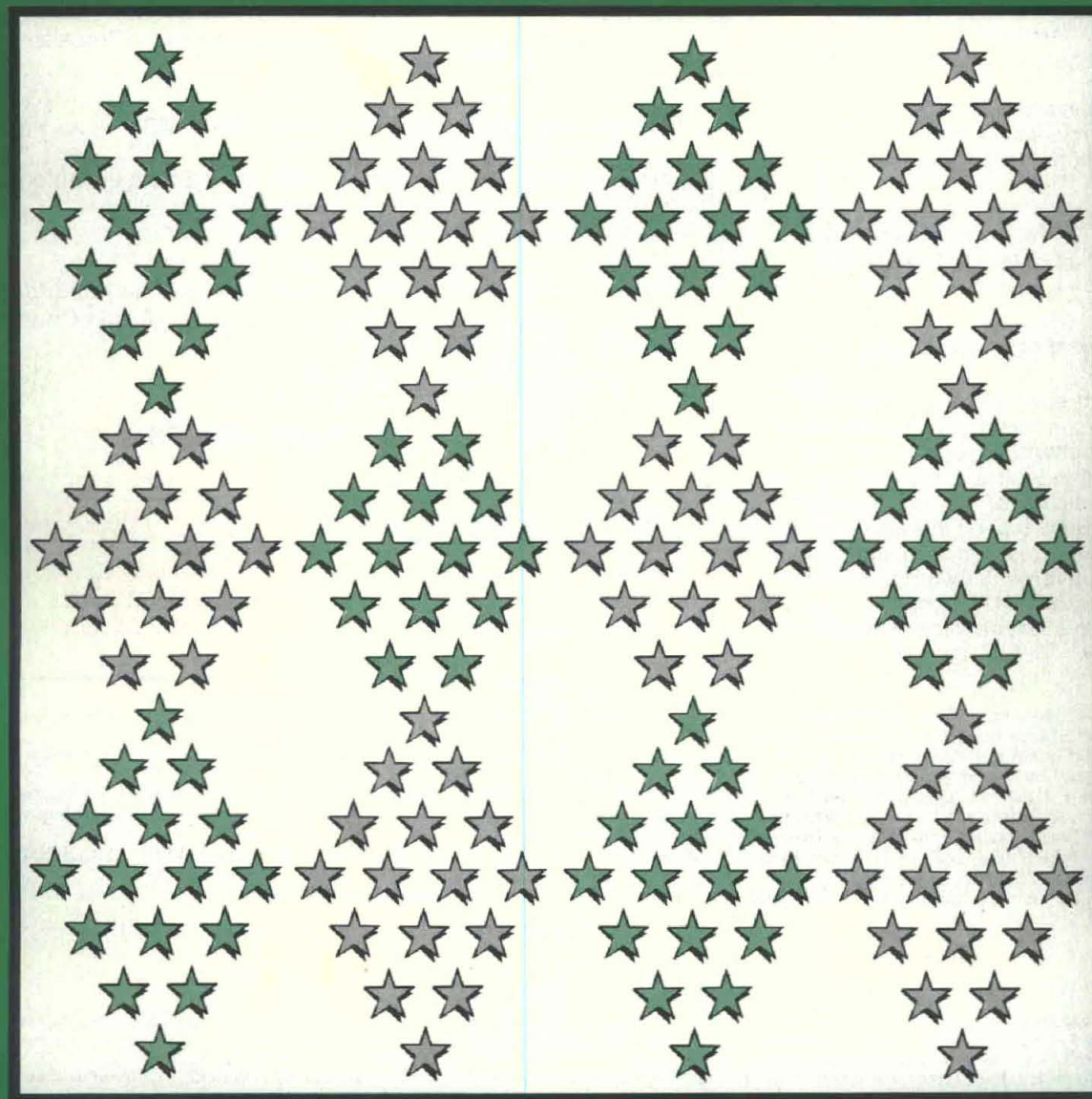
ARMY RD&A MAGAZINE

September-October 1986

DESTRUCTION AVOIDANCE



TOTAL FORCE PREPAREDNESS

R&D ACHIEVEMENT AWARDS

ILS AND STREAMLINED ACQUISITION

A R M Y

Research Development Acquisition RD&A

Vol. 27 No. 5 SEPTEMBER-OCTOBER 1986

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ABOUT THE COVER

The front cover highlights some of the key articles in this issue: total force preparedness efforts in support of the individual soldier, destruction avoidance of weapons systems, importance of integrated logistics support in streamlined acquisition, and presentation of annual Army R&D Achievement Awards. The back cover shows a CH-47 helicopter hub, which is related to a feature story on composites technology.

FEATURES

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Total Force Preparedness

By BG Jerry C. Harrison and Harry A. Gieske

Introduction

There have been a lot of good things happening in the acquisition business during the last five years that provide the kind of support our soldiers deserve. The only problem is no one has been hearing about the successes. This is, I hope, a good news article that captures the results of a lot of hard work and resources devoted to fielding modern equipment.

The Army modernization effort has received considerable attention. The high dollar items such as the Abrams tank, the Bradley fighting vehicle, the Patriot air defense system, the Apache and Black Hawk helicopters, the Mobile Subscriber Equipment system, and the Copperhead artillery projectile get a lot of coverage. While these are very important to our modernization efforts, there are a multitude of other systems in the combat, combat support and combat service support arenas that offer tangible, hands on, battlefield evidence that the Army has gotten some quality equipment for the investment of the taxpayer's dollar. Preparedness has improved and the following is an effort to capture those results.

As the title suggests, we will focus on the soldier as an individual and our efforts to provide him or her the equipment needed to fight and win on any battlefield. The programs we will highlight provide for total force preparedness—literally from the "factory floor to the foxhole." They span ammunition production facilities in the United States to life support of the soldier in combat.

Soldier Support

In response to our worldwide commitments, as well as the growing threat to the individual soldier, we have made very positive gains in improving the well being of the soldier in combat. We have introduced new meals and acquired modern technology water supply systems. Four or five years ago we had no capability to provide our troops water in arid regions of operations. We had equipment shortfalls and had no capability for taking salt or chemical warfare contaminants out of our water supplies. Today we have provided our troops with new purification technology as well as modern lightweight water storage equipment.

Another area that has been significantly enhanced is the capability to provide improved health care to our soldiers. In 1981, a large amount of our hospital X-ray equipment was not certified in accordance with the new federal standards. Some of our diagnostic and treatment equipment was outmoded and 1970s state-of-the-art technology. Today, the majority of the uncertified X-ray equipment has been replaced and newly developed medical equipment encompassing current technologies is being put into our fixed medical treatment facilities and our deployable medical systems.

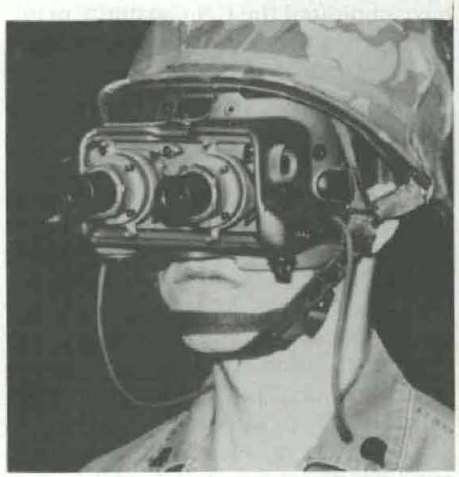
One of the most important steps taken on behalf of the soldier is the establishment of an aggressive chemical defense program. Most of the headlines are given to the retaliatory program. Equal attention should be given to the steps we have taken to protect the individual soldier with new masks, garments, decontamination equipment, and treatment. We needed, and will soon have, an improved chemical defense effort which is responsive to the very real and severe chemical threat.

We've also added to the capability of the individual soldier by providing him with night vision goggles so he can use darkness as an advantage on the battlefield and win against an enemy who intends to fight at night.

Intelligence Improvements

We don't expect the individual soldier to fight alone. The key to success in the AirLand Battle is the integration of soldiers and units into responsive, synchronized forces which can take quick decisive action against the enemy. A key factor in the success of the Army's AirLand Battle doctrine is timely and accurate intelligence. We need to know the location and capabilities of the enemy on a continuous basis.

Since 1981, we have doubled the number of Trail Blazer systems in the inventory, with the latest buy being product improved models of what we had in 1981. Trail Blazer exploits enemy communications in order to monitor his force disposition, locate critical command and control nodes, and develop targeting information.



AN/PVS-5 Night Vision Goggles.

Five years ago we started a product improvement program for the AN/TRQ-32 Teammate, which is used at corps, separate brigades and the non-heavy divisions. It is a wheeled-vehicle-mounted system and provides radio intercept and direction finding information. It is assigned to combat electronic warfare and intelligence units, not equipped with Trail Blazer. By the end of FY85, about half of our inventory were the improved models.

The Army, under its new Army of Excellence force structure design, is currently increasing the number of jamming systems authorized as well as replacing outdated manual systems with new generation equipment. The TLQ-17 is being replaced by the TLQ-17A in ground (Traffic Jam) and airborne (Quickfix) versions. The Tactical Jammer system, which replaces the GLQ-3A/B is a very high-power, track-mounted, highly-automated jammer that can target multiple targets simultaneously.

An area of intelligence collection that is often overlooked is that provided by deep patrols and special forces operations. We have provided a new capability to communicate with secure, burst communication radios which reduce the amount of time deep patrols must transmit to send a message. Thus,

these units will be harder to detect and will remain more survivable behind enemy lines.

At the same time we have improved readiness with our intelligence collectors, we have introduced a revolution in tactical intelligence processing. We have exploited the U.S. capability in micro-computers and have replaced strictly manual processing operations with computer-aided data handling, analysis and display. During the last two years, over 250 Microfix systems have been fielded to provide a quick reaction capability for intelligence and electronic warfare units throughout the world. Also, the Technical Control and Analysis Center is a mini-computer based system which was deployed, beginning in 1983, to all the European corps and divisions, and to the XVIII Airborne Corps at Fort Bragg, NC.

The long-term solution for providing automated assistance is the All Source Analysis System (ASAS), being developed under the Joint Tactical Fusion Program. A brass board of one of the intelligence processing modules of that system was delivered to the 9th Division in October 1985. Research, development, test, and evaluation modules for a limited capability configuration of the ASAS should be delivered to III Corps for test and evaluation by the time this article is published.

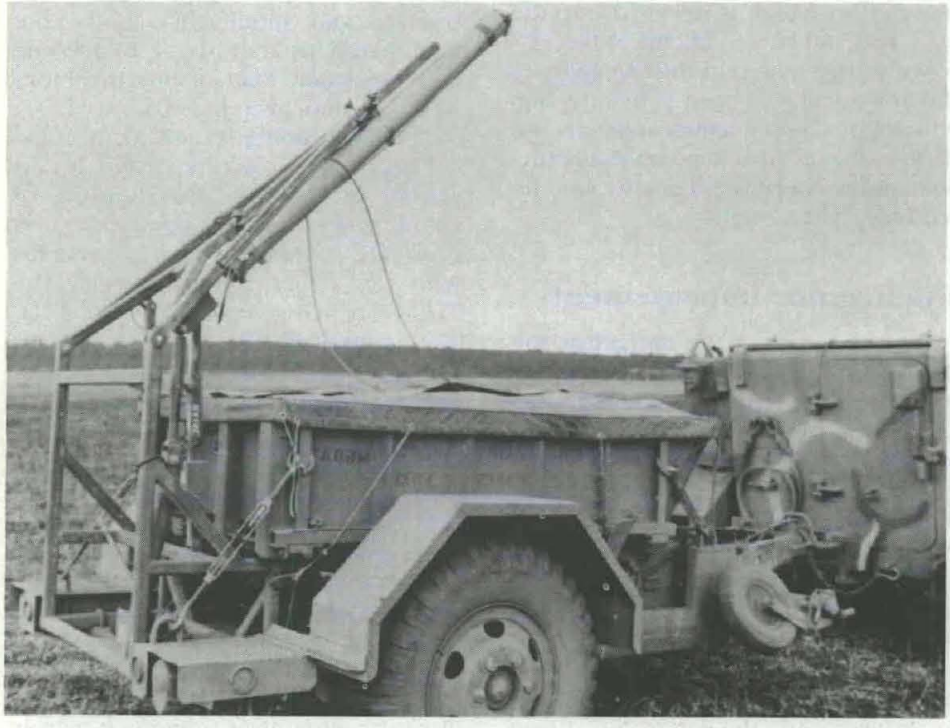
With the introduction of micro and mini-computers into the tactical intelligence function we have streamlined and quickened the whole intelligence cycle, including planning, collection, processing, production, and dissemination.

Command, Control and Communications

There have also been impressive changes in command, control and communications (C3) readiness. Five years ago, in theaters all over the world, tactical control of forces was accomplished with techniques and equipment whose origin is lost in history. Commanders and their staffs had to manually tally and display information, track trends, and evaluate options. The whole process was manpower intensive, slow and error prone.

In 1986 we are fielding the Maneuver Control System, which was initially procured in 1983. This system will provide the corps, division, and brigade commanders with an automated capability to see the battlefield, plan the battle, and execute the plan. The ability to respond to quickly changing situations is the basis of the AirLand Battle success.

A fundamental change in force readiness is also taking place in the area of communications. In 1981 we had no tactical automatic message switches. Instead, we had to rely on old manual torn tape relays. The high frequency radios were outmoded, many with vacuum tube technology. The command radios in the combat units had limited capability and had 25-year-old technology.



Mine Clearing Line Charge.

In 1986, 36 voice and 26 automatic data switches have been fielded, bringing substantial improvements in traffic handling and reliability of common user service throughout the theater. Modern technology, high frequency radios have been fielded to special operations forces and the continued production of these radios will help fulfill our long distance (1,500 mile) net radio requirements.

Since 1981, we have equipped our corps, divisions, brigades and special forces with satellite communications terminals, giving these units a capability that has no predecessor. We are developing the Single Channel Ground and Airborne Radio Subsystem to replace the 25-year-old VRC-12 family of radios. The older radios have limited capacity and no electronic counter-countermeasures capability.

Fire Support Improvements

AirLand Battle visualizes firepower intensive conflict. Enemy targets must be located quickly and attacked before they can relocate and disappear. Fire power must be used to attack deep, disrupt enemy formations and blunt their attack. At the same time economy of force requires that every shot we fire be "fired for effect." This means that the whole fire control process—target detection, and location, and fire command generation, has to be more timely and accurate. Sixteen of the TPQ-37 Firefinder counter battery radar systems are now in Europe, Korea, and with the Army Forces Command (FORSCOM), giving us highly accurate and responsive counter-battery fires.

Newer systems fielded since 1981 have made the whole artillery fire control process more accurate and responsive, as well as improving the survivability of artillery units. Automatic data processing is now thoroughly part of the fire control system. The obsolete Field Artillery Digital Automatic Computer has been replaced by the Battery Computer System. This, along with the Position/Azimuth Determining System, allows more rapid displacement and dispersal of the artillery units leading to greater support to the maneuver units while reducing vulnerability to enemy counterfire.

For control of mortar fire we are now replacing the manual M-10 plotting board with the Mortar Ballistic Computer. This computer reduces computation time to three seconds and interfaces with the Tactical Fire direction system via a digital data link. Thus,

we have truly integrated fire support to the maneuver battalion.

In keeping with the introduction of precision guided munitions, since 1981 we have fielded 154 laser designators to Europe, FORSCOM, the Training and Doctrine Command, and the National Guard. These designators are used with the Copperhead 155mm artillery round, the Hellfire missile launched from a helicopter, and Air Force laser guided bombs. Our anti-tank capability has significantly improved.

Ammunition

A doctrine of firepower intensive operations is useless without ammunition to support it. Ammunition procurement in the past has often fluctuated from year to year. Over the last five years efforts have been made to stabilize the ammunition accounts. We've had some pretty fruitful ammunition development programs in prior years giving us some highly effective, advanced technology ammunition. Since 1981 we have concentrated on the production of these new types.

In 1981 we were producing a new generation of improved conventional munition rounds for the 155 Howitzer. That production is continuing so that today we have considerable rounds in our worldwide stocks. We are also in our sixth year of procurement of Copperhead as previously mentioned.

For fire support organic to the maneuver units, the Army has introduced the improved 81mm mortar system. This system provides greater range, accuracy, lethality, and reliability over the old system. It has been in procurement since fiscal 1984, and by end of FY86 the new smoke and illumination rounds will enter the inventory. By year end we will have 11,000 smoke and 21,000 illumination rounds on hand.

Success in tank warfare has been a continuing challenge as the quality and quantity of enemy armor increases. A new 105mm kinetic energy round was brought into production in FY83 for use in the M1, M60A3, and M48A5 tanks. We've also started production of 120mm tank ammunition to support the fielding of the M1A1 tank, which will have a 120mm gun.

The readiness of Army aviation has also been increased with the production of more effective rockets and gun ammunition for helicopter systems. In FY82, production started on 30mm ammunition for the Apache AAH-64 weapon system. In FY84, production started on the Hydra-70 rocket, which provides greater accuracy, range and velocity for helicopter free-flight rocket systems. Thus, all firepower elements of the force have gained an improvement in preparedness.

Engineer and Wheeled Vehicles

An Army whose tactical doctrine requires agility and responsive maneuver can be defeated if it doesn't have the means to overcome obstacles or create obstacles. Key to our defensive and offensive tactics is equipment to support our ground maneuver plans. We need the ability to both lay and breach mine fields quickly. In 1981 we had virtually no capacity to do this. Mine laying was done using manual methods. Now we have the Ground Emplaced Mine Scattering System which can dispense 800 mines in 20 minutes. At the same time, we are acquiring the ability to breach mine fields quickly and effectively, thus preserving the maneuver.

Modern warfare requires the ability to conduct engineer operations to build barriers, clear roads, and create airfields. In 1981 we had a construction equipment inventory consisting of numerous makes and models of old, obsolescent equipment. We are now executing, using multi-year contracts, a plan which modernizes the inventory in a coherent and consistent way.

An area in which the Congress has taken special interest is tactical wheeled vehicles. Five years ago we had a fleet of over age vehicles and no real plan to fix the situation. Using multi-year contract authority, we have major programs to replace the old fleet with new vehicle designs and adaptations from the commercial market.

Logistics Improvements

Achievements in preparedness have not been limited to the front. Once a force has been committed to combat, the supply line must be capable of pushing the right supplies forward in the right amounts to the right places. In 1981 we faced a major challenge in this regard. Most of our equipment for bringing supplies over the shore was more than 20 years old. The same situation existed in our petroleum handling capability and in heavy truck land transport. Our logistics capability was out of date with our needs and the technology around us.

Today, we have acquired new causeways and air cushion vehicles to support over-the-shore supply operations. We have multi-year contracts to acquire five- and 10-ton trucks to modernize the heavy truck fleet, and procurements are underway to modernize and standardize our materiel handling equipment. We are also rethinking the whole logistics process from factory floor to the brigade trains. We have started an ammunition logistics program and designated a program manager for this effort. We expect to capitalize on advances in packaging materials, robotics, and data processing to improve ammunition logistics. Exploiting the revolution in computer technology, we have introduced automatic data processing down to the battalion level. In 1981, we were working with large and outdated computers, which served only the needs of large units. Today we are fielding the Tactical Army Combat Service Support System to support the missions of personnel, supply, maintenance, medical, ammunition and transportation.

Training and Production Base

AirLand Battle doctrine not only influences what we need for support in the combat theater but also what we do in the United States. We mentioned earlier that AirLand Battle doctrine calls for a firepower intensive force whose maneuver elements are well synchronized with the fire support elements. Making this happen starts in the United States.

