a vehicle to make the civilian community aware of such technologies in a comprehensive manner and in a way that is familiar and available to them, such as a special section of the *Commerce Business Daily* to announce technology available for possible commercialization and patents available for licensing.

We also need policy and procedures for conducting cooperative R&D with industry to develop Army-required products which clearly could have beneficial application in the civilian community, including the use of cost-shared R&D agreements, thus leveraging both Army and industry funds, improving the product for Army use, and ensuring that the product can be obtained by the Army at competitive prices.

Norm Augustine
Chairman and Chief Executive Officer
Martin Marietta Corp.

The defense procurement process unfortunately has produced a buyer-seller adversarial relationship not generally found in the commercial world. At the same time, the most successful military projects have been those where the buyer and seller worked responsibly together to assure the success of the endeavor rather than to assume that each is immune to the subsequent criticism in audits or litigation.

Increased cooperation—and thereby increased probability of success—can be achieved through such means as the Army sharing its future needs more openly with industry; using contract mechanisms which fairly recognize the risks entailed in the task at hand; rewarding good performance and penalizing poor performance; establishing an environment of stability—especially insofar as funding is concerned; and above all encouraging open, constructive two-way communication regarding risks, concerns, and yes, bad news as well as good.

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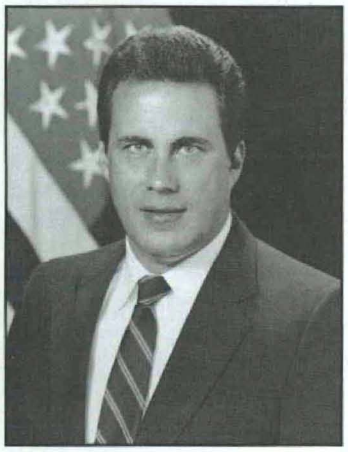


FROM THE ARMY ACQUISITION EXECUTIVE...

All of us in the Army Acquisition Community should dedicate ourselves to the following goal:

Provide the best possible equipment to Army soldiers
- •In the shortest time and
- •In sufficient quantities
- •Consistent with sound business practices and
- •Within available resourses.

To make sure that every scarce RD&A dollar is spent in direct support of this goal, we must better plan and manage our acquisition programs.

In the past, we often focused too heavily on technical performance and did not pay equal attention to cost and schedule. Although that emphasis produced great equipment for our troops, in some cases, it also cost us too much and many programs took too long.

In the future, we can no longer afford to overrun program schedules or exceed budgets. When we miss schedule milestones, we fail to get the most capable equipment to the field when it is needed by our soldiers. The troops lose confidence in the acquisition community and, more importantly, they are not properly equipped to deter or win the next war. We also cannot afford cost overruns. Given the severe budget cuts facing us today, we no longer have the flexibility to bail out programs when they exceed budget cost estimates. Also, programs with cost and/or schedule overruns are likely targets for Army, OSD, and Congressional budget cutters.

There are many ways for highly competent government and industry teams to better plan and manage programs. Realistic requirements, honest cost estimates, fully funded programs, good contracts, and continuous risk management are but a few of the many techniques available. They all work and we must continue to use them. But, they are not enough to fully control programs.

What more, then, can we do to better manage cost and schedule? For large contracts, when the Government shares the risk, an especially useful cost/schedule management technique has been around for a long time. The prescribed process ensures that contractors use systems of their choosing which comply with DOD cost/schedule control system criteria (C/SCSC). These control systems are expected to provide data and associated variance analyses adequate for decision making by both Army and industry managers. The concept is based on a few simple ingredients: a good baseline reflecting a realistic work plan; a system to capture cost/schedule data; a method to compare planned and actual performance based on earned value; sufficient analysis to understand the reasons for variances; predictions of the likely consequences of deviation from plan the to include updated estimates at completion (EACs); timely and accurate reports to management; and, finally, management's wholehearted use of the information.

Fortunately, almost all of our larger contracts require some form of cost performance reports based on C/SCSC. The systems, the processes, and the reports are in place.

Unfortunately, we have not paid enough attention to the information readily available from these reports in all instances. There are far too many examples of cost and/or schedule overruns that were very predictable and should have been detected and reported much earlier by contractor and PEO/PM managers. In retrospect, the information was there, but it was ignored or not recognized fast enough to make smart decisions while good options were still available. If we pay more attention to cost/schedule management, I know we can avoid the unacceptable situations we have experienced lately. For example, one large contract recently had a "surprise" overrun—just one month *after* a major program review! We learned afterwards that data from regular cost performance reports clearly hinted at problems over eight months *before* the decision review. I am sure this came about as a result of inattention or misunderstanding, not because of any deliberate attempt to hide information. Nevertheless, the consequences were much the same. Decisions were made without full information; we lost some trust within the acquisition community; and the large, unanticipated demand on our already tight budget was very difficult to absorb without severely hurting other programs.