Synchronizing the force starts with training—individual, small unit, and large unit. The Multiple Integrated Laser Engagement System (MILES) is the system we use for scoring force on force training exercises. It makes training much more realistic since we can score hits on targets. Since 1981, we have introduced MILES into the reserve components and applied the system to armor, aviation and air defense operations. Now we have the ability to score combined arms training, less indirect fire.

Fundamental to training operations is the adequacy of the facilities used as training centers. While facility construction is addressed under military construction accounts, we would like to call attention to the improvements made in the readiness of communications and automatic data processing that are so vital to the training function, as well as command and control of continental U.S. operations. We have, since 1981, installed new phone systems and

state-of-the-art computers to support all our operations.

Firepower requires the production of the right kind and adequate amounts of ammunition. In 1986, we can't report that we have solved the ammunition production problems. We can, however, report that the ammunition production base program in FY85 initiated an RDX/HMX expansion program as well as facilities for loading insensitive explosives in bombs.

Summary

As you can see the Army has done a lot to get the most from the defense dollar in the combat, combat support and combat service support arenas. In many cases the dollar cost has been relatively small but the payoff has been significant. With a focus on the AirLand Battle and the individual soldier, we have made significant contributions to land power. There have been quantum improvements in our ability to provide the soldier with the personal equipment, command and control, firepower and sustainment he or she deserves. We must manage the resources we are provided so that we can continue to improve our capabilities in the years ahead.

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HARRY A. GIESKE, employed in the Space Division, HQ, Army Materiel Command, is currently working as a senior fellow at the Atlantic Council of the United States. A colonel in the U.S. Army Reserve, he has held a mobilization assignment in the Office of the Deputy Chief of Staff for RDA, Department of the Army.

Army Develops Computerized Target Ranges

Target practice for Army infantry and armor units is being revolutionized. The U.S. Army Armament, Munitions and Chemical Command (AMCCOM) Rock Island, IL, has fielded a new training system that will change the way soldiers prepare for battle. The new system is called the Remote Target System, or RETS for short. It is designed to modernize the Army's live small arms and armor marksmanship training and qualifications, in addition to giving soldiers a real feel for battlefield conditions.

Until recently, soldiers practiced their marksmanship using firing ranges with stationary targets that popped up in the same locations for years. Soldiers knew exactly where targets would appear because bullets had worn a path leading to the target. This will soon become a thing of the past.

"Now these targets can appear anywhere on the range," says AMCCOM Weapon System Matrix Manager Claud Comer. "Under RETS the targets can pop up behind a tree and move from tree to tree."

Targets vary in size from plastic forms resembling infantry soldiers to a silhouette of the Russian T72 tank. The targets are set up on tracks allowing them to be moved to various locations which are programmed into a computer. The targets are linked to a control tower from which the targets are programmed and the results tallied.

This armor moving target carrier is a flank silhouette of a Russian T72 tank. This target can be remotely controlled to move at variable speeds up to 40 kilometers per hour.

One of the major benefits the new range offers over the older traditional ranges is the realistic setting. The sounds of the Russian-made AK47 rifles along with their muzzle flash can be programmed on range simulators allowing soldiers to differentiate between hostile and friendly fire. When a tank is hit, a cloud of dark smoke signals a kill.

Different scenarios can also be programmed into the computer depending on what the unit commander wants. Targets representing ground forces can be programmed to retreat or attack.

"The primary objective is range automation," points out Comer. The new ranges will provide an instant printout that tells the soldiers' commander the quality of marksmen in his troops. Without automation, range qualifications can be very time consuming, it would require someone to go out and count the number of holes in each target.

The first Remote Target System was installed at a multipurpose range at Fort Hood last summer. Combined arms ranging from an M16 automatic rifle to the M1 Abrams tank can be used on the range. Helicopters can also be called in by radio to test their firepower at the range while ground-to-ground or air-to-ground missiles can also be tested at the range.

Future plans call for the introduction of thermal targets for use with the Abrams tank and Bradley Fighting Vehicles equipped with night vision equipment. In addition, laser systems will also be incorporated to conserve ammunition and costs.

Currently, RETS is in use at Fort Hood, TX, and Fort Benning, GA. In the future, Comer expects practically every soldier to qualify on the new ranges. By 1991 the computer controlled Remote Target System will be in operation at 179 ranges in 54 locations around the world.

Destruction Avoidance

By COL Douglas H. Barclay and Duane A. Burchick

Introduction

With weapon systems increasing in complexity, it is no longer sufficient to only provide the operator information pertaining to what the system is doing. The operator also requires information on what the weapon system will be capable of doing when stressed. To be useful, additional information must be organized and presented according to mission priorities. The displayed information must focus on and be directed to the on-going mission and critical weapon system functions.

Maintenance Test Support

A seemingly unrelated problem exists in the acquisition of materiel test support for weapon system maintenance activities. Test systems are typically not planned in the context of an integrated test support for the weapon system. This results in on-line test which is uncorrelated with off-line test designs. Testability as an integrated portion of the weapon system, if addressed at all, is often not designed into the system because of funding constraints and subsequent tradeoffs to meet mission requirements. Plans for off-line test may also be compromised in the exigency of meeting the weapon system operational test schedules before Milestone III. This results in less than desirable maintenance test support being fielded.

Maintenance test research conducted by the Army's program manager for test, measurement and diagnostic equipment has revealed a close relationship between the problems associated with operator access to weapon system performance information and its integrated test capability. The technology that binds the solutions of the operational and maintenance problems presented above is found in test systems. The system testability characteristics and test sensors that allow built-in-test and off-line test access are the same networks required for advanced weapon system operations management.

The measure of test networks to enhance the operational capability of weapon systems is termed destruction avoidance. It is defined as the probability, based on the comprehensiveness of the on-line test system, of predicted hazard occurrence due to weapon system and subsystem failures.

Integrated Test

Destruction avoidance, like maintenance test support, is determined during a weapon development using a systematic process to design an integrated test system. This process is addressed by the Test Support Analysis Model that is currently in development at Fort Monmouth, NJ. The net result of this analytic approach is the definition of an integrated test system.

No longer should test support be planned as merely an assemblage of equipment, but rather as a unified major subsystem of the weapon system. Integrated test is the manifestation of all test functions, both operational and maintenance, from test capability onboard the weapon system to all offboard test equipment at organizational through depot maintenance echelons. It is the integration of all test functions in order to optimize both the weapon system operational characteristics and the weapon support system.

A weapon system's combat effectiveness can be significantly increased if an on-line test subsystem is designed for and integrated into the weapon and used properly by the local combat commander. Thus, an effective weapon on-line subsystem can be a matter of combat survival. The greater the technology and complexity of the weapon system, the more destruction avoidance becomes a function of both test and tactics. Test capability, however, is determined early in the development cycle, whereas tactics unfold in the heat of battle.

A task of the weapon system project manager is to assure that the on-line test capability is sufficiently comprehensive, and that the weapon system architecture allows the installation of an "expert" real-time, analytic system that can capture, process and project destruction avoidance information. The operator and test subsystem will do the rest.

An on-line test subsystem can be designed to assist the operator in combat by giving him the requisite hazard information in advance of entering critical phases of the mission, and thereby permit him to adjust his tactics either to compensate for reduced weapons capability or to avoid an accumulation of hazardous stress on weakened system functions. This on-line test is manifested in monitoring networks and by data capture, scanning and analysis functions that allow tactical decisions to be made regarding mission phases so as to enhance the weapon system and crew survival. Destruction avoidance is that capability of the on-line test subsystem to avert various levels of mission disasters such as:

- Immediate and Catastrophic—this requires instant reaction, such as helicopter mast failure;
- In-Mission Adjustments—this involves seconds to react, such as tank stand-off and fire in lieu of a running assault; and
- Emergency Repair—this involves minutes to react, such as maintenance in the forward battle area.

Destruction avoidance is the timely sensing of prime mission capability failures based on the detection of sub-indenture failures. It involves the probablistic manipulation of accumulated data from environmental, operational and critical failure variables, while concentrating on mission failures vice those elements which can be handled as deferred maintenance.

Data Capture

The requirement to capture data of weapon system variables is important in both maintenance and operational environments. Emergency repairs in

the forward battle area must not be prolonged by excessive test procedures that sometimes exceed an hour before the fault condition can be directly identified. This is an excessive time requirement when the weapon system is vulnerable to hostile action. A system's data capture capability can shorten this time by performing an electronic handshake with simpler contact off-line test support to hand off the known "up" parameters and built-in-test fault identifications. This arrangement can greatly reduce the test sequence and simplify the test cable interfaces. Consequently, weapon system faults can be assessed in a fraction of the time commonly experienced today, and thus contribute to reducing weapon system vulnerability.

Data capture in the operational environment provides an essential foundation for battlefield management systems that employ on-line fault prediction and warning capabilities as shown in the accompanying illustration. Individual Line Replaceable Units are monitored for fault potentials in critical mission functions. Lower level built-in-test accesses detailed conditions such as in-circuit responses that indicate incipient failures of higher order functions.

Local microprocessors execute adaptive scanning techniques to prioritize failures that are most sensitive to the current mission. Subsystem microprocessors narrow the scan to higher level fault dependencies, execute adaptive analysis of failure probabilities, and correlate higher faults to system operational parameters. A final display processor converts subsystem data to system over-stress susceptibility according to mission phase and operating conditions, accumulated hazard probabilities, and specific failure alarms. Such timely data allow the operator to employ tactical variations if needed to enhance the chances for mission success.

Battlefield Payoff

Examples of payoffs to a battlefield commander of weapon systems capable of destruction avoidance are illustrated in the following scenario:

A cavalry squadron commander is given a 48 hour alert to prepare for a night assault. The squadron's mission will be to perform a screening action to advance, locate and contact enemy forces, to execute an orderly tactical withdrawal through advancing friendly armor battalions, and finally, to protect the divisional left flank. During the pre-operations briefing, the squadron support battalion is told to reprioritize maintenance action and emphasize night vision and communication capabilities. The support battalion materiel management officer accelerates the refurbishment of all thermal sensors and communication equipment with destruction avoidance readouts that show hazard probabilities greater than 10 percent for the projected duration of operations. Consequently, these critical capabilities are fortified in time for the initiation of operations.

During the squadron advance in the evening of the second day, an armored cavalry platoon commander is alerted by one of his tanks that a turret stabilization system shows a probability of failure greater than 80 percent within a designated operating time. The commander changes the leapfrog advance, and places the reporting tank in an overwatch role, allowing "healthier" tanks to maintain the initial advancement. Just past 0200 hours, the adversary is located by the advancing cavalry elements, which then initiate a withdrawal using fire and maneuver tactics.

The "weak" tank does indeed subsequently experience a turret stabilization malfunction, but is still able to perform effectively using its manually controlled firing system from the overwatch position, and then deploying to rear positions by leapfrogging past the lightly engaged, fully operational cavalry assets. Thus, the on-line destruction avoidance subsystem is able to achieve its maximum utility by forecasting significant problems and allowing the degraded weapon system to be properly utilized. The end result is the enhancement of the crew's survivability and the access of critical information used to increase the probability of mission success.

As the battle develops, an advanced attack helicopter receives a hit and loses its starboard engine. The pilot disengages from combat, and starts back to the Forward Armament and Refuel Point. A minute later he is alerted to a growing hazard—a significant probability of engine power loss inside of seven minutes. He radios his condition and location to the Aviation Unit Maintenance Group which, in turn, requests diagnostic information.

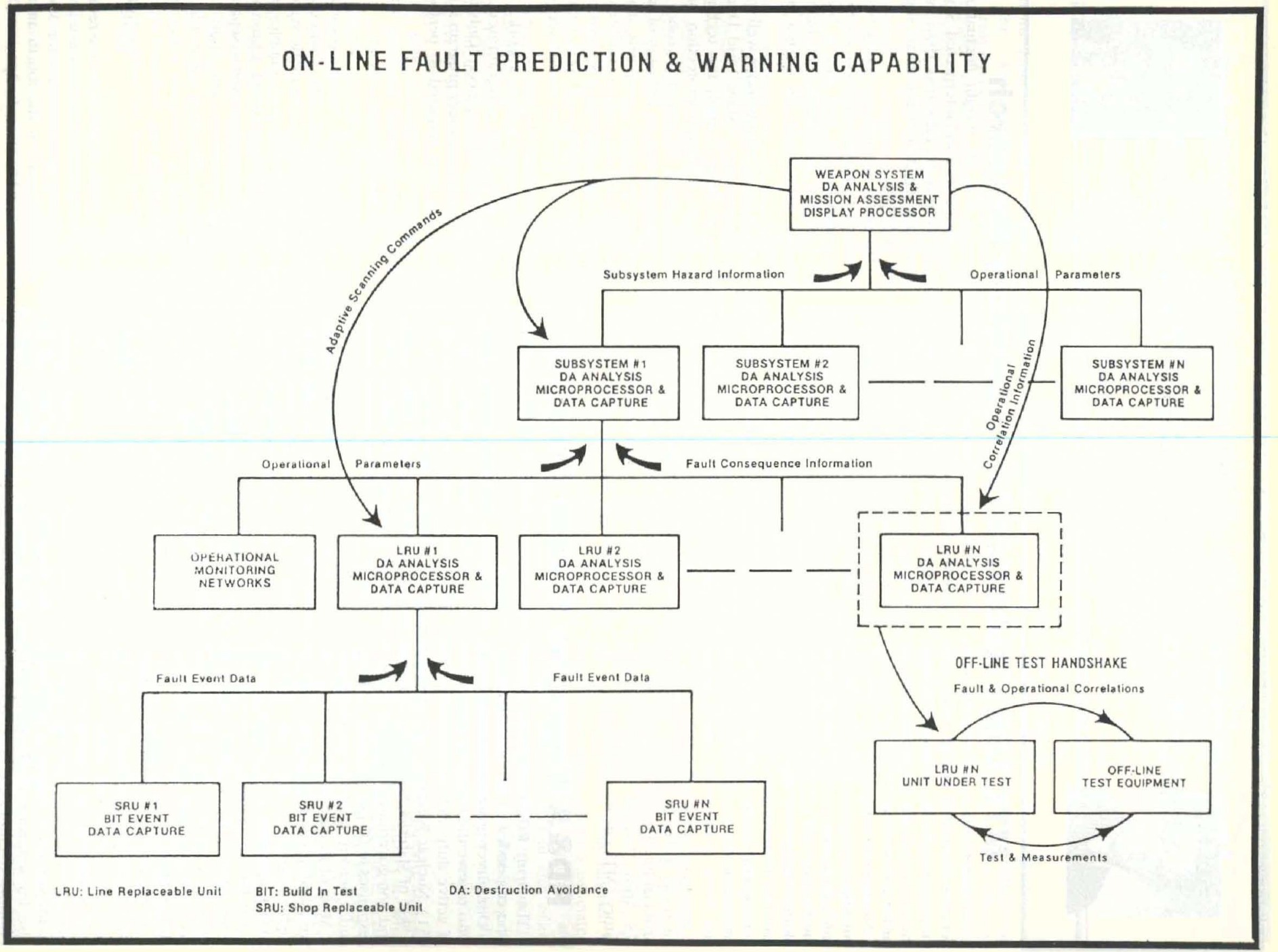
The on-line test system reports engine heat build-up, a slow pressure loss in the transmission lubricating oil, and a positive metallic particle oil contamination in the engine. An analysis of these conditions by the on-board test subsystem concludes that lubrication elements have been damaged and could subsequently cause a major engine failure. The pilot elects to stay airborne for two more minutes, seeking out and then landing on a protected hillside to the rear of the forward battle area. The corps Aviation Unit Maintenance Group dispatches a helicopter to retrieve both crew and downed aircraft.

The night assault results in the adversary taking heavy losses and subsequently withdrawing from the contested area. Night vision and communication equipment operate with excellent operational availability in all squadron weapon systems, significantly contributing to the overall success. Additionally, many weapon systems are salvaged with partial mission capability vice the degrading of this equipment beyond repair or being abandoned because it is inoperable.

After the battle, corrective maintenance operations commence with high test efficiencies realized through effective information transfer from the on-line data capture capabilities. Each Line Replacement Unit, subsystem and weapon system captures its own status data. Then given the destruction avoidance capability, operational data can be passed down from higher system processors to Line Replaceable Units enabling the diagnosis of intermittent failures in the off-line maintenance environment. The net results are: dramatic decreases in test times, dramatic decreases in incidents of No Evidence of Fault, significant increases in maintenance productivity, significant decreases in system maintenance down time, and significant increases in system availability.

Conclusion

The concept of an integrated test system must be initiated during the initial design of system hardware or during major product improvements of weapon systems. Test engineers must be part of the development team to insure that testability is designed into the system hardware and that test equipment compliments on-board diagnostics. Analytic tools must be integrated with the integrated logistic support analysis to measure capability during design and define the highest pay-off areas for mission success. By starting now to develop this capability, we can achieve battlefield management systems that will assure battlefield commanders of an increased degree of success in future engagements.


ON-LINE FAULT PREDICTION & WARNING CAPABILITY
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Adaptive Scanning Commands
Subsystem Hazard Information
Operational Parameters
SUBSYSTEM #1 DA ANALYSIS MICROPROCESSOR & DATA CAPTURE
SUBSYSTEM #2 DA ANALYSIS MICROPROCESSOR & DATA CAPTURE
SUBSYSTEM #N DA ANALYSIS MICROPROCESSOR & DATA CAPTURE
Operational Correlation Information
Operational Parameters
Fault Consequence Information
OPERATIONAL MONITORING NETWORKS
LRU #1 DA ANALYSIS MICROPROCESSOR & DATA CAPTURE
LRU #2 DA ANALYSIS MICROPROCESSOR & DATA CAPTURE
LRU #N DA ANALYSIS MICROPROCESSOR & DATA CAPTURE
OFF-LINE TEST HANDSHAKE
Fault & Operational Correlations
Fault Event Data
Fault Event Data
SRU #1 BIT EVENT DATA CAPTURE
SRU #2 BIT EVENT DATA CAPTURE
SRU #N BIT EVENT DATA CAPTURE
LRU #N UNIT UNDER TEST
OFF-LINE TEST EQUIPMENT
Test & Measurements
LRU: Line Replaceable Unit
BIT: Build In Test
SRU: Shop Replaceable Unit
DA: Destruction Avoidance

COL DOUGLAS H. BARCLAY is the program manager of test, measurement and diagnostic equipment for the Army. He received his B.S. degree in industrial management from Auburn University in 1961, an M.S. degree in operations research from the University of Alabama in 1973, and an M.S. degree in systems management from the University of Southern California in 1980.

DUANE A. BURCHICK is a senior staff scientist and the test systems branch manager for DCS Corp. of Alexandria, VA. He received a B.S. degree in physics from the University of Maryland in 1968, and has subsequently engaged in Army and Navy electro-optics and test systems research.

MTL Uses Robotics for Laboratory Research

The robot pulls a jar from the temperature-controlled water bath. Its dual-function hand uncaps the jar, sets the cap to one side, then positions the jar for the next task.

Moving with quiet precision, the robot lifts a composite, or resin-impregnated fiber sample, out of the water in the jar, dries the sample between two blotters to remove the surface water droplets, then weighs it.

Reversing its initial steps, the robot returns the composite sample to the jar and the jar to the water bath. This task is repeated at precisely-timed intervals 24 hours a day in the new Robotics/Artificial Intelligence Laboratory of the U.S. Army Materials Technology Laboratory (MTL) in Watertown, MA.

According to lab manager Suzanne G. W. Dunn, "Laboratory robots have to be very precise and accurate because of the relatively small size of the materials to be tested. One inaccurate measurement could ruin months of research."

Officially known as the Immersion Robotics Work Cell, the prototype robot is designed to determine the rate of diffusion of liquids in composite materials—that is, the amount of liquid that is being absorbed in the composite sample. The diffusion of water is particularly significant, MTL officials say, because water absorption is one of the major causes of material degradation.

A computer linked to the robot records the weight of each composite sample and displays the results in graph form so that the weight fluctuations may be analyzed and interpreted. Since each sample weighs less than two grams, the weight differences are slight but revealing.

The water immersion tests are being conducted on glass-reinforced composite materials—the type that is being used in the manufacture of lighter, stronger rotor blades for today's helicopters.

"So far, the robot is working well with water immersion testing," said Dunn. "Later, we hope to apply this technology in the chemical protection program by using the prototype robot to determine the rate of diffusion of hazardous chemicals in composite materials. It can also be used to evaluate the corrosion rate of metals in various corrosive environments for MTL's Center of Excellence for Corrosion/Deterioration Prevention and Control."

The Immersion Robotics Work Cell was designed and programmed by Dunn, an industrial engineer. "Only five percent of the computer program is for the actual steps required to perform the immersion test," she said. "The other 95 percent tells the robot what to do if something goes wrong."

The Immersion Robotic System is one of four robotic systems presently in the robotics lab at MTL. Dunn plans to program the second robotic system to prepare and introduce samples to a High Performance Liquid Chromatographic, an instrument used to separate chemical compounds into individual components. The third robot will be programmed to determine water content in materials, and the fourth is presently being used for instructional purposes.

Dunn is scheduled to give the results of the water immersion tests in a presentation entitled "Robotics for Materials Evaluation" at the fourth annual International Robotics Symposium Oct. 20-22 in Boston.

RD&A Magazine Survey Results

The *Army RD&A Magazine* staff extends a sincere thanks to the 375 persons who responded to our biennial readership survey.

Our survey group was chosen by taking a systematic random sample of persons who receive the magazine on an individual basis. This group is comprised mostly of active duty and reserve Army officers who are in a Functional Area of R&D (51), Nuclear Weapons (52), or Contracting and Industrial Management (97), or a Skill of Materiel Acquisition Management (6T). A small segment of government and non-government civilians is also contained in this group. The breakdown of responses is: 65 percent active, 24 percent reserve, 7 percent government civilian, and 4 percent industry and academia.

Most of the questions in the survey were similar or identical to the questions we asked in our 1984 canvas of the readership. We were pleased to note that the highly favorable results of the 1984 survey were also reflected in the 1986 survey. In fact, in almost every area of concern there was some improvement over 1984.

On the other hand, as in all endeavors of this nature, we can see room for improvement. For example, while the active duty officers overwhelmingly approved of our new policy of sending the magazine to their home address, we still received complaints about magazine distribution. We are continuing to work on the problem.

By far, the most popular department is "From the Field" with "Career Programs" and "Capsules" almost tied for a slightly distant second. As far as the magazine content is concerned, most of the respondents would prefer more coverage of new technology, RDA management, and materiel or, in many cases, more coverage of everything. In fact, several comments addressed a desire for an overall expansion in the size and frequency of publication of the magazine. We would like to do that also, but unfortunately the budgetary facts of life won't allow it. However, we will continue to emphasize RDA management and policy, materiel, and new technology while not neglecting your other areas of interest.

Integrated Logistic Support Management For the Streamlined Acquisition Process

By Michael L. Hart

In the January-February 1986 issue of the *Army RD&A Magazine*, U.S. Army Communications-Electronics Command representatives outlined their preferred choice for nondevelopment item (NDI) acquisition. This article can in part be construed as describing an initiative undertaken to meet challenges imposed by the new streamlined acquisition process.

The streamlined acquisition process has received considerable emphasis in recent Army literature and is graphically illustrated in the January-February issue. As citizens first, and then active participants in the Army acquisition process, integrated logistic support (ILS) managers recognize the need for expedited acquisition of better designed equipment which responds to user requirements. However, ILS managers are also deeply aware of the special challenges imposed on ILS management during any streamlined process.

Each ILS manager has a horror story on managing and planning ILS execution for an accelerated acquisition program (including NDI). The baseline objective of any ILS manager is to establish a cohesive management team which is representative of the ILS elements and which can produce ILS products commensurate with the maze of potential acquisition strategy and design alternatives. This objective has often not been accomplished for heretofore "normal" acquisition processes without at least a few significant adverse impacts on First Unit Equipped milestones. How then can an ILS manager plan and execute a successful ILS program for a streamlined acquisition process?

Strategy

If the direction is to have a truly streamlined acquisition process, logic dictates that system design must freeze as soon as possible to accomplish production and logistic requirements. Since ILS products such as publications, spares and repair parts, and training evolve commensurate with system design, lead time must exist to accommodate recent design changes.

In a streamlined acquisition process where system design is susceptible to changes at any moment, the ILS manager must have the ability and authority to redirect an entire ILS program. If he does not, availability of ILS products matching the design configuration at materiel fielding will simply not occur.

The answer is to arbitrarily freeze design and thereby allow ILS time to "catch up." This need is vividly illustrated when one considers that development of a test program set to automatically test a printed circuit board must essentially wait until the board design is complete.

Design freeze has been a mystic objective sought by ILS managers for many years. Since each design engineer has the preordained and justifiable right to change design for improved performance, design freeze will continue to be a mystic objective. Even NDI acquisition cannot realistically guarantee exclusiveness from design change.

Some combination of the following factors must occur if ILS is not to become the bottleneck of the streamlined acquisition process. Ideally, all factors should be implemented. However, priorities necessitated by political, funding, or manpower constraints invariably reduce or eliminate one or more of these factors from a given materiel acquisition program.

- Design Engineering Recognition of ILS. The design engineer should be an active participant on the ILS management team. Via membership, the engineer can gain an appreciation for design change impact on the various ILS products and on life cycle cost. In addition, membership will enhance consideration of system design features which respond to ILS needs, enhance system performance, and address new Army requirements such as Manpower and Personnel Integration (MANPRINT).

- Program Management Planning of ILS. Although ILS plans are included in overall system planning and strategy documents, emphasis on ILS must continue to be applied from program management levels. Absence of such emphasis places the burden on the ILS manager to expend extra time forcing or justifying ILS requirements such as funding, in lieu of managing integration of ILS products and elements. The above cited article on NDI acquisition is a case in point. The relative gross negligence of ILS in the article is indicative of the hill which ILS managers invariably climb with respect to program management.

- Elimination of ILS Requirements. ILS policy and guidance are currently oriented to the heretofore "normal" acquisition process. This collection of policy and guidance easily fills two 3-inch black binders with no associated documents included. Examples are configuration management and materiel release. Any attempt to plan and execute ILS for a streamlined acquisition process must occur within the boundaries of reduced or relaxed ILS policy constraints.

- Reduced Logistic Support Analysis (LSA) Performance. Contrary to what everybody would like to believe, a classic or theoretical LSA was never performed on a heretofore "normal" acquisition program. LSA efforts were tailored to peculiar acquisition strategies, oftentimes without documented LSA planning, but invariably producing essential LSA Records. Under constraints of a streamlined acquisition process, a planned and compressed LSA must be executed to rapidly address available technical data and to expeditiously provide an LSA Record pacifying ILS management team requirements.

Since specific LSA tasks and methods are used to generate and update data for LSA records (MIL STD 1388-1A/-2A), these tasks and methods must be accordingly streamlined without compromising essential LSA Record re-

quirements. These tasks must be reduced in complexity to accommodate baseline information from system designs evolving from compressed acquisition strategies.

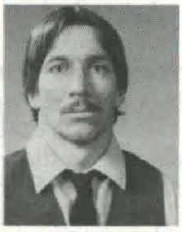
Time consuming explorations for the optimum materiel system logistic support concept must be sacrificed in favor of rapidly establishing a feasible logistic support concept and then adding related logistic support data. Logistic modeling can be a positive factor in establishing feasible support concepts and in generating LSA Record data. However, most available models cannot be practically applied to compressed acquisition programs since non-standardization of data elements preclude timely availability of required data.

- Recognition of Logistic Lead Times. Certain procedures leading to availability of ILS products are fixed from a lead time standpoint. These procedures are either mandated by regulatory guidance or procurement statutes, or by system-peculiar funding or acquisition strategy. System-peculiar constraints will always exist and only sound management can overcome the peculiarities involved. Policy, however, can be eliminated or changed to allow compression of the ILS program. For example, policy could be changed to eliminate the need for National Stock Number assignments (and various other provisioning technical documentation) prior to materiel fielding. New requirements imposed by Total Package/Unit Materiel Fielding also present a scheduling problem since the entire materiel fielding planning process must occur within coordination time frames which pacify gaining commands.

Summary

The above factors provide an overview of various actions considered necessary if ILS compatibility with the streamlined acquisition process is to occur. Some combination of the factors must occur if an ILS manager is to have a reasonable chance of generating necessary ILS products by First Unit Equipped milestones.

A streamlined acquisition process must be accompanied by streamlined ILS requirements, whether through policy reduction, improved communications, or unilateral ILS managerial decisions. Otherwise, ILS will be playing catch-up; one ILS program to support initial fieldings and a second to accommodate life cycle requirements.



MICHAEL L. HART is a supervisory general engineer in the ILS Office of the Armament, Munitions and Chemical Command. He previously served in various capacities at the Army Materiel Command and holds an M.E. degree in industrial engineering from Texas A&M University.

New Office Coordinates Test Technology

A new office to coordinate test technology throughout the U.S. Army Materiel Command (AMC) has been established at the Test and Evaluation Command. It will serve as the focal point for this increasingly important aspect of test and evaluation, according to Frederick D. Mabanta, acting group leader for the Central Test Technology Coordinating Office (CTTCO).

The four major functions of the new office are to develop a "road map" for the future through formal long-range test technology forecasting and planning, to coordinate test technology efforts by avoiding duplication, to promote joint efforts and standardization in test technology, and to foster sharing technology with other major commands and Army activities.

The plan Mabanta hopes to follow on the forecasting side is to take information gathered by research and contract teams and to develop technical profiles in several areas. These would include technology, commodity and weapons-specific areas.

The technical profiles will be analyzed to identify their implications on testing and to identify technical challenges. The end result of all the forecasting and planning will be recommendations to be used as a basis for developing test technology plans.

Coordination also will be a vital function of the new office. Avoidance of duplication in testing technologies is important to minimize cost. More importantly, though, is the ability to promote an early decision on required technological capabilities.

"Sharing technological information will be critical to assure maximum benefits from the efforts of the technical community and for standardizing testing capabilities. We will have mechanisms such as periodicals, symposia, conferences and computer data bases to exploit the wealth of technological information available," Mabanta said.

"The key to the CTTCO concept is information," Mabanta said. "We need to gather information on weapon development technology early so that we can plan and program and be ready and waiting with the right technology at the right price when the weapon systems are ready for testing."

Mabanta expects the new office to be in a unique position to observe the testing process, to offer recommendations and to render assistance on specific testing problems.

Army R&D Achievement Awards Recognize 39 Employees

Thirty-nine Army in-house scientists and engineers have been selected to receive Department of the Army R&D Achievement Awards in recognition of outstanding achievements that have improved capabilities of the U.S. Army and contributed to the national welfare during 1985.

Comprised of a 2-inch cast bronze medallion and a wall plaque, the awards will honor 31 personnel employed at activities of the U.S. Army Materiel Command, seven assigned to the Army Corps of Engineers, and one employed by the Army Medical R&D Command. Listed by major commands and individual installations, the recipients of Army R&D Achievement Awards are:

U.S. Army Materiel Command

● Electronics Technology and Devices Laboratory:

A team composed of Theodore Lukaszek, Elizabeth Hatch, Kenneth Klohn and Dr. Arthur Ballato, will be recognized for a major contribution to advancing the state of the art in fabricating a surface acoustic wave stablized 1680 MHz microwave oscillator. This innovative technology development, applied to the resolution of a frequency drift problem in Army meteorological radiosondes, has significantly enhanced the Army's technical capability in this field. The achievement was realized without any increase in size, weight or additional power requirements.

● Combat Systems Test Activity:

Dr. Samuel F. Harley will be commended for conceiving, designing and developing intelligent instrumentation systems for evaluating combat vehicles and weapon systems. These revolutionary instrumentation systems have capabilities and features that have never been present in field instrumentation before and permit the Army to evaluate combat vehicle performance during realistic testing situations.

● Ballistic Research Laboratory:

Dr. Peter Plostins will be cited for analysis of transitional ballistic phenomena leading to a correlation of the inbore balloting behavior of sabot launched anti-armor ammunition and the severity of the disturbances during sabot discard. This research resulted in a more comprehensive understanding of transitional ballistic phenomena.

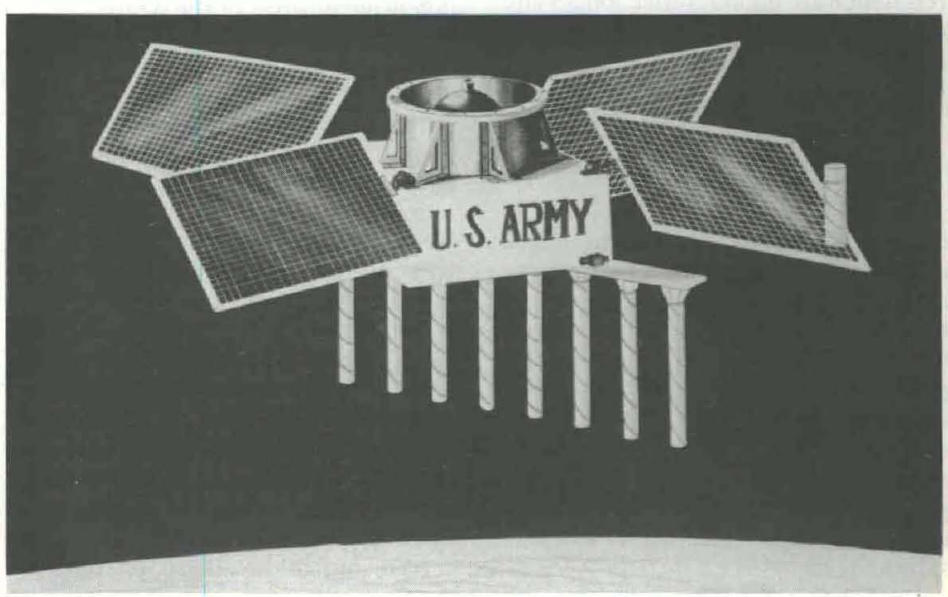
James O. Pilcher II and Mark A. DeWilde were selected for the award in recognition of their research in the area of tank gun accuracy. Their work resulted in a unique system for continuous sighting from the muzzle of a tank which has formed the basis for what will be a substantial improvement in the accuracy of tank guns.

Dr. Charles H. Murphy is being recognized for outstanding scientific contributions to the understanding of the effect of rotating liquid payloads on the stability of Army projectiles. His work, expressed in the form of interactive computer codes, is most valuable to the projectile designer.

Jerry L. Watson, Dr. E. Harris Walker, and Gould Gibbons Jr. will be commended for developing advanced techniques for improving the survivability of the M1E1 tank. They developed shields of composite materials which prevented sympathetic detonation between rounds in the ammunition compartment, so that only the round which was hit by enemy attack would detonate.

Thomas A. Havel and Tony J. Ricchiazzi will receive the award for their work which as lead to the development of an applique armor system applicable to lightweight vehicles. Their work provided the Army with an important new system having a major impact on the survivability of combat vehicles.

George E. Hauver is being honored for his new discoveries about armor penetration phenomenology and the development of a technique for the quantitative assessment of the penetration resistance of special types of armor. His work is directly applicable to the design of the high efficiency armor required for the future to reduce vehicle weight and to furnish greater protection and mobility than is currently available.



Proposed Battlefield Location and Information System Satellite.

● Aviation Research and Test Activity:
Dr. Yung H. Yu is being cited for contributions to the development of the holographic interferometry and computerized tomography techniques for three-dimensional transonic rotor flow field measurements. This work represents a significant advance in rotary wing technology and will influence the design of all future helicopter rotors.

● Armament RDE Center:
Dr. Pai-Lien Lu will be recognized for his innovative research in providing a new powerful diagnostic technique to the munitions community. He conceived, constructed and implemented a new fiber-optic multi-profile photography for characterizing the detonation waves inside munitions and was able to analyze the deleterious effect of the symmetry on the penetration of armor by shaped-charge jets.

Dr. Shih C. Chu will receive an R&D Achievement Award for development of an effective non-isothermal elastoplastic theory for analyzing and designing weapon components. The use of this theory provides a more rigorous analytical tool in the development of current and future lighter weapons to achieve greater mobility and deployability.

A team composed of Dr. Giuliano D'Andrea, Robert Cullinan (deceased), Robert W. Murray, Paul J. Croteau, and John J. Wrzochalski are being cited for outstanding technical leadership in the development of a new large caliber composite gun barrel technology. They introduced and demonstrated gun barrels which are lighter, stiffer, longer and capable of operating at higher pressures and being retrofitted in existing mounts.

● Chemical RDE Center:
Dr. William S. Seegar will be recognized for conceiving and managing a program resulting in the development of miniature telemetry capability. Identified as the Battlefield Location and Information System (proposed), it provides for precise satellite positioning anywhere on earth, plus transmission and relay of data from multiple sensors of the user's choosing. The program was conducted at the Johns Hopkins University Applied Physics Laboratory.

Dr. John P. Carrico is being commended for planning and implementing a major program to field a new generation of chemical/biological detection agent systems that operate on the basis of state-of-the-art principles of infrared and ultraviolet laser detection.

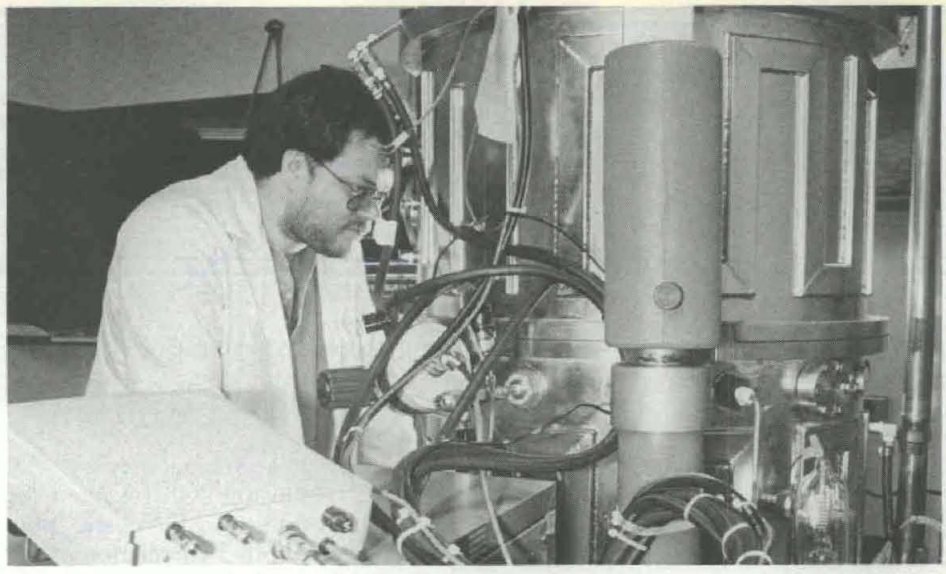
Dr. Barbara A.B. Seiders will receive an R&D Achievement Award for contributions to the basic understanding of antibody/antigen interactions, receptor function, and protein engineering which have resulted in significant gains in chemical/biological detection and contamination control.

Dr. Philip G. Koga developed a modular antibody-based coating coupled to microsensors based on fiber optics. This hybrid technology will greatly facilitate detection of threat agents in the field and will significantly improve the defensive posture of the Army.