Cost/schedule management techniques can help avoid such problems, but only if we all understand and pay attention to the information emanating from the process. The key to success is the enthusiastic commitment of government PEOs and PMs, and contractors—not just their staffs, but top executives as well. To measure this commitment, a manager need only ask a few questions:

1) Do I have trained people and a good system in place to gather and analyze cost/schedule data?

2) Do I personally understand the baseline which forms the foundation for data collection and analysis?

3) Does the baseline match the contract?

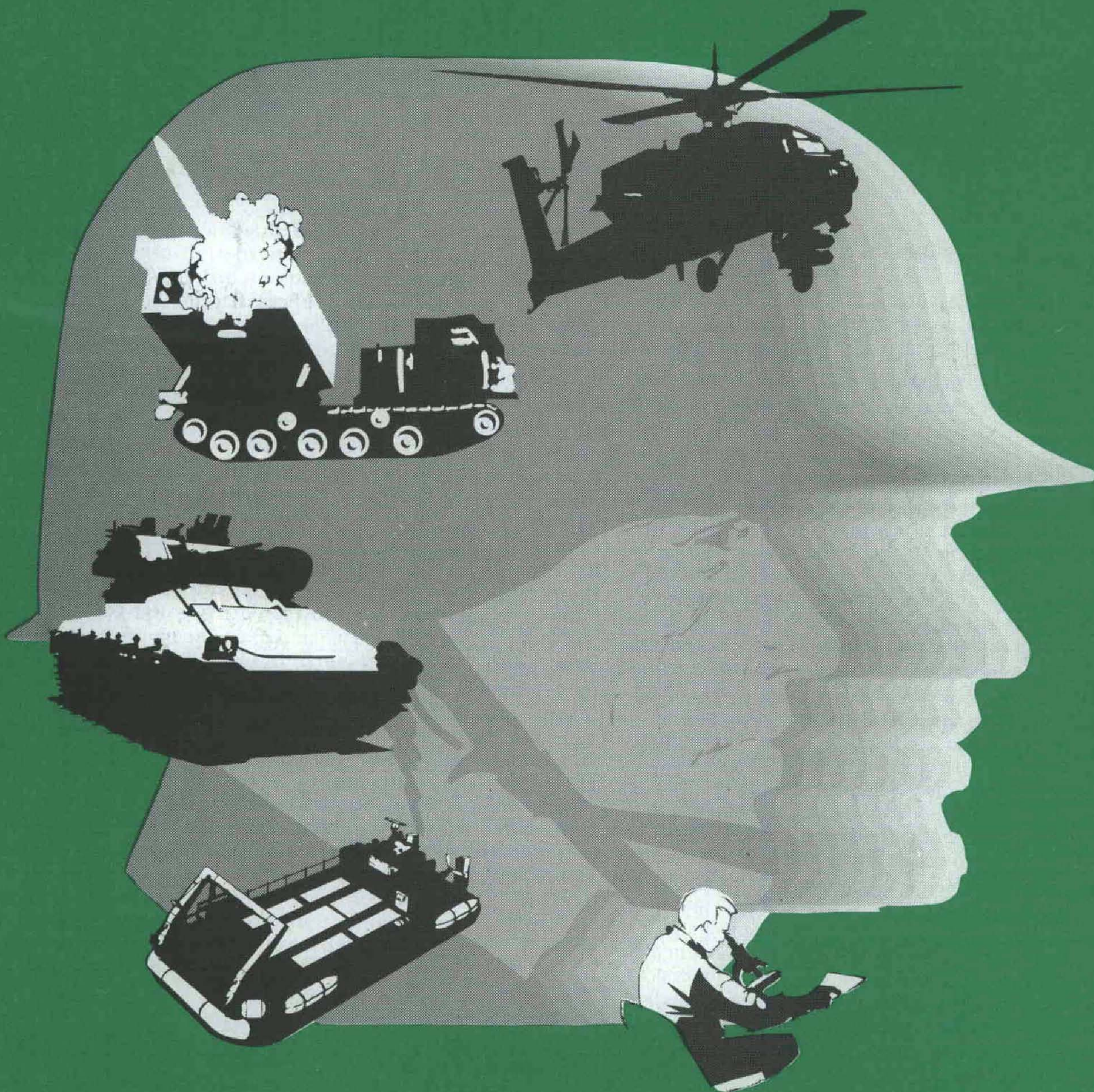
4) Do I understand and regularly use cost performance reports?

5) Do I reward people when they identify and report accurate and timely bad news as well as when they report good news?

If the answer is an emphatic "Yes!" to all of these questions, a good system is probably in place and serving you well. If not, identify the problems and get on with the solutions. If you need help, matrix support from AMC or my staff is available.

I know that cost/schedule management techniques, by themselves, are not sufficient to guarantee program success, but I consider them necessary. I am convinced that without good cost/schedule management systems, we will not meet the goal we have now accepted for ourselves—that of providing the soldier with enough of the best equipment, on time, using sound business practices, and within budget.

Stephen K. Conver



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