Linda L. Szafraniec is cited for development of a simple acid-based reaction simulant for binary agent systems. Her efforts will allow Army engineers and contractors to evaluate the performance and effectiveness of new binary munitions hardware and predict the behavior of the actual binary agent systems during flight.

Abraham L. Turetsky is credited with pioneering research in obscurant and pyrotechnic countermeasures which are effective at infrared, radar, and multispectral wavelengths. His work continues to form the basis for advanced defensive systems.

Dr. Herbert S. Aaron and David I. Rossman will be recognized for research into the synthesis of toxic organophosphorus compounds, commonly known as G-agents. Their work resulted in development of a new binary synthesis procedure for these agents which may lead to a more effective chemical munition for the U.S. deterrent capability.



Application of a coating provided by ion-plating system.

U.S. Army Corps of Engineers

● Construction Engineering Research Laboratory:
Vincent F. Hock and Dr. Larry D. Stephenson were selected for the award for their efforts in the development of the Ion Plated Composite Ceramic Anode, a major breakthrough in corrosion mitigation technology. A phenomenal increase in anode service life (more than two thirds longer than conventional anodes) was achieved as a result of this work.

● Cold Regions Research and Engineering Laboratory:
John H. Rand and Ben Hanamoto are being recognized for their major work in developing a complete system for controlling ice at Corps navigation locks. The system has reduced the possibility of lock gate damage, decreased winter lockage times and provides for safer operation of the locks.

● Engineer Topographic Laboratories:
Laslo Greczy is credited with initiating an exploratory development project for a Terrain Analyst Work Station which served as a vehicle to demon-

strate a capability to create, update, revise and intensify digital topographic data as well as terrain analysis product generation capabilities using soldiers in the field.

● Engineer Waterways Experiment Station:

Dr. Lillian D. Wakeley and Donald M. Walley are credited with development of an expansive salt-saturated concrete for use in underground disposal and isolation of defense-generated radioactive waste. The results of their work have increased the ability of the nuclear industry to isolate radioactive waste in salt-saturated environments.

U.S. Army Medical R&D Command

● Walter Reed Army Institute of Research:

Dr. Sanford L. Berman will receive an R&D Achievement Award for his superior leadership in the development of bacterial and viral vaccines for human use. Through his guidance and scientific expertise, vaccines for bacterial meningitis, shigellosis, dengue fever, and viral hepatitis were produced. Production and testing of vaccines such as these will not only benefit the soldier who will be protected from debilitating or life-threatening disease, but will also enrich the base of scientific knowledge.

Army Developing Improved Eyewear

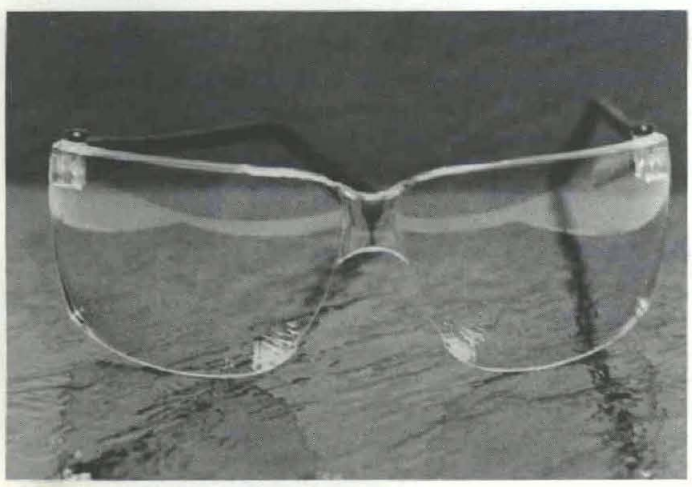
Army researchers are working on wraparound eyewear that is resistant to both fragmentation rounds and low-energy, fixed-frequency lasers. To insure user acceptability, the eyewear must be visually appealing to the combat soldier and not degrade his visual acuity.

"If it's ugly, he's not going to wear it," explained Melvin W. O. Jee, a spokesman for the U.S. Army Natick Research, Development and Engineering Center's armor program, which is responsible for developing the eyewear.

With ballistic test support from the Army's Materials Technology Laboratory (MTL), Natick has already developed polycarbonate plastic eyewear that stands up well to fragments from fragmentation rounds.

Now Natick's challenge is to imbue the plastic with low-temperature coatings, dyes or tints that will protect soldiers against eye-damaging lasers without compromising the plastics' ballistic limits. Any temperature above 105 degrees Centigrade tends to soften or melt the plastic, Natick officials say.

"It's easy to apply laser protection to glass, it's not so easy with plastic," said Robert Fitzpatrick, MTL's program manager for laser hardening materials structures.



Protective wraparound eyewear.

As Natick develops prototype laser-protective eye armor, MTL tests the ballistic limits of the experimental eyewear in its small gas gun facility. Here, tiny projectiles measuring between .1-and .22-caliber are propelled by high-pressure gases toward the target, simulating fragments. Various velocities are used to determine the ballistic limits of the target.

Because polycarbonate plastic does not shatter upon impact, small groupings of two or three projectiles may be fired into each lens. Cameras activated at microsecond intervals catch the projectile at the moment of impact. The resultant photographs produce revealing clues as to what type of failure, if any, the eyewear has sustained.

"The gas gun is a tool to determine if a material has been degraded," said Fitzpatrick. "It gives us clues for advising Natick and others on how to improve the material."

In addition to evaluating Natick eyewear, the small gas gun facility is being used to run ballistics tests on the aviator's helmet protective visor for the Aviation Systems Command.

Prototype, holographic-coated eye protective devices are expected to be delivered to Natick in December. Holography involves the use of lasers to produce images on a photographic plate-like substance.

If MTL and Natick agree the lens is ballistically sound and laser safe, small scale production will start under a pilot program, according to Frank H. Bissett, chief of Natick's Chemistry Branch.

Bissett explained that this work is a mere stopgap measure. "We know that next-generation, tuneable-laser technology is available now in the lab. If it should show up on the battlefield, we will have to be ready for it." Tuneable lasers can be tuned to any frequency from ultraviolet to near infrared.

Natick and the U.S. Army Medical Research and Development Command represent the Army within the triservice tuneable laser protection community. A triservice research program has been established to develop protective devices for use against tuneable lasers. This program is sponsored by Natick, the Medical R&D Command, the Naval Air Defense Center in Warminster, PA, and Wright-Patterson Air Force Base in Dayton, OH.

Composites: The Road to Innovative Technology

By James P. Waller and Drew Orlino

Background

The Aviation Applied Technology Directorate (AATD) of the U.S. Army Aviation Systems Command (AVSCOM), Fort Eustis, VA, began research and development in composites more than two decades ago. These pioneering efforts established the feasibility of using composite materials in primary aircraft structural applications such as main and tail rotors, tailbooms, and flight control components. It became very evident that composite construction offered many advantages over conventional metal structures such as aluminum. Composite construction provides improvements in reliability and maintainability, safety and survivability, fatigue life, and durability while at the same time achieving a reduction in weight and cost.

Once the initial feasibility of using composites in helicopter structures was established there were initial R&D efforts to investigate the effects of raw materials usage and fabrication process variables on the final strength properties of fiberglass reinforced plastic sandwich specimens. The effects of resin and void content on laminate strength were evaluated and functional relationships and quality control methods were compared. Improved resin impregnation processes resulted in sandwich and solid laminate specimens with consistent reproducible mechanical properties needed to develop suitable strength and analysis data for large skin/stringer panel designs.

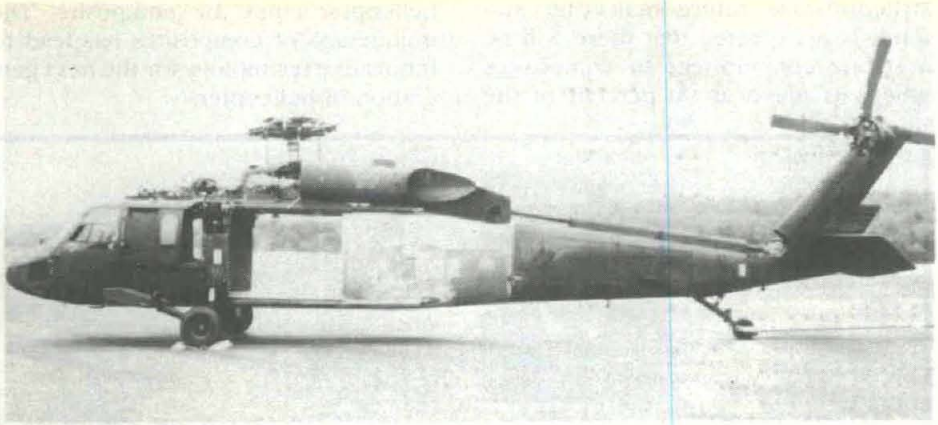
With the basic tools in hand, AATD began to exploit application of composites to more complex airframe structural elements. In studying the application of composite materials to the main rotor blade, AATD and the Naval Air Development Center explored fabricating an irregular contoured box beam wing section of a main torsion box assembly. Fabrication techniques for filament winding and tape lay up were investigated and methods to automatically apply composite material at 45 degrees as well as uniaxial and hoop fiber orientations were subsequently developed. The tape lay up processes were later optimized to reduce fabrication costs associated with rotor blade manufacture.

The first major rotor blade R&D program to incorporate this technology was the Advanced Geometry Blade (AGB) which was designed, fabricated, laboratory tested and then flight tested on the CH-47 helicopter in a joint Army/Air Force program. The AGB concept was unique in that two different sets of blades were fabricated, one from Boron fibers and the other from fiberglass. The Boron blades were flown on the aft pylon with fiberglass on the forward pylon. Blade performance during flight test was very good. However, the Boron blades were quite expensive due to the limited availability of the R&D Boron fibers and the high cost of the tungsten substrate. Nevertheless, the success of this program lead to the development of the composite rotor blades for both the CH-46 and the CH-47 helicopters.

During this time period, a new tail rotor design concept, using a monolithic spar of directed glass fibers in an epoxy matrix, was developed. The concept made use of the anisotropic property of the material which resulted in the elimination of the pitch change bearings and reduced reliability and maintainability costs. The Elastic Pitch Beam Tail Rotor was successfully flight tested on the UH-1 helicopter. It was through the success of this program that the elastic pitch beam tail rotor was introduced on the UH-60 Black Hawk helicopter.

The airframe work of the mid- to late 1960s consisted of fabricating and testing large sandwich cylinders, truncated cones and curved panels of the fiberglass/epoxy and honeycomb core designs. Analytical predictions were compared with test results, and modifications to the analyses were made where needed. Fiberglass tooling was used as an inexpensive tooling material to fabricate the 72-inch long and 58-inch diameter wide skin shells.

Low cost composite blade for the UH-60 Black Hawk.



Composite rear fuselage for the UH-60 Black Hawk.

Technology in the 1970s

With this technology available, AATD aggressively pursued composite component technology in the 1970s. Extensive full-scale design, fabrication, laboratory and flight testing commenced in areas of the helicopter such as main rotor blades, tail rotors, tailbooms and the rear fuselage. Composite main rotor blade concepts such as the "D" spar and the multitubular spar were fabricated and flight tested. These concepts resulted in rotor blades with increased aerodynamic performance, improved strength to weight ratios, increased blade solidity, greatly increased operational service life and improved ballistic damage tolerance against the high explosive incendiary threat at a cost savings when compared with metal blades.

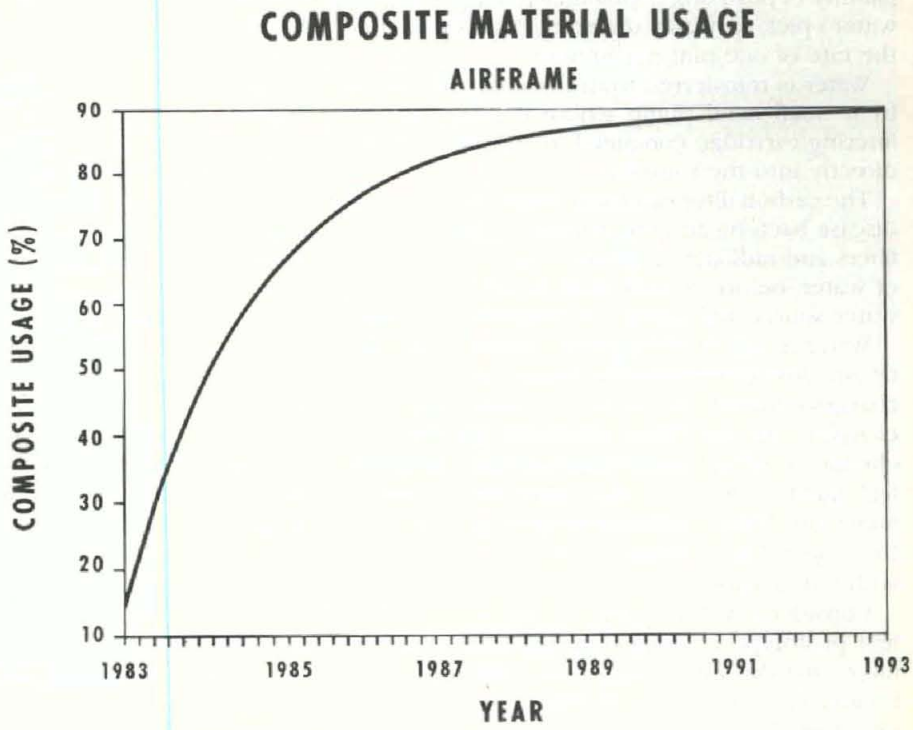
Composite tailbooms for the AH-1G and OH-58 were designed, fabricated and flight tested to evaluate composite component designs and producibility. To match the stiffness of the metal designs while reducing or matching tailboom weight required using the higher modulus graphite fiber/resin system. Only one tailboom was fabricated for the AH-1G and flight tested for approximately eight hours. It was the first major piece of composite airframe structure. The tailboom for the OH-58 was a second generation design with emphasis on long term environmental durability. The vertical stablizer was made of fiberglass, the horizontal stablizer was made of Kevlar, and the tailboom was made of graphite. There are nine of these at various locations throughout the United States undergoing a five year environmental evaluation.

In the mid-1970s, investigations were conducted to explore the use of composites in a medium utility transport helicopter. Results of the study indicated that a blend of cost and weight savings could be achieved from a predominantly composite helicopter. To make the cost savings a reality required manufacturing technology programs directed at addressing rotor and airframe fabrication problems. Programs such as the K-747 Composite Blade for the AH-1S Cobra, Low Cost Composite Blade for the UH-60 Black Hawk and the Composite Rear Fuselage for the UH-60 Black Hawk have resulted in a cost reduction for rotor blades and airframe structure while providing improvements in reliability, maintainability, safety, survivability and weight.

In 1981, culminating two decades of composites research and development, AATD awarded two contracts to design, fabricate, laboratory test, and flight test two predominately composite helicopters as part of the Advanced Composite Airframe Program (ACAP). The weight and cost goals of 22 percent and 17 percent respectively were exceeded by both contractors as compared to a conventional metal airframe while achieving stringent military requirements of improved ballistic tolerance, crashworthiness, and reliability and maintainability. In addition, two significantly different approaches were investigated for manufacturing. One approach used modular construction while the other used large half shell structures. Both approaches exceeded the weight and cost goals. It became apparent that the best manufacturing approach is highly dependent on the design criteria.

Summary

The results of the ACAP have demonstrated that composites can be used effectively in the design and manufacture of helicopter airframes. This is the



first program that saw extensive use of computer-aided design/computer-aided manufacture in both the design and manufacturing. The manufacturing problems which surfaced during the ACAP are currently being pursued to increase airframe producibility at reduced production and life cycle costs. The success of the ACAP has reduced the risk of committing to composite structures in an engineering development program.

Demonstration of an advanced composite rotor hub is currently being pursued with a manufacturing technology program to follow so that fabrication problems associated with its manufacture can be cost effectively solved. Preliminary design studies have been completed on the CH-47 hub and the UH-60 hub. The results of these efforts have lead to an advanced development effort on the AH-64 Apache.

Work during the past two and a half decades has clearly established the feasibility and applicability of composite structures for future helicopter systems. It is expected that there will be a strong commitment to composites where as much as 90 percent of the helicopter could be composite. The uniqueness of composites has lead to innovative technology for the next generation of helicopters.

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Device Permits Individual Water Purification

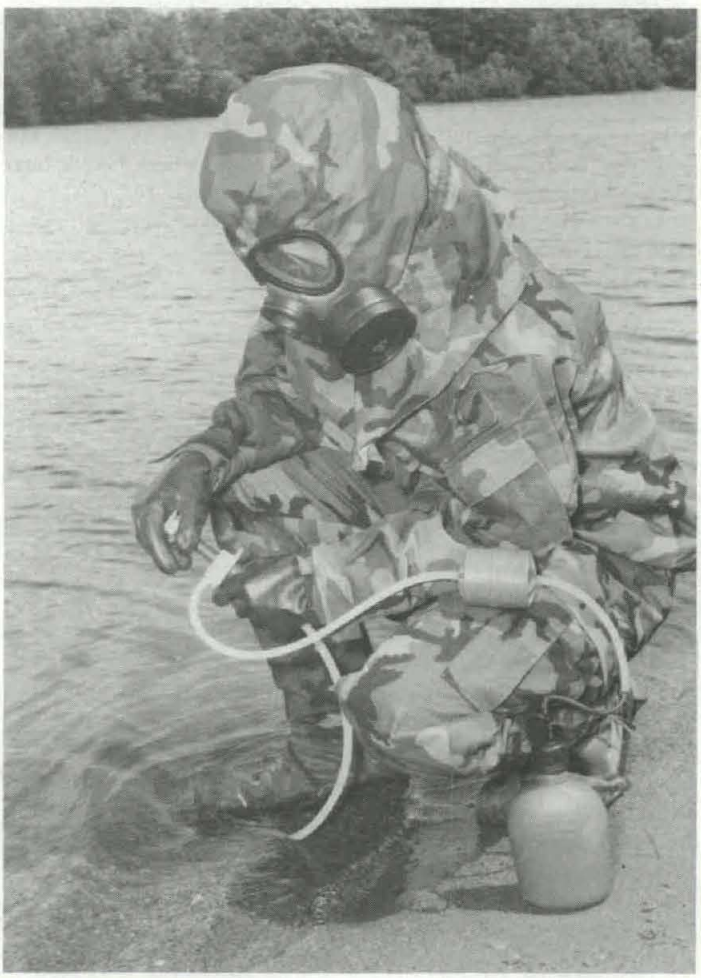
The U.S. Army Natick Research, Development and Engineering Center, Natick, MA, is developing a device that will enable each soldier to produce potable water while in a nuclear, biological or chemical environment. Weighing less than a pound, the unit gives the individual soldier the capability of purifying contaminated fresh (not brackish or sea water) pick-up water under emergency field conditions, at the rate of one pint per minute.

Water is transferred from the contaminated water source by a small hand pump where it passes through a carbon filtering cartridge contained in a disposable plastic housing directly into the canteen.

The carbon filter can microstrain and remove water-borne disease bacteria and other particles such as debris, asbestos fibers and radioactive fallout, and provide up to 400 quarts of water, before replacement is needed, depending on the water source and amount of undissolved solids.

Water is forced through the carbon cartridge on both the up and down strokes of the pump. Two positive and negative charges induced into the matrix attract and hold oppositely-charged particles. Three adsorbers capture and hold organic chemicals including chemical warfare simulants, live chemical agents, herbicides and other volatile and organic contaminants. When pumping becomes difficult due to clogging, the disposable cartridge/canister is discarded and replaced with a new canister.

Considerable development effort remains to be done. The first prototype is being redesigned to make the pump and filter cartridge more rugged and give it more capacity. One hundred prototype II units, which will also include a floating pre-filter, should be available by the end of FY87.



Hand pump and filtering cartridge for purifying water.

Sixteen Papers Recognized at 1986 Army Science Conference

The 15th Army Science Conference was held recently at the U.S. Military Academy, West Point, NY. More than 300 outstanding scientists and engineers exchanged information concerning "Technology for the Soldier"—the theme of the 1986 conference.

Army scientists and engineers from research laboratories and other installations submit papers competitively during the year of the conference. The conference is highlighted by presentations of selected papers and awards for those papers which are considered outstanding.

Ninety-six of the 360 papers submitted were chosen for presentation. In addition, four papers were presented during one of several special sessions of the conference.

The papers were selected from proposals submitted by military and civilian scientists and engineers engaged in research and development efforts at numerous Army research activities. This selection was based on scientific value of the material to the Army, the originality of its applications to an Army project problem, and the clarity and conciseness with which the proposal was submitted. These standards were also applied to the completed papers by the Army Science Advisory Group in selecting those papers which they considered worthy of special recognition. For comparative ranking, the advisory group's selections were transmitted to the judges panel, which is composed of members of the Army Science Board.

Members of the judges panel were: Dr. Louis M. Cameron, panel chairman, director of Army research and technology, Office of the Deputy Chief of Staff for Research, Development and Acquisition, Department of the Army; Dr. Irene Peden, professor of electrical engineering, University of Washington; Dr. Ernest Petrick, chief scientist, Land Systems Division, General Dynamics Inc.; Dr. Elizabeth Rock, professor of chemistry and director of Science Center, Wellesley College; Dr. Phillip Sidwell, private consultant; MG Laddie Stahl (AUS Ret.), manager, Special Programs and Projects Operation, General Electric Co.; and Dr. Chris Zarafonetis, private consultant, Biomedical Research and Development Inc.

After registration, Dr. Ronald Kerber, deputy under secretary of Defense (research and advanced technology), addressed the attendees in a special session. Concerning the goals of the Army's Science and Technology Program, Kerber said that because America has chosen not to match the Soviets man to man, system to system, we have to use science and technology to keep the competitive edge. Systems must be reliable, maintainable and supportable.

Seventeen percent of the scientists and engineers in the U.S. are supported by U.S. Defense dollars. America's scientists and engineers are significant in helping America's future, Kerber said. "The only choice for this country, in my opinion, is to have a strong technological base," added Kerber.

One of the ways the country is building a strong technological base is through the University Research Initiative (URI)—a multi-service program totalling over $100 million. Under URI, the Army sponsors 11 university centers in 11 major critical areas. The URI program is an excellent opportunity for the in-house laboratories to work closely with the universities to insure research continues in matters of interest to the Army.

The keynote address was given during the general session by LTG Louis C. Wagner Jr., deputy chief of staff for research, development, and acquisition, Headquarters, Department of the Army.

According to Wagner, in the past 40 years, scientific achievements have surpassed all previous accomplishments made by mankind.

Wagner dramatized the rapid evolution in science and technology by addressing three critical areas of Army research: microelectronics, artificial intelligence and biotechnology. A detailed text of Wagner's keynote address appears on page 32 of this issue.

Following the general session, four papers were presented during a special session. These papers were entitled: *Application of Theoretically Computed Vibrational Spectra to the Remote Sensing of Chemical Agents and Study of Energetic Materials, Development of a Genetically Engineered Malaria Vaccine for Man, Novice to Expert: Implications for Artificial Intelligence Systems, and Automated Screening of Reconnaissance Imagery.*

LTG Louis C. Wagner Jr.

The 96 remaining papers were presented in 20 concurrent subsessions.

Sixteen papers were selected for recognition at the awards ceremony. All cash awards were made under the Army Incentive Awards Program. Contractors are ineligible to receive awards.

Dr. Hamed M. El-Bisi, assistant director for research and technology, Office of the Deputy Chief of Staff for Research, Development and Acquisition, provided the opening remarks and was the master of ceremonies at the awards banquet. El-Bisi emphasized the key responsibility of the in-house R&D community in assuring the maintenance of our leading edge in technology that is so vital to the national deterrence posture.

Dr. Jay R. Sculley, assistant secretary of the Army (research, development and acquisition), gave the banquet address and presented the awards.

Sculley stated that the purpose of the ceremony was to acknowledge the audience in general and to emphasize the awards. Sculley also stressed that the work performed by the Army's scientists and engineers contributes signifi-

cantly to supporting the soldier. The work also "enhances the synergism between the Army community and industry."

One paper was selected as most outstanding and received a Category 1 award. The authors shared the Paul A. Siple Medallion, certificates of achievement, and a $2,500 cash prize for their work in developing a genetically engineered malaria vaccine.

Titled *Development of a Genetically Engineered Malaria Vaccine for Man,* the paper was authored by: LTC Wayne T. Hockmeyer, MAJ W. Ripley Ballou, COL Carter L. Diggs, Department of Immunology, Walter Reed Army Institute of Research (WRAIR); MAJ Robert Wirtz, Dr. Imogene Schneider, Department of Entomology, (WRAIR); Dr. Louis H. Miller, National Institutes of Health; Dr. Richard Beaudoin, Navy Medical Research Institute; and Dr. James F. Young, Smith, Kline and French Laboratories.

Development of the malaria vaccine was accelerated through recombinant Deoxyribonucleic acid technology. Malaria transmission to man results from injection of sporozoites during mosquito feeding. Disparate strains of falciparum malaria exhibit a common sporozoite surface protein. The gene which codes for that protein has been cloned and grown in E. coli. bacteria. The cloned protein is highly immunogenic in mice and is expected to induce immunity to malaria sporozoites in man.

Malaria is a severe disease threat in much of the world. One million people die from malaria each year, and more than 200 million people suffer its symptoms of fever, muscle pains, headaches, and chills. Malaria is no longer a public health problem in the United States, but it poses a threat to military personnel stationed overseas.

In addition to its recognition at the Army Science Conference, this paper is indeed of Nobel quality. The work that has been presented here is world class, said Sculley.

Three Category 2 awards, consisting of a bronze medallion, certificates of achievement, and cash honoraria were also presented. Recipients, their organizations, and the titles of their papers are as follows:

- Authors: Dr. Peter G. Canonici, Paul H. Gibbs, Dr. John W. Huggins, Dr. Carol D. Linden, CPT Carolyn M. MacDonald, MAJ Kelly T. McKee, Cmdr. James Meegan (U.S. Navy), MAJ John Morrill, Dwayne D. Oland, COL C. J. Peters, and MAJ Lauren V. Reed. Organization: U.S. Army Medical Research Institute of Infectious Diseases. Title of Paper: *Ribavirin Prophylaxis of Sandfly Fever—Sicilian Infection in Human Volunteers.*

Dr. Jay R. Sculley

- Author: Dr. Anand Prakash. Organization: Ballistic Research Laboratory. Title of Paper: *REBATRON: A Compact Accelerator for Producing High Energy Ultra-High Current Electron Beams.*
- Authors: Ernesto R. Cespedes and Dr. Daniel H. Cress. Organization: U.S. Army Engineer Waterways Experiment Station. Title of Paper: *Analysis of Passive Imaging Concepts for Remote Minefield Detection Applications.*

Eleven Category 3 awards were presented. Awardees received honoraria and certificates of achievement. Recipients are as follows:

- Authors and Organizations: Dr. George F. Adams, Ballistic Research Laboratory; and Dr. Michael J. Page, Naval Research Laboratory. Title of Paper: *Thermochemistry of Boron Compounds.*
- Authors and Organizations: Dr. Joel M. Dalrymple, Dr. Jonathan F. Smith, MAJ John C. Morrill, U.S. Army Medical Research Institute of Infectious Diseases; and Dr. Marc S. Collett, Molecular Genetics Inc. Title of Paper: *Evaluation of a Recominant Vaccinia Virus Vaccine Candidate for Rift Valley Fever.*
- Authors: Raymond L. Ross, John J. Winter, Dr. Robert A. Lux, Samuel Dixon, Deborah A. Dekanski, and Thomas R. AuCoin. Organization: U.S. Army Electronics Technology and Devices Laboratory. Title of Paper: *The Zero-Bias Depletion Diode: A Promising Subharmonic Mixer.*
- Authors and Organizations: Dr. Andrzej W. Miziolek, Ballistic Research Laboratory; Dr. Carl F. Melius, Dr. Larry R. Thorne, Sandia National Laboratories; Dr. Paul J. Dagdigian, Johns Hopkins University; and Dr. Millard H. Alexander, University of Maryland. Title of Paper: *Gas Phase Combustion Chemistry of Nitramine Propellants.*
- Author: Dr. Aivars Celmins. Organization: Ballistic Research Laboratory. Title of Paper: *A New Crater Size Model Derived by Fuzzy Data Analysis.*
- Author: Dr. Byron H. Lengsfield, III. Organization: Ballistic Research Laboratory. Title of Paper: *Application of Theoretically Computed Vibrational Spectra to the Remote Sensing of Chemical Agents and the Study of Energetic Materials.*
- Authors: COL Lewis Lorton and William H. Langley. Organization: U.S. Army Institute of Dental Research. Title of Paper: *Computer Assisted Postmortem Identification.*
- Author: Dr. Hyder Lakhani. Organization: U.S. Army Research Institute for the Behavioral and Social Sciences. Title of Paper: *Enlisted Manpower Costs of the Bradley Fighting Vehicle and the M113: An Application of a Prototype Army Manpower Cost (AMCOS) Model.*
- Authors: Dr. Wayne D. Gray, Dr. Sharon A. Mutter, Merryanna L. Swartz, and Dr. Joseph Psotka. Organization: U.S. Army Research Institute for the Behavioral and Social Sciences. Title of Paper: *Novice to Expert: Implications for Artificial Intelligence Systems.*
- Authors: Dr. Robert T. Kroutil, John T. Ditillo, and Dennis F. Flanigan. Organization: U.S. Army Chemical Research, Development and Engineering Center. Title of Paper: *An Autonomous Background Compensation Algorithm for Stand-Off Chemical Agent Detection.*
- Author: Dr. Frederick W. Rohde Jr. Organization: U.S. Army Topographic Laboratories. Title of Paper: *Radar Descriptors for the Classification of Terrain Features.*
- Author: Dr. Peter C. T. Chen. Organization: Benet Weapons Laboratory, U.S. Army Armament Research, Development and Engineering Center. Title of Paper: *A New Method of Predicting Residual Stresses in Autofrettaged Gun Barrels.*

Sculley, in closing, stressed the success of the 15th Army Science Conference. The informal exchange of ideas among friends with a common purpose—the nation's defense—is an invaluable benefit of the Army Science Conference, Sculley said.

Open for Business . . .
The Directorate for Contracting

By MG David W. Stallings

Introduction

The Directorate for Contracting, located within the Office of the Deputy Chief of Staff for Logistics, Headquarters, Department of the Army, is fully activated and open for business. This new directorate became operational in July 1984 and gradually assumed more and more duties until, with its full staff essentially on board, it officially accepted formal transfer of contract-related functions from the assistant secretary of the Army for research, development and acquisition (ASA (RDA)) on July 30, 1985.

Background

Historically, management of the Army's contracting functions at the HQDA level has been vested in the Office of the ASA(RDA). In recent years, as defense budgets have grown to meet our force modernization needs, Congress has intensified its interest in how we, as stewards of public funds, conduct our contracting business. Questions regarding contract clauses, pricing, extent of competition, source selection criteria and evaluation procedures, and many other aspects of the contracting function are frequently asked by the members of Congress and their staffs on specific programs and contracts.

The number of Congressional hearings regarding the contracting process itself has increased dramatically. The resulting new legislation, as well as the advanced technology being incorporated in new Army weapons systems, have significantly increased the complexity of the contracting process.

Further, as budgets have increased, the volume of contractual actions has increased. The accompanying table illustrates this point.

ARMY PROCUREMENT STATISTICS

Fiscal Year	Contractual Actions	Cumulative % Change	Then Year Dollars	Cumulative % Change
1980	3,651,179		18,654,131	
1981	3,881,588	6	24,058,494	29
1982	4,144,100	14	29,744,847	59
1983	4,323,842	18	30,047,894	61
1984	4,603,644	26	33,380,721	79
1985	4,471,457	– 2.9	37,496,676	12.3

Recognizing the need to improve Army Staff (ARSTAF) support to the secretariat, the Army vice chief of staff, in September 1983, directed an independent study to determine those contracting functions for which the ARSTAF should have responsibility, and the organization required for their accomplishment. The study, titled "HQDA Contracting Functions, Organization, and Staffing," was completed in the fall of 1983. Based on the study recommendations, the vice chief of staff, in early 1984, approved the establishment of a Directorate for Contracting within the Office of the Deputy Chief of Staff for Logistics, (ODCSLOG), capable of efficiently and effectively executing the ARSTAF responsibilities for the Army-wide contracting program.

Acquisition Letter 85-32 issued by the ASA(RDA) revised the Army Federal Acquisition Regulation Supplement to accomplish the transfer of contracting responsibilities to the director of contracting, ODCSLOG, effective July 30, 1985.

Organization and Functions

Thirty-one military and civilian professional contracting and support personnel are directly assigned to the new directorate. An additional 33 personnel comprise the U.S. Army Contracting Support Agency, a Field Operating Agency.

As director, my responsibility is to manage the contract functions of the Army for the ASA(RDA) and under the direction of the chief of staff and the deputy chief of staff for logistics. These contracting functions are managed in consonance with government-wide and Department of Defense policies as expressed in the Federal Acquisition Regulation (FAR), issuances of the Office of Management and Budget (including Office of Federal Procurement Policy), the General Services Administration, the Defense FAR Supplement, and pertinent DOD directives and instructions. Further, this management is exercised on a world-wide basis over all contracting functions in the Army except real property transactions.

The new directorate has three divisions. The Contracting Policy and Procedures Division has responsibility to develop, issue—with Army secretariat approval, and maintain contracting policies for the Army. This is accomplished through the issuance of Acquisition Letters which include changes to the regulation supplement.

Further, this division develops, coordinates with the Army secretariat, and issues contracting procedures addressing all aspects of the contracting function, both pre- and post-award. Significant workload areas are commercial activities, cost and price analysis, contract financing, contract placement and administration, review and comment on proposed legislation affecting procurement, and coordination of contract-related audits at all levels.

Another important part of the division's mission is to provide advice and assistance to the Army acquisition community in the interpretation of contracting policies and procedures. Division personnel also serve as Army members on various interagency groups developing procurement policy for government-wide application.

The second division is the Office of the Competition Advocate General

(CAG). The office was established in March 1985 as a result of the Competition in Contracting Act of 1984. It is responsible for enhancing full and open competition by all means available, to include ensuring that all Army procurement planning recognizes competition as the preferred method of contracting and that appropriate emphasis is given to this objective.

The CAG is charged with devoting special attention to areas which offer the greatest opportunity for cost savings through increased competition and maintains direct contact with all competition advocates at Army purchasing activities world-wide (totaling approximately 240). Active liaison with Congress, industry and other DOD competition advocates is also maintained.

The competition office maintains close contact with competition advocate offices at major Army commands (MACOMS), develops annual competition goals for approval by the Army secretariat, and monitors and assesses the performance of each MACOM against assigned goals on an ongoing basis. The staff maintains up-to-date statistics, reviews and evaluates quarterly competition reports from the MACOMS, and prepares all reports on competition, including the CAG's annual report to Congress.

The third division is the Acquisition Division. This division is responsible for reviewing acquisition plans and, depending on the commodity, dollar threshold and acquisition phase, either approving them or recommending secretariat approval of those plans requiring Department of the Army reviews. The scope of requirements in the plans covers a broad range from modular furniture to the Abrams tank. The division supports the CAG by reviewing justifications for other than full and open competition for procurements exceeding $10 million, and then disapproving the justifications or recommending ASA(RDA) approval of them.

The Acquisition Division also processes Government Accounting Office decisions on protests and results of DOD inspector general (IG), DA IG, Army Audit Agency and other reports dealing with contracting issues. Key issues are extracted from these reports by the Policy and Procedures Division and disseminated to all Army contracting activities and the Army Staff.

The U.S. Army Contracting Support Agency, a Field Operating Agency which supports the directorate, consists of three offices: the Field Assistance Branch, the U.S. Army Procurement Research Office, (located at Fort Lee, VA.) and the Statistics and Management Information Branch.

The Field Assistance Branch provides on-site advice and assistance to the Heads of Contracting Activities and contracting offices. This service was not being provided prior to the activation of the Directorate for Contracting. Further, this branch administers the Army Acquisition Management Review Program by conducting surveys of Army contracting activities to assess effectiveness and efficiency of operations. This branch is also responsible for providing oversight and direction for the Acquisition Management Review programs of each of the Army Heads of Contracting Activities and managing the development and acquisition of a Standard Army Automated Contracting System (SAACONS). SAACONS will use automated data processing techniques to produce contractual documents, thus eliminating an enormous paperwork burden for the installation contracting offices.

The U.S. Army Procurement Research Office is another important part of the Field Operating Agency. It is responsible for conducting and publishing research studies of procurement management policies, methods and operations; testing and evaluating procurement concepts, methods and techniques; and performing consultation services to Army procurement organizations. This group also reviews and recommends changes to proposed acquisition regulations and directives; maintains liaison with other federal and DOD procurement activities, and academic and business communities; sponsors and supports technical and functional conferences; and periodically conducts acquisition research symposia.

The third group within the field operating agency is the Statistics and Management Information Branch, which has primary responsibility to direct, manage and collect data of the Procurement Reporting Mangement Information System. These data are compiled from the DD Form 350/1057 reports provided by MACOMs, and Heads of Contracting Activities and contracting offices and is the basic management data base for contracting within the Army and the DOD. This branch also compiles competition reporting data and reports awards of $3 million or more for Congressional notification.

Accomplishments and Goals

Although the Contracting Directorate has been formally established for only a short time, we have already had some significant accomplishments:

- We have assumed responsibility for maintenance of the Army's principal contracting regulation—the Army Federal Acquisition Regulation Supplement.
- We now prepare and disseminate all Acquisition Letters, which is the vehicle for revising the Federal Acquisition Regulation Supplement as well as for providing other policies, procedures and guidance regarding current issues in the dynamic contracting environment.
- Directorate personnel now represent the Army on DOD-wide committees and working groups.
- We are involved in developing and defending budget requests for personnel and funding to staff installation contracting offices.
- In our annual report to Congress for fiscal year 1985, we announced that the Army exceeded its annual competition goal of 46 percent by .9 percent. In doing so, our buying activities competed $14.9 billion of a $31.7 billion total budget.
- Also during FY85, 48 percent of all spare parts purchased were competed; the spare parts breakout effort resulted in a cost avoidance of $250 million; value engineering saved $60.1 million and more than $4.7 million in refunds were obtained from contractors.

Looking forward to things we want to accomplish this year, one of my major goals is to further enhance communications between this directorate and contracting and requiring activities in the field. Two programs we are sponsoring are helping us accomplish this objective more quickly and effectively than I anticipated. First, in August of last year, the secretary of the Army and chief of staff of the Army issued a joint message directing MACOM commanders to sponsor "Contract Awareness Days" at their installations. The major thrust of this initiative is to bring together all elements on an installation, such as the garrison commander, Directorate of Engineering and Housing, Directorate of Logistics, Directorate of Personnel and Community Activities, Directorate of Information Manage-

ment, inspector general and any others who generate contractual requirements or interface with the contracting function.

I recently participated in Fort Drum's Contract Awareness Day and can state unequivocally that these get-togethers have real benefits in terms of a clearer understanding by all parties concerned of the team work approach that is required to accomplish our mission in today's increasingly complex contracting environment. Second, we have started a series of "one-on-one" working-level conferences between this office and each Army MACOM Principal Assistant Responsible for Procurement (PARC) and his staff. These conferences last about one and a half days at a location selected by the PARC, and address various topics agreed in advance to be of interest to all attendees. Our first conference was recently held with TRADOC at Fort Monroe and was considered by all to be very informative and helpful. Although it will take us nearly two years to complete visits to all 16 MACOM PARCs, we have received enthusiastic support from the field and feel it will be time well spent.

Some of our other important goals for FY86 are:

- we are currently testing the prototype Standard Army Automated Contracting System at Fort Meade, and expect to have all of FORSCOM's installation contracting offices automated by the end of this year;
- promoting proper Army-wide training and education of installation contracting personnel and insuring that installation contracting offices are properly staffed/graded and organizationally placed in effective positions; we have made a good start in this area as Army regulations now require the installation contracting function to be designated as a directorate on the same level as other principal staff elements;
- improving acquisition plan and acquisition strategy reviews to ensure that they reflect consideration of sound business practices, competition, quality assurance requirements, and streamlining objectives;
- developing an effective and timely contract policy network between field activities, ARSTAF elements, ASA and OSD levels;
- developing a consolidated commercial activities package of guidance/procedures for Army-wide use; and
- achieving a competition goal of 50 percent competitive contracting dollars in FY86.

In summary, we have had a busy year, including staffing the new directorate, but now our doors are officially open and we stand ready to assist the contracting community in any way we can. If you would like more information or assistance from the Directorate for Contracting, ODCSLOG, you can reach us at Autovon 225-2583 or commercial (202) 695-2583.

MG DAVID W. STALLINGS is director of Contracting, Office of the Deputy Chief of Staff for Logistics, Department of the Army. He holds a B.S. degree in business administration from Marshall University and a master's degree in business administration from Shippensburg State University.

Army Attacks Materials Problems

Jet engine bearings corrode. Drill bits wear out. Plastic aircraft canopies become brittle in the sun's ultraviolet light. These types of problems are being studied by the Materials Technology Laboratory (MTL) in Watertown, MA.

MTL's new Facility for Accelerator Research in Materials (FARM) contains a 100-kilovolt ion implantation accelerator that can make metals stronger and modify the optical properties of plastic.

Until now, conventional coating and plating techniques have been used to combat corrosion and wear problems, said FARM group leader 1LT(P) Edward A. Johnson. However, these methods cause dimensional changes and provide poor adhesion, says Johnson.

The accelerator consists of a gun-like tube that shoots ions, or charged particles, at a target within a vacuum chamber. The ions penetrate the surface of the target material and burrow a tiny distance below it—usually less than a micron, Johnson said—or just enough to change the atomic and molecular structure of the material.

This strengthens the material without changing its dimensions. Johnson said thin new surface layers can "dramatically improve the corrosion and wear resistance, micro-hardness, friction, heat resistance, fracture toughness, fatigue life, optical properties, and electronic properties of ordinary materials."

Traditionally, ion implantation has been used to make expensive computer chips. Now the process is being used to make longer-lasting artificial hip and knee joints, jet engine bearings for the Navy, and cutting tools and molds for basic industries.

"We've got the only accelerator in DOD designed to implant materials other than semiconductors," said Dr. Forrest C. Burns, a research nuclear chemist in the Materials Characterization Division of MTL's Organic Materials Laboratory. "This is not primarily a research machine. It was designed to solve real surface problems."

MTL is using the accelerator to attack three common Army problems:

- Drill bits used by the carload for helicopter repair at Corpus Christi Army Depot in Texas frequently wear out. MTL is doing a study to determine savings that could result from strengthening drill bits through ion implantation.
- MTL is attempting to strengthen the retaining pin that holds the rotor blade of the Huey helicopter. The pin has proven defective in the past.
- Glint or glare from helicopter windshields can reveal the location of the aircraft and make it more vulnerable to attack. MTL is attempting to modify the optical properties of plastic canopies so that their light refractive characteristics are altered and the problem is overcome.

"We're developing an arsenal of tools for making new surfaces," Johnson said. "We have a whole new family of surface treatments that can help Army technicians."

Both men encourage technicians at Army depots and commodity commands who are experiencing real surface problems in critical components to call them. Their telephone number is Autovon 955-5229 or Commercial (617)923-5229.

The 100-kilovolt ion implanter was first used in October 1985. By the spring of 1987, MTL expects to add a 1.7-megavolt tandem electrostatic accelerator. That machine will also be used to beam ions at incredible speeds through large vacuum systems toward various targets.

"The Army today is where the Navy was a few years ago," Johnson concluded. "We're working hard to get this ion implantation technology into the field."

Are you listening, Army depots and commodity commands?

DA Selection of Lieutenant Colonel PMs

By MAJ Richard D. Nidel

In the last issue of Army RD&A Magazine BG William S. Chen, who was former PM, Division Air Defense Gun system, presented an overview of centralized selection of product managers from his perspective as president of the PM Selection Board. The following article presents a Military Personnel Center perspective.

Introduction

AR 70-17, System/Program/Project/Product Management, provides guidance to materiel developers regarding the appropriate management form to be applied to acquisition management within the Army. While a standard convention is not readily defined, within the Army we see program managers as general officers, project managers as colonels and product managers as lieutenant colonel acquisition managers. Program and project managers are typically chartered by the secretary of the Army, while product managers receive their charters from the commander of a particular materiel development command, agency or activity.

Project Manager Selection

In recent years, Army project managers (colonels) have been selected by the DA Project Manager Selection Board. This board, consisting of general officers, convenes in the DA secretariat for central selection as one of the colonel level command selection boards. Currently, more than 200 Materiel Acquisition Management Program colonels or promotable lieutenant colonels comprise the eligible population. The results of the Project Manager Selection Board are announced to the Army with the release of the colonels command selection lists.

Product Manager Selection

The selection of lieutenant colonel product managers has previously been conducted by a Military Personnel Center (MILPERCEN) administrative board. Materiel developers, the Army Materiel Command (AMC) and Information Systems Command (ISC), provided requirements for product manager selection to the MILPERCEN board, which consisted of colonels or promotable lieutenant colonels. Board members and the officers eligible for selection are members of the MAM Program (Skill, 6T, previously the Project Manager Development Program (PMDP)).

At the request of AMC, the Army chief of staff approved the elevation of product manager selection to the DA level in July 1985. In March 1986, as a separate board in the lieutenant colonel command selection process, the first DA centrally selected Product Manager Board was held. The announcement to the Army was contained in a worldwide Milpo message in October 1985. Eligibility requirements included:

- be in the grade of lieutenant colonel or promotable major;
- be a member of the MAM Program and assigned Skill 6T;
- have not declined consideration by this Product Manager Selection Board;
- have not previously declined any lieutenant colonel level command or product manager position if selected as a principal or declined activation for any designated position as an alternate; (prior command does not preclude eligibility for product manager selection);
- not have a projected separation or retirement date earlier than three years from the expected assignment date; and
- not be in a centrally selected command position where release by required report date is not possible.

BG Chen's article in the July-August issue covered the membership of the board and its procedures.

The purpose of the board was to select product managers for product management positions requiring activation or fill during the remainder of FY86 and FY87. These positions were previously approved by the materiel development commands/agencies or activities as chartered or to-be-chartered positions.

The board was provided with each eligible officer's performance microfiche, recent Officer Record Brief (ORB) and hard copy photograph. Each officer's file was evaluated six times—once in each of six commodity categories (aviation, communications-electronics/ADP, armament/munitions, missile/air defense artillery, tank-automotive, and other). For example, some officers have received system-specific experience through assignments in TRADOC, AMC and the DA Staff associated with the same system or project. Other officers have obtained a broad experience base through MAM assignments associated with multiple systems or within several commodity areas. Therefore, officers may be more competitive in only one, or in several of the project commodity areas.

After voting the files, the board was required to slate a principal and no less than four alternates for each of the projects. Unlike command slating, where MILPERCEN determines the unit that each selectee will command, the PM boards actually slate officers to specific positions based on their unique qualifications.

As with the command selection boards, first time considered officers were restricted to 10 percent of the total selections, and could not appear on any alternate list. In addition to the alternates for each particular project, an alternate list was developed within each generic commodity area, to accommodate unknown requirements before the convene date of the next board. Officers slated to specific projects are also included in the appropriate commodity category alternate list.

Activation of Alternatives

An alternate product manager selectee, slated to a specific project, may be activated if the officers slated ahead of him decline or are excused for operational reasons from appointment. When the principal or higher ranked selectee accepts the appointment, there is no probability of an alternate being activated for that project. However, inactivated slated alternates remain eligible for activation from the alternate list, within that commodity category, for unforecasted product manager vacancies.

In the event of a need to activate an alternate for an unforecasted vacancy,

MILPERCEN will review the order of merit listing to select the officer best qualified to fill the specific product management position.

Officers may request not to be considered by the product manager board by submitting a letter to the appropriate career management branch. This declination of consideration will remain in effect for future consideration at that grade, until removed by the officer.

Once selected or activated as an alternate, an individual who declines a product manager appointment precludes any future lieutenant colonel command and product manager consideration. Likewise, an officer declining command is not eligible for future product manager or command consideration.

The command to which a product manager selectee is assigned may request that the officer be excused from appointment. Such requests are highly discouraged and must clearly identify the operational impact to be suffered by the loss of the selectee. These requests must also be approved by the MILPERCEN commander.

An officer excused from a product manager appointment merely retains eligibility to compete for future selection. There is no guarantee that any excused officer will be selected for a future product manager position.

An officer's competitiveness for selection from board to board is largely affected by the nature, type and number of PM positions requiring the specific qualifications that the officer possesses. For example, this year's board saw only one project in the tank-automotive commodity category. However, next year's board may see as many as four tank-automotive requirements. Consequently, mathematical odds of an officer with appropriate tank-automotive experience being selected as a product manager next year would have quadrupled.

Commanders and individual officers must seriously consider the potential professional development and career implications associated with excusals from centrally selected product manager appointment. Based on the number of eligible officers and product manager positions, the current opportunity to serve as a lieutenant colonel PM is less than 10 percent.

Identification of Product Managers

The Officer Master File, maintained by MILPERCEN, contains information to identify officers selected, serving, or who have declined centrally selected command. In addition, information is maintained on those who commanded prior to the inception of the centrally selected command process. A similar system of identifying product managers is being developed.

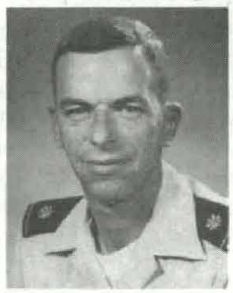
Product Management Trends

In preparation for the first DA selection of product managers, materiel developers identified, staffed and approved several new positions. It is expected that the number of product manager positions will continue to grow over the next few years from the current base of approximately 40 positions. At this time there appears to be potential for about 20 additional product managers.

Budgetary instability can impact on the existence of programs, as well as the level of management emphasis being applied. Consequently, there may also be inherent instability in program, project or product manager positions. These factors and others have resulted in the near-instantaneous creation of positions requiring short lead time report dates. This situation is far less than desirable.

Officers eligible and competitive for PM selection should be advised of the potential need to react quickly in response to selection. As military professionals, we must maintain an awareness and appreciation for the potentially high return on investment for outstanding service in these key materiel acquisition management positions.

The next regularly scheduled Product Manager Selection Board will be in session Jan. 20-30, 1987 to select officers for product manager positions requiring fill during the remainder of FY87 and FY88.



MAJ RICHARD D. NIDEL was the MILPERCEN career programs manager for Functional Areas 51 and 97 and Skill 6T when he wrote this article. He is now the DA systems coordinator for trucks in the Office of the Deputy Chief of Staff for Research Development and Acquisition. He has a B.S. degree in chemistry from Duquesne University and an M.S. degree in chemical engineering from the University of Virginia.

New Generator Could Lighten Force

A prototype of a lightweight, backpack-carried direct current generator that powers the infantryman's field radio could eliminate forever the need to supply him with throwaway batteries.

Soon to be evaluated by the 9th Infantry Division at Fort Lewis, WA, the G-67/G generator has been modified by Harry Diamond Laboratories (HDL) as part of the Army's effort to lighten the force.

The generator is dubbed "Big Foot" because the modification included the addition of an oversized stirrup into which the operator inserts his boot to provide support during use. The generator delivers 30 watts, weighs only four and a half pounds, and measures 4 inches by 4 inches by 5 inches.

Originally designed for recharging a 24-volt nickel cadmium battery, Big Foot also can be used with any rechargeable battery in the 12 volt to 24 volt range.

A single rechargeable battery can replace a truckload of two and a half pound, throwaway magnesium batteries now used to power the AN/PRC-77 infantry field radio.

While the primary purpose of Big Foot is to recharge the nickel cadmium battery, in an emergency it can power the radio by itself if the battery is dead or lost.

"It eliminates the need to supply batteries," said HDL engineer John Hopkins, "and you're never in danger of losing communications." Paul Clohan, HDL project leader, notes that a soldier can charge the battery and operate the radio simultaneously, or can operate the radio without a battery.

Because Big Foot provides a continuous power source of higher voltage than does the magnesium battery, the sensitivity of the field radio is increased—especially when transmitting.

The Successful El Salvadoran Mission

By Christine Richard

An extraordinary 15-month "design-to-fielding" effort drew to a close earlier this year when the U.S. Army Tank-Automotive Command's (TACOM) RDE Center's Design and Manufacturing Technology Directorate completed its final support for convoy security vehicles for the government of El Salvador.

The effort began in February 1985 when El Salvador asked the command—via the Directorate for International Logistics—to design and build an armored personnel carrier using the chassis of an M37B1 three-quarter-ton truck. The Salvadorans had a fleet of these trucks and wanted to use them as a base for vehicles that would provide troop protection from small arms fire in a hostile threat environment.

El Salvador maintenance welders and fabricating personnel had previously built a mild-steel prototype to fit atop the M37B1, but this did not provide adequate ballistic protection. They hoped to use their own facilities—and TACOM's technical assistance—to construct a better armored prototype in their own country, using their original vehicle configuration.

Design and Manufacturing Technology Directorate personnel traveled to El Salvador the week of Feb. 25, 1985, to inspect the existing prototype and obtain pertinent design and manufacturing data. They discovered that the small country lacked the precision welding equipment, material handling equipment, flame-cutting equipment, and adequate trained personnel required to fabricate the vehicle from the necessary materials—high-hard and dual-hard armor steels. Dual-hard armor, which provides better ballistic protection than high-hard armor steel, was to be used where crew protection was most critical.

Since El Salvador lacked the necessary facilities and technical skills, TACOM offered a suggested course of action:

- build the prototype at the command then transport it to El Salvador where it would be used as a training model;

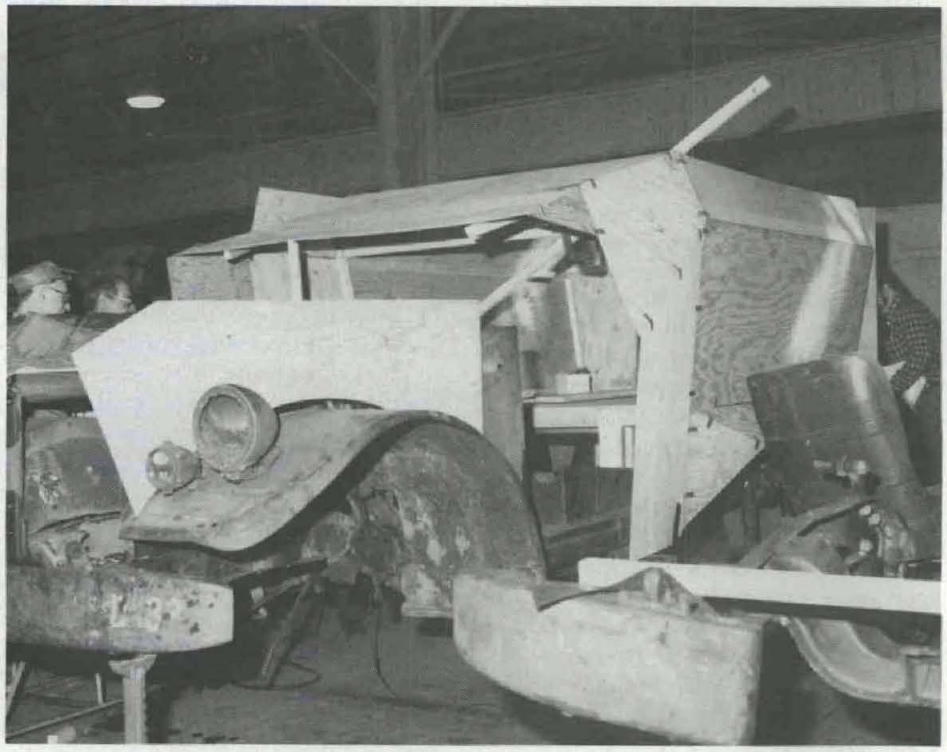
- precut all necessary armor at TACOM, weld specific pieces together, then ship the materials in kit form to El Salvador for final welding and assembly. Kits for 66 vehicles would be involved; and

- invite a team of El Salvador maintenance welders and fabrication personnel to travel to the command to observe the prototype construction and participate in a two-week armor welding and assembly training session.

These suggestions satisfied the El Salvador government, and on March 19, 1985, a team of six technicians traveled some 2,500 miles from El Salvador to TACOM's fabrication facilities. They learned to operate modern welding and flame-cutting equipment, prepare the various types of steel before welding, weld the dual-hard and high-hard armor materials together, and secure the armor shell to the M37B1 chassis for final assembly.

During the training period, TACOM personnel had to always remember that the Salvadorans did not have any high technology equipment facilities. Everything they learned would have to be performed in their own country's limited production facilities.

To save the time, money, and energy expended in travel, training, and fabrication, the El Salvador government could have bought a shipment of already produced armored vehicles. However, the Salvadorans elected to construct the vehicle themselves.



Prior to building the prototype from armor, a wooden mock-up was made to validate the design.

The completed El Salvador vehicle is ready to be shipped overseas.

That construction could not have taken place without the support of a number of TACOM offices. Along with the Design and Manufacturing Technology Directorate and the Directorate for International Logistics, the Directorate for Procurement and Production, and the Directorate for Product Assurance and Test also provided valuable assistance. These offices reviewed engineering drawings, ordered vehicle armor kits, controlled cost expenditures, reviewed armor welding and cutting equipment specifications, supplied all materials required to build the prototype, and arranged for two TACOM personnel to spend extended periods in El Salvador to assist in the production start-up and on-site training once the prototype vehicle was received and new welding equipment was in country.

Before the shipment took place, TACOM designers and fabricators made some minor modifications to the original El Salvador prototype concept. These included changing the driver compartment doors and rear crew compartment doors from a flush design to a surface mount design, cutting the hood configuration straight across in front of the windshield, and arranging the rear fenders in a flat top configuration with sloping pieces fore and aft.

Also, prior to shipment, the vehicle's armor was subjected to live fire ballistic testing. This testing, conducted on March 29, 1985, demonstrated that the armor was successful in protecting the crew against an M16 rifle's 5.56-millimeter ball ammunition. The rifle was fired perpendicular to the vehicle from a distance of 25 meters and the only damage was paint chipping. The armor deflected eight of the eight rounds fired and proved itself satisfactory to meet the threat it would encounter once in El Salvador.

The prototype then underwent rigorous road testing. Normal road testing and evaluation on a new vehicle can take several years to complete. However, due to the high demand for the vehicle, testing was compressed into a two-day time frame. Product Assurance Directorate personnel drove it 300 miles over the kinds of terrain the vehicle would experience once in El Salvador, including dirt, grass, gravel, mire, and mud. They tested its handling capability, braking characteristics, suspension performance, balance, and speed. They subjected it to stop-and-go conditions, sustained highway travel, moderate grades, quick turns, jarring, and bounces. It successfully passed the road testing and was then ready for camouflage painting.

For many vehicles, the Army will develop a camouflage pattern, taking into account the vehicle's size, weight, and type, using light reflection and computer-aided design. Because of the short time frame, TACOM painter, Robert Downs designed the pattern by first making a scale drawing on paper then transferring the three-color camouflage design to the vehicle with a chalk outline. After painting, the prototype was ready for air shipment to El Salvador.

An unbelievable period of only 74 days had elapsed from the time the RDE center was told to build the vehicle and the time it was loaded for flight on April 27, 1985. Follow-up assistance has also been impressive. The Design and Manufacturing Technology Directorate has overseen the procuring, assembly, and shipment of the 66 engineering kits to be used in El Salvador to form the armored personnel carriers on the M37B1 chassis. The last kit was shipped overseas at the end of May.

The Salvadorans are now producing the personnel carriers at a rate of two per week, and reports indicate that the vehicles have been highly successful in field action.

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ARDEC Leads the Way to Future Firepower

By Austin Chadwick

Introduction

Amid the scenic lake country of northwestern New Jersey, tomorrow's explosive battlefield firepower is taking shape. Simultaneously, today's is being refined.

Beneath the craggy face of historic Picatinny Peak, which overlooks the installation that bears the same first name, Picatinny Arsenal, the U.S. Army Armament Research, Development and Engineering Center (ARDEC) is pursuing future military weapons and ammunition, from small arms to large cannon, including propellants, fuzes and explosives.

ARDEC also is applying its engineering expertise to the task of improving present-day systems during production and after fielding. Its quick response teams stand ready to provide engineering expertise to Army ammunition plants and government-owned, contractor-operated facilities as well as the user in the field.

As a research, development and engineering center, ARDEC provides full-spectrum support for armament throughout the Army. ARDEC is a major activity of the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), headquartered in Rock Island, IL. In turn, AMCCOM is a major subordinate command of the U.S. Army Materiel Command (AMC), headquartered in Alexandria, VA.

Since the U.S. Army Laboratory Command (LABCOM) manages AMC's technology base program, ARDEC's relationship and interface with LABCOM is extremely important as well. LABCOM identifies technologies required of ARDEC, and oversees their maturation to the component level. These components are then integrated into systems.

At the heart of the Picatinny site near Dover, NJ, lie ARDEC's three diverse scientific and technical organizations: the Fire Support Armaments Center, the Close Combat Armaments Center, and the Armament Engineering Directorate. Through these three organizations and the center's technical support elements—the Advanced Systems Concept Office, Engineering Support Directorate and Program Support Office—innovative, exciting weapons and munitions move toward their place on the battlefield of the future, while existing systems and the manufacturing processes and facilities that produce them undergo improvement.

Fire Support Armaments Center

ARDEC's responsibility for today's and tomorrow's indirect-fire systems is overseen by the Fire Support Armaments Center. With the Electromagnetic (EM) Propulsion Laboratory located at Picatinny, ARDEC is playing a leading role in the development of kinetic-energy weaponry for possible incorporation into the high performance weapons of the next decade and beyond.

EM propulsion technology involves the acceleration of objects using the interactive forces between very large electric currents and the magnetic fields they produce. Since an electromagnetic launcher employs electrical energy, projectiles can achieve much faster speeds than conventionally propelled rounds. At ultra-high velocities, small projectiles are devastatingly lethal.

ARDEC research shows that EM guns and launchers can be designed to achieve currently impossible velocities. Versions are being looked at for tactical use as artillery, anti-tank and air defense weapons.

One of several key U.S. pioneers of this technology, ARDEC has been working with EM propulsion since 1978, when it joined forces with the Defense Advanced Research Projects Agency in an effort to develop an electromagnetic rail gun for the Strategic Defense Initiative program. To date, ARDEC has built in its laboratory a 16 megajoule homopolar generator that can provide 1.5 million ampere pulses, successfully launched a 317 gram projectile at a muzzle velocity of 13,900 feet-per-second and developed a number of promising tactical and strategic weapon systems conceptual designs.

ARDEC also is concentrating on near-term challenges. Among these is the application of engineering advances to the special logistics needs of the Army's new light infantry divisions.

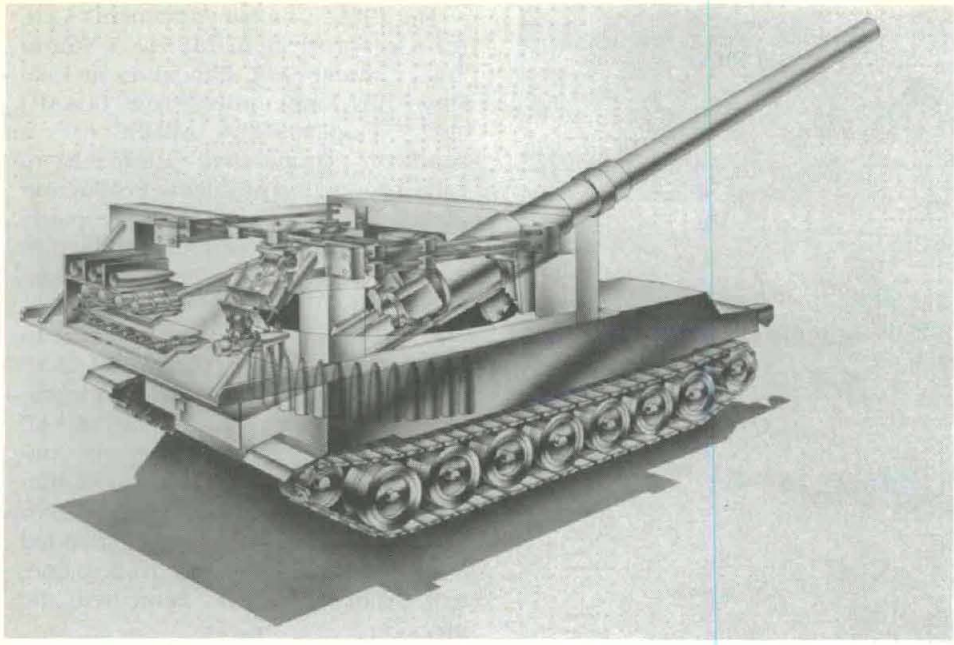
Innovative approaches to building a lightweight artillery weapon whose performance equals the M198, 155mm towed howitzer, presently used in the field, are under way. Engineers are reducing weapon weight to enhance mobility, without reducing firepower capability, in pursuit of a howitzer that can be lifted and towed by the helicopters and trucks slated for the light divisions. In addition, ARDEC is devising ways to lessen recoil force in order to maintain the stability and safety of these light weapons.

The solutions to these challenges—composite materials and recoil system technology—may also provide highly desirable spin-offs for other artillery, tank and cannon weapon systems.

ARDEC's immediate goal is to field a towed howitzer that weighs 9,000 pounds, 40 percent less than the M198, has the same range and, for accuracy and crew safety, is more stable when fired. With the support of the Army Materials Technology Laboratory in Watertown, MA, the center is exploring the use of graphite and fiberglass as alternatives to aluminum and steel in the weapon's carriage, trails and cradle.

At the same time, new ways of managing recoil energy must be devised, since hydropneumatic throttling systems now used are not acceptable. One approach being considered by ARDEC engineers is the feasibility of monitoring and optimizing recoil energy dissipation by electronic feedback control. Another promising alternative is "soft" recoil whereby the recoil stroke is lengthened by a spring that pushes the tube assembly forward immediately prior to firing.

A third exciting ARDEC artillery program is the effort to develop a robotic



Integrated Smart Artillery Synthesis Robotic Demonstrator.

system capable of grasping ammunition and inserting it with a mechanical arm into the breech of a large gun. Called the Integrated Smart Artillery Synthesis or ISAS, this system is envisioned to be the self-propelled howitzer of the 21st century.

ISAS will use an advanced propulsion mechanism selected from three candidates: liquid propellant, EM propulsion or unicharge (a system of equal-sized, rigid-cased units of propellant replacing the family of bag charges currently used). Tomorrow's artillerymen will experience less battlefield stress and fatigue as a result of faster and surer loading and resupply. Manpower requirements will decrease, while battlefield survivability will increase due to ISAS.

SADARM (Sense and Destroy Armor), another promising ARDEC field artillery program, is an anti-armor munitions system possessing all-weather, fire-and-forget lethality. The SADARM round ejects three lethal submunitions over a target area.

Ejected from the carrier round at a predetermined height, these submunitions, which are called "smart" munitions, fall spirally to earth by parachute, searching electronically for an enemy armored vehicle. When a target is "sighted" by a munition's sensors, a warhead detonates and jets an explosively formed penetrator into the top of the vehicle. If no target is observed, the munition will self-destruct just before it strikes the ground.

SADARM's greatest asset rests in its ability to defeat massed armored attacks, day or night, by halting enemy vehicles at maximum range before they can reach the front lines. It is being designed for use in rockets for the Multiple Launch Rocket System as well as 155mm howitzer projectiles.

Close Combat Armaments Center

ARDEC's second major organization, the Close Combat Armaments Center, is responsible for managing the RDE center's direct-fire or "line-of-sight" mission.

Researchers and engineers are overseeing initiatives like the Advanced Combat Rifle (ACR) program, whose purpose is to place a significantly more combat-effective individual weapon in the hands of the American soldier. The ACR will possess considerably better hit probability, combat load and target acquisition than the current M16A2.

Among the technologies being examined for the ACR is salvo fire. Engineers are looking at equipping the weapon with this three-round burst, predetermined dispersion capability. Each round will fire precisely in the direction that the weapon is pointed, before any resulting recoil can distort accuracy.

Caseless ammunition, another promising technology, also is being considered for the ACR. Lighter, smaller and less costly than traditional brass-cased rounds, caseless ammunition consists of a bullet seated securely in a solid block of propellant. Without brass casing, which must be extracted from the weapon upon firing, caseless rounds are a highly desirable alternative for the high rate-of-fire gun mechanisms tomorrow's field soldier will carry.

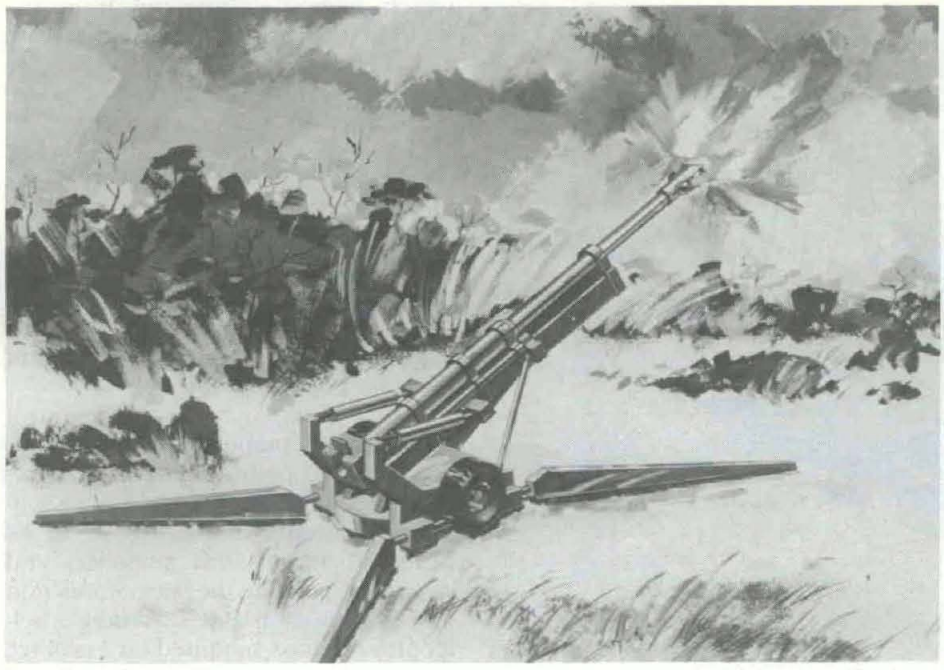
Together with the Aviation Systems Command in St. Louis, MO, ARDEC is looking at ways to counter the air threat of the future as well. This joint program, known as the Precision Aircraft Armament Control Experiment (PAACE), will yield the optimum helicopter gun necessary for the mobile battlefield of the next century.

PAACE is employing modern control theory and computer technology to produce the point fire accuracy necessary to engage both enemy helicopters and ground units. To aid in its development, ARDEC engineers and scientists are using the Ware Simulation Center in Rock Island, IL, where a helicopter fuselage, mounted on a massive motion simulator, allows the PAACE weapon to be fired in the laboratory itself, under controlled environmental conditions. Use of the Ware facility is saving precious R&D dollars by reducing development time and flight test requirements.

Armament Engineering Directorate

The Armament Engineering Directorate, ARDEC's third major organization, is responsible for the center's propellants, explosives, pyrotechnics and manufacturing methods and technology missions. One of ARDEC's foremost initiatives for this important area is the improvement of anti-armor lethality through the development of more powerful, higher density, less sensitive explosives. The latter characteristic is being pursued in response to the Army's quest for increased crew survivability on tomorrow's battlefield.

Several technological advances ARDEC has made in the area of insensitive munitions show great promise. An insensitive propellant for Low Vulnerability Ammunition (LOVA), under development with the Ballistic Research Laboratory at Aberdeen Proving Ground, MD, is foreseen as the alternative to the M30 propellant that is currently used in 105mm tank rounds. Because LOVA propellant is less likely to ignite when it comes in contact with spall fragments, it will significantly improve combat vehicle crew survivability. Except for a new primer, standard cartridge components will be used and ballistic performance characteristics of



Light Weight Towed Howitzer.

the rounds will be unchanged, in spite of the propellant substitution.

Under ARDEC's More Powerful Explosives Research Program, additional efforts to develop tomorrow's explosives are progressing. A new Cage explosive, Tetranitroadamantane (TNA), so called because its molecular configuration resembles a cage, has undergone detonation velocity and plate dent testing. The measurements resulting from these tests indicate that TNA is nearly as powerful an TNT. The results also confirm that the performance of caged explosives can be accurately predicted. This represents a significant step in ARDEC's search for a more powerful explosive.

Another key mission is ARDEC's manufacturing methods and technology effort. The center is involved in every facet of the life cycle of its assigned items, beginning with basic research through production, deployment and field support. For this reason, a strong and active interface with all the various organizations and facilities that are part of production is maintained.

For example, ARDEC has developed an advanced process for reclaiming explosive material from rejected, loaded projectiles slated for demilitarization. A high-pressure water jet is used to remove explosive material from the projectiles safely and economically. At a pilot facility at Iowa Army Ammunition Plant, the new process has shown itself to be 35 percent more energy efficient than the steam/hot water method currently used. The new system readily recovers 75 percent of the washed-out explosive. More importantly, no explosive buildup from recycled water, a critical safety consideration, collects in the high pressure pump that is used.

Other Efforts

An equally important part of ARDEC's mission is to provide fast, expert engineering support to arsenals and GOCO plants in response to the varied problems these facilities encounter. Each of the center's three major organizations frequently dispatch quick response, trouble-shooting teams in an effort to provide timely solutions to these problems.

One of the Fire Support Armaments Center's more notable support efforts resolved a serious problem that Louisiana Army Ammunition Plant experienced in metal parts production for the M483A1 155mm high explosives projectile. When cracks were discovered in the ogive and base forgings of the round, ARDEC was asked to ascertain the cause and suggest corrective action.

A technical team immediately went to the Louisiana plant, conducted a thorough investigation and determined that the problem had been caused by overheating during forging. The team suggested to plant officials a number of corrective measures for better controlling the temperature at which the metal parts were forged. These recommendations were adopted and the cracks disappeared.

The Close Combat Armaments Center's resolution of M856 5.56mm Tracer ammunition difficulties at Lake City Army Ammunition Plant (LCAAP) also exemplifies how ARDEC uses a hands-on, cooperative approach to solve production problems. Production of the M856 was in serious jeopardy due to the inability of initial production rounds to achieve acceptable performance levels.

A team from the center was sent to the plant to work together with LCAAP personnel. During the next eight intensive weeks, the joint ARDEC-LCAAP team determined that dimensional control of the bullet jacket during machining was the major cause of the M856 Tracer's inaccuracy and recommended a series of tooling set and process control refinements that remedied the problem.

Likewise, the Armament Engineering Directorate's resolution of Lone Star Army Ammunition Plant's (LSAAP) low production, high reject problem on the plant's newly opened, automated 105mm M1 high explosive projectile melt pour line is indicative of the kind of support ARDEC provides the ammunition plants and GOCO facilities. In response to LSAAP's request for assistance in solving this serious problem, an ARDEC team was sent to LSAAP to work with plant personnel. The team examined the line and made a number of process and equipment operation recommendations that, when adopted, increased production by 300 percent per shift, reduced rejects to less than one percent and decreased the cost of each projectile from $21.69 to $6.43 per round.

In these areas, ARDEC is helping assure that the Army is ready to meet the enemy on the battlefield and win.

AUSTIN CHADWICK is a public affairs specialist in the ARDEC Public Affairs Office. He holds B.A. and M.A. degrees in English from the University of Rhode Island.

Automatic Target Recognition

A technology base program that will enhance capabilities for automatic target recognition is under way within the U.S. Army Laboratory Command (LABCOM).

Some major issues that the program will address are the false alarms that sensing systems currently give and ways to reduce them, the need to improve recognation of targets, and the need for faster searching for targets.

An integrated demonstration planned for completion before the end of fiscal year 1987 will be part of the program and will feature hardware that will combine the information from several sensors. Future Army systems will use a number of different kinds of sensors, and many combinations will be possible.

The Army currently uses infrared systems to find targets and identify them. There are drawbacks to using an automatic target recognition system that relies solely on infrared systems. Infrared is not suitable for use in all weather. For example, fog that obscures vision will also make infrared difficult or impossible to use.

Infrared systems recognize objects by thermal characteristics. Many objects on the terrain contain physical features that might resemble shapes of known targets. Infrared recognition of these other objects and mistaking them for targets leads to a high number of false alarms.

In addition, hostile forces could obscure targets and prevent their detection by an infrared recognition system. A fully automated target recognizer, which would operate without human help, is not possible with existing technology. Combining various sensors, including infrared sensors, may make an autonomous target recognition system possible.

A system of multiple sensors would gather a diverse set of information about a target and blend it all together. Blending a range of information about a target increases the possibility of detecting a target and being able to recognize it. More information will also decrease the probability of false alarms and improve the chances of overcoming the enemy's attempts at camouflage, concealment, and deception.

Types of sensors that could potentially be used include advanced infrared, television, and different forms of radar. Industry that becomes involved with the program will utilize algorithms that will enable this blending of sensors and will present combinations of sensors for field testing and evaluation.

Though studies have indicated that combining several sensors in an automatic target recognition system will reduce false alarms and increase the probability of detection and recognition, no data have been gathered that clearly indicate the most combat-effective and cost-effective approaches.

Within LABCOM, Harry Diamond Laboratories (HDL) has been given the task of directing and coordinating the demonstration program. Donald B. Dinger, HDL director, has been designated as the LABCOM executive agent for the demonstration program.

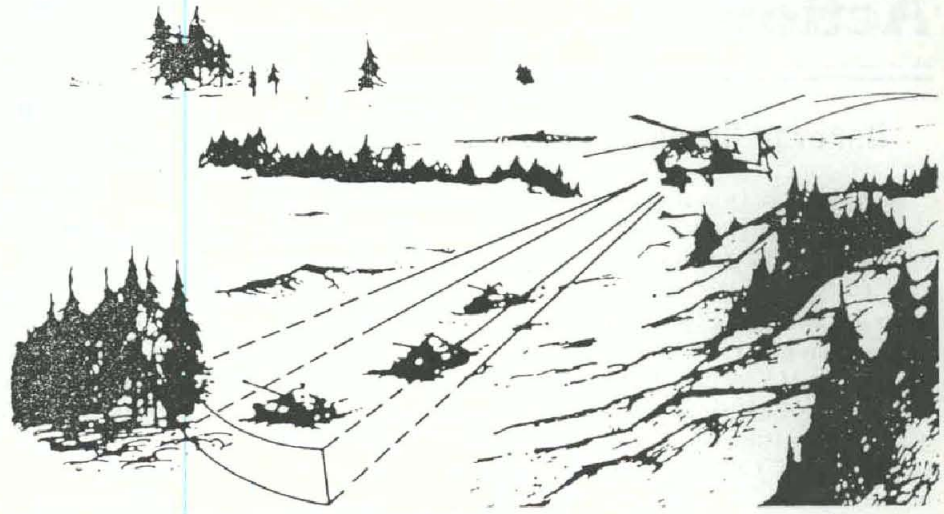
Because of the widespread involvement of other major subordinate commands within AMC, Richard Vitali, LABCOM technical director and AMC assistant deputy chief of staff for technology planning and management, chairs the steering committee that has been established to provide guidance for the project. Dinger serves as the committee's vice chairman.

HDL officials expect that industry will play a broad participatory role in the program from the beginning. Interested parties will be asked to provide an in-depth investigation of the issues related to automatic target recognition, providing hardware and software for test and evaluation on an Army test bed. A solicitation was issued earlier this year seeking industry response to a multi-sensor fusion demonstration in fiscal year 1987.

The results of the integrated demonstration program will benefit all future combat vehicle development programs but will be especially relevant to the light helicopter family. The target acquisition system in the light helicopter, experimental (LHX) will automatically search a predetermined sector, detect and identify targets, and present the crew member with an identified and prioritized target within a required number of seconds. The multisensor fusion demonstration contract will include a requirement that the contractor meet the set LHX schedule for demonstration and testing.

The automatic target recognition system is generic in nature and will eventually be included in other combat vehicle programs, including the Apache product improvement program, the M1 main battle tank product improvement program, the program for the family of armored vehicles, and various robotic programs.

"There are other programs that address portions of this problem," Dinger said. "The key to this demonstration program is to generate and evaluate a maximum amount of data in the near term on performance of an integrated system. This program will benefit the LHX first but other programs stand to benefit as well."



A helicopter automatically searches for and detects targets of interest within a specified sector of the battlefield.

From The Field . . .

Belvoir Tests Prototype Generators

The Belvoir RDE Center is testing new prototype generator sets designed to withstand the harsh environments of nuclear, biological and chemical warfare, while emitting less heat and noise than the models currently in the Army's inventory.

The Signature Suppressed Diesel Engine Driven generator set program, sponsored by the project manager for mobile electric power, was launched to update the mobile power units used by our armed forces. Current generator sets emit infrared and noise "signatures" that make command, control, communications and intelligence systems easily distinguished from less critical targets. The new generator sets are being designed to produce external temperatures no more than plus or minus four degrees Celsius from the average ambient background. Noise signature requirements include non-detectability at distances of 300-400 meters.

The new generator sets must also withstand a variety of climatic conditions and be operable by soldiers in arctic clothing. In addition, nuclear, biological and chemical survivability has posed new requirements for these systems. Both of these factors will necessitate radical changes in structural design and housing, while the sets must continue to meet stringent size and weight requirements.

The Army has initiated extensive testing of the prototype generator sets at Belvoir RDE Center and at Aberdeen Proving Ground. These tests will permit evaluation of generator set operational characteristics. Environmental, endurance, reliability, and maintainability are among the tests being performed.

Personnel Actions . . .

Donovan Becomes AMC DCS for DE&A

BG Claude B. Donovan III, former program manager, Light Vehicle System (Prov.), has assumed new duties as deputy chief of staff for development, engineering and acquisition, HQ, U.S. Army Materiel Command, following retirement from the Army of BG Michael L. Ferguson.

Donovan is a 1958 graduate of the U.S. Military Academy and has an M.S. degree in mechanical engineering from the University of Alabama. He has also completed the Infantry School, the Ordnance School, the U.S. Army Command and General Staff College, and the Industrial College of the Armed Forces.

Donovan has served previously as program manager, Bradley Fighting Vehicle System; readiness coordinator, U.S. Army Readiness Region VIII, Aurora, CO; commander, Red River Army Depot, Texarkana, TX; and project manager, M60 Tank System, U.S. Army Tank-Automotive Command, Warren, MI.

Other key assignments have included commander, 123d Maintenance Battalion, 1st Armored Division, U.S. Army Europe; logistics staff officer, Support and Evaluation Branch, Maintenance Division, Supply and Maintenance Directorate, Office of the Deputy Chief of Staff for Logistics, HQ, Department of the Army; and staff officer, Plans, Policy and Test Division, Materiel Plans and Programs Directorate, Office of the Deputy Chief of Staff for Research, Development, and Acquisition, HQ, Department of the Army.

Donovan is a recipient of the Legion of Merit, Soldier's Medal, Bronze Star Medal with four Oak Leaf Clusters (OLC), Meritorious Service Medal with OLC, Air Medals, Army Commendation Medal, Expert Infantryman Badge, Senior Parachutist Badge, Ranger Tab, and the Army General Staff Identification Badge.

Two Missile Chiefs Chosen as PMs

James C. Katechis

Alan D. Sherer

Two civilian managers at the U.S. Army Strategic Defense Command have been chartered by the secretary of the Army to direct major projects in support of the Strategic Defense Initiative (SDI).

James C. Katechis and Alan D. Sherer were appointed Army-level project managers for, respectively, the Exoatmospheric Re-entry-vehicle Interceptor Subsystem (ERIS) and the High Endoatmospheric Defense Interceptor (HEDI). Both projects involve technology for ground-launched non-nuclear missiles that can be candidate elements for decisions regarding strategic defense.

In conjunction with being designated project managers, Sherer and Katechis were promoted into the government's Senior Executive Service.

Prior to being named project manager, Katechis served for more than two years as chief of the ERIS Project Office. He is responsible for an effort that is developing the technology for a low-cost ground-launched interceptor. The ERIS effort is expected to validate technology for intercepting ballistic missile reentry vehicles above the atmosphere during the midcourse of their flight.

The project, one of the Army's five largest efforts in SDI, has awarded a five-year, $468 million prime contract for design, fabrication and testing of ERIS.

Like Katechis, Sherer has been chief of his project office for more than two years. The HEDI program is pursuing research and validation of technology for a non-nuclear interceptor which would operate in the upper reaches of the atmosphere in conjunction with a ground-based radar. The prime contract for HEDI was awarded in January at a value of $331.5 million for a five-year effort.

Both Katechis and Sherer bring extensive technical and managerial experience to their project manager positions. Katechis has been involved in research and development of missile systems technology for most of his 27-year career, 22 years of which have been with the Army.

Katechis has also served as chief for interceptor research and development in the Sentry Project. In the early 1980s, Sentry was a key element in the Army's ballistic missile defense (BMD) program, predecessor of the program currently being conducted by the Army Strategic Defense Command. During the Vietnam War, he served as the deputy project manager in the Army Aircraft Survivability Equipment Project in St. Louis, MO.

Sherer has held a number of increasingly responsible management positions in both industry and the government during his 22-year career. He was chief of the Engagement Controller Office for the Sentry Project prior to assuming management of the HEDI effort in 1983.

From 1977 to 1982, Sherer was employed in engineering and management positions with Huntsville firms specializing in computers and systems engineering.

Capsules . . .

Belvoir Works on New Mine Killer

A vehicle magnetic signature duplicator at the Belvoir Research, Development, and Engineering Center is ready to enter full-scale development as a unique countermine system to protect fighting vehicles.

The system will enable the Army to counter magnetically-fuzed mines. It works by projecting an electro-magnetic signal ahead of a vehicle to explode mines in its path. In operation, the duplicator will be used as a complementary system with other countermine equipment like the blades and rollers used with the Army's M1 and M60 tanks. It will be adapted for use with other vehicles later. A contract for full-scale engineering development of the system is scheduled to be awarded this fall.

Army Will Develop Flywheel-Engine Truck

The Troop Support Command's Belvoir Research, Development and Engineering Center has begun a program to develop a prototype flywhel-engine-powered truck based on a commercial 4,000 pound warehouse forklift.

The flywheel-engine design would use a flywheel spinning at high speed to store energy. This would enable the operator to shut down the engine and operate the forklift on its own stored power for brief periods of time. The engine-off periods allow the vehicle to run without emissions. Because of this, the forklift could be used to go in and out of enclosed storage areas which have limited ventilation. A flywheel also has the potential of reducing fuel consumption up to 40 percent.

Belvoir plans to award a contract through Oakridge National Laboratories for these prototype trucks in the near future. Delivery is scheduled in late 1987.

Conferences & Symposia . . .

ASA (RDA) Addresses Safety Workshop

More than 100 safety professionals attended the Army System Safety Workshop held in Atlanta, GA, earlier this year. Hosted by the Army Safety Center, the workshop brought together a wide range of experience and backgrounds in a coordinated effort to address system safety issues facing the Army today.

The purpose of the workshop was to implement the materiel actions of SafeArmy 1990, the Army's 5-year plan designed to achieve excellence in Army safety, through an integrated program of initiatives.

Keynote speaker for the workshop was Dr. Jay R. Sculley, assistant secretary of the Army (research, development, and acquisition). Sculley told the attendees, "We must recognize that there is no such thing as a perfectly safe system or piece of equipment. The philosophy we must embrace is one of managing risk in the context of total system cost and effectiveness.

"Efforts of safety professionals in the test and evaluation process will be crucial if we are to make the risk management process work. In addition to moving the Army toward a philosophy of managing risks instead of letting risks manage us, we are faced with the challenge of coping with an explosion of technological advances and an approaching period of reduced funding. To meet this challenge, we must integrate system safety into the basic research programs in our labs, in industry, and in the universities. We must initiate and aggressively pursue system safety research and education programs which will enable us to provide a high standard of system safety without unnecessarily impeding the acquisition process."

Upcoming Conferences

- AMCCOM Acquisition Conference, Nov. 5-6, 1986, Davenport, IA. POC: Howard Lewis, (309) 782-5369 or AV 793-3369/6602.

Executive's Corner . . .

Deputy Chief of Staff for RD&A LTG Louis C. Wagner Jr. Discusses . . .

Technology for the Soldier

The following remarks, which have been edited for publication, were initially presented as the keynote address during the 15th U.S. Army Science Conference at the U.S. Military Academy, West Point, NY

Introduction

This year, the 15th Army Science Conference is dedicated to the central theme, "Technology For The Soldier." The soldier should be paramount in our technology thrust and be the focus of our efforts. Army Chief of Staff GEN John A. Wickham Jr. has mandated that of the five key operational capabilities, the one that has first priority is the "Soldier and Unit Performance." Sounds to me like we have our marching orders.

During the last four decades there has been a horrendous technological revolution. My research shows that the scientific advances made during the last 40 years surpass all of the previous accomplishments made by mankind. The potential advances that are possible for us to attain in the future are mind boggling. The limits of our imaginations are the limits of what can be attained.

This awesome technological revolution led to the start of the most dramatic modernization effort in the history of our Army. We initiated the fielding of a vast array of major weapon systems to include the Abrams Tank, the Bradley Fighting Vehicle, the Blackhawk and Apache Helicopters and the Multiple Launch Rocket System. These and many other systems will provide a credible conventional capability well into the 1990s.

Today, I would like to discuss three highly promising areas of the technological revolution: microelectronics, artificial intelligence/robotics and biotechnology.

Microelectronics

During the 1970s and 1980s microelectronics have significantly changed the way modern armies are operating. The all-pervasive computer, in all phases of military operations from fire control to guidance and navigation, is probably the most visible symbol for these changes.

As we approach the 21st century, there is a new microelectronics revolution in the offing which will cause massive changes in the way the military conducts its operations. New microelectronic device concepts will lead to processing speeds and memory densities that are unheard of by today's standards. These changes will undoubtedly alter the shape of the modern battlefields and operational capabilities in ways that are still not fully understood.

A convenient measure for the state-of-the-art in microelectronics has been a plot of the number of transistors that can be accommodated on one chip. For almost two decades the number of such transistors has doubled every 1 1/2 years, while the cost per chip has not increased.

Stimulated by process innovation, particularly submicron technology such as that being developed by DOD's own Very High Speed Integrated Circuits Phase 2 Program, this trend will continue throughout the 1990s and give us 1,000 MBIT transistor chips. To illustrate the magnitude of such an achievement, it may be stated that this represents more than 12,000 typewritten pages on a chip not larger that a fingernail, and costing perhaps between $10-$100. Such densities also enable us to build machines with the computing power of today's supercomputers on one chip.

In addition to such vastly increased conventional devices, there are new technologies emerging which will break the speed barrier of conventional structures and lead to device operating speeds in the picosecond range. By now, we can already envision optical computing at light speed and no longer constrained by the slowing down of metal interconnect systems.

Microelectronic devices in the 21st century that can operate at higher speed and store more information will enable systems applications that are currently not affordable or practicable. These include artificial intelligence and expert systems whose concept and applications potential are now in place, but whose storage and computing thru put requirement can only be met presently by hosting on very large stationary computers.

Artificial Intelligence/Robotics

The first industrial revolution did wonders towards extending man's muscular strength and productivity via mechanical power and automation. This decade has already witnessed the birth of a second industrial revolution that is extending dramatically man's intelligence through manufacturing robotics and control systems. As the century turns we shall be witnessing more robotics and artificial intelligence imbedded systems in every conceivable human endeavor. In the Army, we are committed to exploiting this artificial intelligence/robotics revolution both on the battlefield and throughout our support systems.

Down through history the classical image of the battlefield has been of an area covered with the blood and gore of maimed and dying men. The measure of a nation's war fighting capability was the number of men under arms that each nation could muster, the capability of the nation to arm that force, and the degree to which that force was trained to win.

This early image will continue to change we hope, and we will someday achieve the promise of an ability to project potent military power on the world scene without the concomitant penalty of excessive human suffering and human sacrifice on the battlefield. Some scientists envision that men and women will be able to fight their battles from heavily protected remote locations using machine intelligence to plan and manage campaigns executed by intelligent but fearless machines; gone hopefully would be the images of the dead and dying, to be replaced by images of soldiers at consoles with only burned and twisted machines strewing the battlefield.

However I am not naive enough to believe this will come soon. Clearly, the foregoing is an exaggeration when expressed in terms of our own times, for it looks beyond the intervening process of evolutionary change and incremental improvements in the way we do business, however the trend is clear and irreversible.

Biotechnology

Biotechnology offers one of the most far reaching revolutions of all. Man has already acquired the power to transcribe and manipulate the life molecule, the gene. We have already begun to reap the dramatic benefits of this technology on two fronts, the biomedical and the chemical and biological warfare defense.

In the biomedical area, the immense promise of biotechnology for increasing the combat readiness of the Army is being realized initially in vaccine development. This technology, at least in principle, has the potential for eliminating most infectious diseases as serious and deadly hazards of military operations.

The year 2000 may well see American soldiers protected against such traditional scourges of the battlefield as dysentery, hepatitis, malaria and typhus. This is best illustrated by the current malaria vaccine development effort.

Malaria is a devastating global threat to our soldiers. All that we could do to prevent or control the disease until now is the pill every day. Even that becomes ineffective periodically due to drug resistance and often gets complicated with potential side effects. Then came genetic engineering, a powerful tool of biotechnology. Researchers at the Walter Reed Army Institute of Research, in collaboration with scientists from the National Institutes of Health (NIH), were able to clone the gene which expressed the malaria infective agent. This was the critical first step to producing vaccine lot quantities of this immunizing protein.

Based on this work, a candidate vaccine was developed. Scale-up of this process has been accomplished and the first production lot of the candidate vaccine has been received and successfully tested in laboratory animals. Testing human volunteers began in April of 1986.

In 1969, a major national policy declaration essentially ended our involvement in all biological warfare related research and severely curtailed our chemical warfare research. That regrettably led to a severe set back while the threat continued to grow and by the late 1970s the nation became rudely aware of the reality of having fallen behind in both the offensive and defensive arenas. Thanks to many of you, after a dramatic push we seem to have narrowed the gap considerably. With the advent of this significant revolution in biotechnology, we are faced with both unparalleled opportunity to enhance our defensive posture as well as the awesome prospect of a limitless threat. We are sparing no time or reasonable resources in facing up to this challenge and you are the architects of our future posture in this arena.

At our Chemical Research, Development and Engineering Center, the basic applications of this remarkable tool have already been demonstrated.

Current decontamination options are logistically burdensome. Fielded decontamination solutions are bulk liquids, some are flammable, and all are extremely caustic. They are not suitable for use on chemical casualties or wounds, vehicle/aircraft interiors, or on soldiers' personal effects. Enzymes, as natural biological products, would be ideal for non-caustic decontamination of materiel, casualties, and wounds.

In the area of soldier protection, the Natick RDE Center also capitalized on biotechnology in seeking novel solutions that would revolutionize the design of chemical and biological protective garments. Natick's initial investigations discovered a unique ion complex of a naturally occurring polymer that degrades GD agents. Research continues in collaboration with the Chemical RDE Center and the Office of the Surgeon General to validate and extend this application on a broad front.

Natick also collaborates with the Chemical RDE Center in developing a cheap microbial source to unique enzymes that could be immobilized and used for both detection and decontamination of chemical warfare agents.

Universities and Industry

It should be quite evident by now that we face an overwhelming challenge. On your shoulders lies the awesome responsibility of assuring this nation maintains its leading edge in military technology. You are the principal architects, catalysts and trustees of the Army's continuing push and insertion of that critical technology.

It is equally clear that we cannot do it alone. In order to stay in the race and remain on top we must marshal all national intellectual and innovative resources. The in-house laboratory community must seek and bring about a strong partnership with their peers at the university, at federally funded R&D centers and industry.

We have been expending over $100 million in support of university programs and over $400 million for industrial independent R&D (IR&D) annually, a very significant investment equivalent to over half the size of the total Army 6.1/6.2 budget. Industry has already made significant progress focusing their IR&D on relevant technology. We still need to exercise a more vigorous role in coupling that effort to a well defined in-house investment strategy.

On the university side, however, we still have a long way to go towards coupling the unlimited potential of university resources. In spite of the progress made by our Army Research Office in this regard, the in-house laboratory relationship with the universities has been generally passive and still requires a tough long-term acquisition strategy guided by more challenging scientific and technological objectives.

Recognizing this national priority, the White House, Congress and DOD launched a new FY86 university research initiative (URI) that should foster a greater role for the university in support of national security and create an environment far more conducive to a collaborative and synergistic in-house laboratory-university relationship.

This is not a business-as-usual program. It is a new way of doing business with the university, with a new management philosophy.

The Army's strategy for URI implementation is to establish major university research and education centers in technology areas of critical interest to the Army. For each center, an executive steering committee shall be formed from senior in-house scientific and engineering personnel knowledgeable in the field, chaired by the lead lab representative, that will closely oversee planning and execution of the program. It is incumbent on the committee and the Army Research Office to ensure maximum return on the investment.

Summary

We have a unique opportunity for the Army in-house laboratory community to become the central node in a strongly interactive peer network made up of their industry peers through independent R&D, the federally funded R&D Centers through appropriate tasking, and the universities through URI and other Army Research Office sponsored programs—all teaming up to meet the technological challenge of tomorrow.

There are many challenges that face the scientific and engineering community. Those challenges must be met.

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